

Chapter 1

Introduction to Human-Environment Interactions Research

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Abstract Contemporary theories about the reciprocal interactions of human beings with the environment are only fully intelligible in the light of the historical roots of such theories. In this introduction we provide an overview of the major Western intellectual currents up to those that are commonly used today. Three main themes help organize this broad array of theories and approaches: environmental determinism, cultural determinism, and human-environment interaction concerned with the processual relationships between people and environment as grounded in historical, social, and ecological contexts. This chapter also provides an overview of the four parts of the book and discusses the coverage, diversity, and parallels in themes and approaches across all chapters.

Contemporary theories about the reciprocal interactions of human beings with the environment are only fully intelligible in the light of the historical roots of such theories. Modern notions of homeostasis reflect ancient concerns and assumptions about the order of nature, just as our current fascination with chaos theory reflects a contemporary jaundiced view of the social order. Every society has philosophical explanations about the natural world and human beings' place in it. It is through such explanations that members of a society articulate their normative rules and the broad outline of how they can best function as societies that depend on natural resources for their survival.

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Human-environment interaction (HEI) provides a framework that brings together scholarship sharing both disciplinary depth and interdisciplinary scope to examine past, present, and future social and environmental change in different parts of the world. Key to all of these approaches is that they must be interdisciplinary and cut across the social and the natural sciences. While building upon disciplinary expertise, this type of work asks new questions that purely disciplinary research tends not to ask; it brings new methods and theories to the challenges posed by societal concerns and connects theory and practice in ways that address problems that arise from human interactions with environment. This volume brings senior and junior scholars together and, in so doing, connects these historically influential traditions to new and cutting-edge approaches that give us a glimpse into current and future trends in interdisciplinary science of human-environment interaction.

In this introduction, we provide a broad view of the major Western intellectual currents up to those that are commonly used today. Three main themes help organize this broad array of theories and approaches: environmental determinism—the determining effect of nature upon society, cultural determinism—that sees cultural context as the only way to understand our place in nature, and human-environment interaction—concerned with the *interaction* of people and environment. These themes represent three points on the intellectual spectrum. One view overemphasizes the influence of environment, while the second overemphasizes the role of human culture. The third view bridges the gap between the other two themes, providing a framework to examine HEI as dialectical and diachronic processes rather than unidirectional.¹

Deterministic explanations in HEI date back a long time in human history. Yet they seem recurrent. In academia, the history of deterministic explanations has promoted inter- and intradisciplinary divisions fueled by theoretical dualisms (e.g., nature-culture, agency-structure, materialist-idealist, rational-moral) rather than having societal problems or crosscutting questions informing the direction of scholarship. Our current environmental and societal issues defy reductionist and deterministic interpretations as well as panacea policies (Ostrom 2007), but we are still learning how to move from segmented to complementary disciplinary knowledge and integrative science. An emphasis on human-environment interaction recognizes the complexity of historical and contemporary factors affecting society and environment at various scales; because of the value put on fieldwork, HEI research has an explicit concern with corroborating deductive and inductive perspectives. As such, it encourages interdisciplinary collaboration constructed around shared questions, common frameworks, and metalanguages across disciplines. A glimpse into the traditions leading to these perspectives may serve as a useful reminder of the challenges and opportunities ahead.

¹Discussions that follow are based in part on a more detailed discussion that can be found in Moran (2006).

1.1 Environmental Determinism

Determinism assigns one factor as a dominating influence over the whole system. From Greco-Roman times through the early part of the twentieth century, scientific theories stressed single-factor explanations to the neglect of the complex interactions of biological systems. At the heart of their argument was the role that their strategic location in the Mediterranean played in the acquisition and maintenance of such power. Writers rose to the task by explaining that the “middle latitudes” (i.e., Greece) were most conducive to favorable cultural developments because in that locale, humans were subject to an ideal proportion of the basic four elements (fire, water, earth, air). A hot tropical climate was believed to foster idleness and resignation (Thomas 1925: 227), while the climate of Greece, with its seasonal changes, balanced the exposure to the elements and thus was the most conducive to progress. These ideas, which were endorsed by Hippocrates, Aristotle, and other major figures of ancient Greece, set a trend that was followed by the Romans. Roman writers cited geoclimatic reasons for the Roman conquest of the rest of the civilized world. Cicero attributed this success to the strategic location of Rome itself. Like Greek authors before him, Vitruvius felt the optimal location was one midway between the two extremes of hot and cold. He pointed to Rome’s dominance as proof of the correctness of his judgment. Because of the protection afforded classical learning in Christian monasteries and Arab centers of scholarship, the human-environment theories of classical times survived the turmoil that followed the breakdown of Roman rule (Castaglioni 1958: 258–263).

Arab scholars elaborated on classical theories. The Arab conception of the human-environment relationship was twofold. One part consisted of an astrological explanation that considered humans to be part of the cosmos, resulting in their character and outlook being determined by the ruling stars of their environment. The other part was a purely geographical explanation based on climatic considerations (Alavi 1965: 68). The Arab scholar Al-Mas’udi discussed the importance of the availability of water, natural vegetation, and topography in determining the sites of human settlements. He also correlated the climate to the humors of the body, showing how a certain climate can give rise to humoral imbalances and thus to particular virtues or vices (Alavi 1965: 69–70). Arab scholars preserved and translated the Greco-Roman classics and, in the process, added some of their own interpretations to the texts. As a result, when the classics were read in twelfth- and thirteenth-century Europe, it was with the addition of commentaries by Arab and Jewish scholars from Cordoba, Seville, Toledo, Baghdad, and Damascus.

With the discovery of the East Indies and the New World, Europeans were thrust into contact with cultures and environments that differed considerably from their own. Among the adventurers, missionaries, and merchants of those days were naturalists and curious travelers; their accounts of the strange habitats and ways of native Asians, Africans, and Americans excited intellectual interest in explaining cultural and environmental differences. The role of human culture in buffering the impact of environment upon society began to be appreciated, and the scope of possible explanations for similarities and differences in human populations expanded.

In the late nineteenth century, a general trend toward organizing increasing amounts of archaeological and ethnological data resulted in an attempt to illuminate the processes by which human cultural history changes. A very simple heuristic device was quickly discovered—many cultures with similar artifacts and customs could be grouped by geographic location. Geographers and, later, ethnographers seized upon this notion. They viewed the interrelation of groups with their habitats as producing specific kinds of cultural traits. Friedrich Ratzel (1844–1904), a scholar with broad ethnographic interests who was the founder of anthropogeography, emphasized the primacy of habitat in bringing about cultural diversity (Helm 1962: 630). He explained human cultural evolution as being spurred by the conflicts over territory between migrating peoples. His thesis thus centered on the migration of groups, which promotes the diffusion of cultural traits (Harris 1968: 383). While diffusion may produce divergence in the original traits, Ratzel also believed that migratory peoples usually “hold fast to their natural conditions of existence [that is, culture]” (quoted in Thomas 1925: 140).

The environmental determinist trend continued in the twentieth century with the work of geographers Ellsworth Huntington (1915) and Griffith Taylor (1951). Huntington believed that variations in temperature and humidity were beneficial, provided they were not taken to extremes. He eventually postulated what he came to regard as an ideal climate for maximum human efficiency: one with moderate seasonal changes, average humidity, and abundant storms. Although Huntington was far from naïve, he formulated his generalizations as if climate was the only important factor.

An elementary problem with these deterministic theories is their misuse of inductive reasoning. The inductive approach requires that one observe the facts and then form a generalization that will fit all the observed facts. It has been more common among determinists to formulate a generalization first and then set out to prove it with an unclear methodology and an inadequate sample. Selective sampling led to confirmation of many deterministic generalizations. At a time when so little was known about the workings of the physical world, it is striking how broad the scope of these generalizations was.

1.2 Cultural Determinism

Unlike environmental deterministic theories, which emphasize the influence of nature on human behavior and institutions, cultural deterministic theories viewed nature as a relatively static factor or backdrop, and human history and culture as shaping human communities. Franz Boas (1858–1942) proposed what has come to be called historical possibilism—that is, nature circumscribes the possibilities for humans, but historical and cultural factors explain what is actually chosen. Boas (1896: 901–908) rejected the idea that the environment was a primary molder of culture and sought explanation for cultural differences in the particular cultural history of a people. Boas did not come to this position immediately, but rather

after initial acceptance of the environmental deterministic views of his day. When Boas went on his trip to Baffin Island to study the Eskimo, he did so “with a strong presumption in favor of the primacy of geographical factors in the life of the Eskimo” (Boas 1964[1888]; Harris 1968: 265). In *The Mind of Primitive Man*, Boas (1963[1911]) pointed out that the environment furnishes the material out of which people shape and develop the artifacts of daily life as well as their theories, beliefs, and customs (Thomas 1925: 278). Yet while he granted that the environment had a general influence, Boas criticized the one-sided notion that the same type of environment will, in a given stage of culture, produce the same results everywhere. While the followers of Boas insisted that there was no Boasian school, there was a certain common ground that they shared. Regarding the environment, their approach was a reaction to environmental determinism. Lowie (1883–1957), for one, in his *Culture and Ethnology* (1917) set out to disprove the environmental deterministic notions that “culture reaches its highest stages in temperate regions,” that the concept of liberty is directly correlated with altitude, and that island inhabitants are accomplished seafarers. Lowie argued that under the same geographical conditions, radically different cultures have developed. Alexander Goldenweiser saw the environment as a static force and culture as the dynamic element that shaped the use of natural resources. He also suggested (cf. Ferndon 1959) that humans change the natural environment (e.g., turning forests into cultivated fields) and, as a result, make their own environment instead of being determined by it (Goldenweiser 1937: 452–453). As we will see later, this view (that people do not adapt to environment but modify their environment to suit them) has returned as historical ecology, emphasizing historical context and agency (Balée 1998; Balée and Erickson 2006).

Alfred Kroeber (1876–1960), like other anthropologists of his day, subscribed to the Boasian credo that the physical environment is there merely to be acted upon by human culture. Kroeber’s (1939) approach in *Cultural and Natural Areas* can be likened to that of his contemporary, British geographer/anthropologist C.D. Forde (1902–1973). Both of them emphasized the need for collecting ecological data and viewed such data as potentially valuable in explaining cultural similarities. Forde, for example, after summarizing the history of economic systems in relation to ecology and social organization, concluded that neither an evolutionary sequence of “economic stages” nor the nature of the subsistence base could explain the changes in culture (Forde 1934). Economic and social activities, he concluded, are products of the long, but largely unpredictable, processes of cultural accumulation and integration.

Kroeber’s conclusions in *Cultural and Natural Areas* resemble those of Forde’s in *Habitat, Economy and Society* (1934). With that effort, Kroeber’s fleeting use of technoenvironmental explanation ended, and he turned his idea of culture area increasingly toward notions of diffusion and “areas of culture origins.” In regard to his earlier culture/environment explorations, Kroeber (1939: 205) became baffled and wrote, “The interaction of culture and environment become increasingly complex when followed out. And this complexity makes generalization unprofitable, on the whole.” He noted that in each situation or area, different natural factors are likely

to be “impinging on culture with different intensity” (ibid.). In spite of its merit recognizing cultural differences and the complexity of HEI as one moves from local to higher levels of analysis, an overemphasis on the singularity of local phenomenon continued to plague theoretical approaches that insist on cultural determinism, discouraging attention to comparative work informing robust generalizations.

1.3 Human-Environment Interactions

The eighteenth century was a period when natural historians concerned with human progress formulated evolutionary sequences that attempted to explain human society in terms of increased human control over nature. One of these figures, Anne-Robert-Jacques Turgot (1727–1781), foreshadows the cultural ecological approach of Julian Steward. In his *Universal History* (1750), Turgot interpreted the band organization of hunters as a response to the necessity of pursuing game over vast areas. Such pursuit resulted, in turn, in the dispersal and diffusion of peoples and ideas. On the other hand, where easily domesticated species were present, a pastoral way of life with greater population concentrations and greater control over resources might emerge. During this period, the Scottish School (an intellectual elite in Scotland in the eighteenth century) made efforts to correlate social organization with subsistence. A major figure of this school was historian William Robertson, whose book *The History of America* (1777) is a landmark for its discussion of the conditions for cultural similarities around the world. Robertson believed that cultural similarities were evidence of independent invention, arguing that similarities between the resource bases of two groups would lead to similar adaptive responses. Whenever Robertson encountered seemingly “nonadaptive” traits, he attributed such behaviors to the group’s borrowing the trait, despite its nonadaptiveness, from neighbors with whom they had had previous contact. Thus, Robertson dealt with two of the major research questions in cultural ecology: diffusion vs. innovation and explaining adaptive vs. maladaptive cultural behavior.

The Scottish School included many writers, such as Adam Smith (1723–1790), Adam Ferguson (1723–1816), David Hume (1711–1776), and James Millar (1735–1801), all of whom examined the evolution of complex societies and the cultural and materialistic forces that lead to social stratification (Voget 1975: 90). These men looked at the interrelation of cultural units, especially those involved in the economics of a society, rather than the evolution of ideas per se. Adam Smith emphasized the division of labor as basic to understanding the increasing complexities of a modern nation (Voget 1975: 78). Ferguson and Millar attempted to correlate various institutions, such as land tenure, marriage, and slavery, to the subsistence base found in various cultures. In so doing, they tried to correct some of the distorted accounts and explanations of prehistoric life by utilizing a variety of data sources and by avoiding racial and ethnocentric ideas about primitive “nature” or “intellect” (Harris 1968: 29–31). Millar and others also emphasized control over resources and accumulation of an economic surplus as accounting for

differing institutions. In the writings of these men, we see a growing awareness that any explanation of cultural diversity must include a consideration of a broad range of factors. They do not use single-factor deterministic explanations, nor do they overemphasize individual choice, cultural determinism, or the purposeful movement of nature toward “progress” and higher civilization. Turgot and the Scottish philosophers emphasized adaptation from one subsistence mode to another.

The nineteenth century was the heyday of the naturalists. The similarities and differences in living organisms impressed them and stimulated their search for explanations. The contributions of Charles Darwin (1809–1882) to ecological theory are particularly notable. Darwin found inspiration for his theory of evolution in the works of Charles Lyell and Thomas Malthus (1766–1834). Darwin took a copy of Lyell’s (1830) *Principles of Geology* with him on his HMS Beagle voyage and confided in his diary that it “altered the whole tone of [his] mind.” Through Lyell’s account of the geological record, Darwin saw an alternative to the narrow Biblical time scale and was impressed by the relationship between environmental change and modifications in biological forms. Malthus’s (1798) *An Essay on the Principle of Population* influenced Darwin with its idea that the natural trend of the human population was to increase unless stopped by disease, war, or famine. Darwin extended this notion to plant and animal populations.

Darwin’s synthesis appeared in 1859 under the title *On the Origin of Species by Means of Natural Selection*. In this work, Darwin began by assuming that all living things are related and that the diversity of species results from a continual branching out. Such branching is a product of the process known as natural selection. According to the principle of natural selection, those organisms most fit to survive and reproduce in a given environment will outreproduce less well-adapted organisms and that species not adapted to current environmental conditions will be reduced to insignificant numbers and possibly to extinction.

If biological evolution reflected only the process of adaptation to environment, it would be a static, nonevolutionary process. For evolutionary change to occur, there must be random changes in species that are not responses to current needs but that under given circumstances give an advantage to individuals who share the trait in a population. It is easy to misunderstand Darwin’s view of natural selection. The Lamarckian idea (Jean-Baptiste Lamarck, 1744–1829) that organisms improve themselves by their own efforts and that they pass on these advantages to their offspring appeals to common sense and to the notion that evolution travels along a progressive path (Gould 1980: 76). However, it is not in this manner that species evolve. The specter of Lamarck in evolutionary theory can be traced to his central notion that organisms respond to felt needs, and indeed, Lamarck’s ideas are relevant to the notion of specific evolution as proposed by Marshall Sahlins and Elman Service (1960) and to Steward’s (1955) emphasis on adaptive processes in local environments. In contrast, Darwinian theory emphasizes that genetic variation arises randomly and proceeds undirected. Selection acts upon unoriented variation and changes result from reproductive success. Darwinian theory’s power derives from its complexity, from its refusal to be a mechanistic theory driven by environmental determinism (Gould 1980: 81) or by purpose. It is

less appealing than Lamarck's theory because it presents us with a universe devoid of intrinsic meaning or direction. As Roy Rappaport noted (1984), human beings have had to invent culture and ritual "to give meaning to a world devoid of meaning." Lamarck's theory, while failing to explain how species evolve, suggested instead how human cultural evolution occurs. It is in this realm wherein we can expect rapid acquisition of adaptive traits through ideological and behavioral change and its transmission through socialization. Technological change and cultural change work in Lamarckian ways, and they have unleashed a rate of change inconceivable in the slower, undirected process of natural selection.

Modern evolutionary theory and genetics have put to rest the simplistic notions of determinism. The functions and forms of organisms can be understood only by careful accounting of complex processes of interaction. This is best expressed in the contrast between genotype and phenotype. The genotype refers to the hereditary potential of an organism. The phenotype, on the other hand, is the product of the interaction between the genotype and the environment where the organism is located. Some species tolerate a minimum of environmental change and exhibit a minimum of phenotype variation (i.e., highly specialized species). Bacteria, for one, tolerate only minute differences in habitat temperature. The human species, by contrast, manifests great phenotypic variations and can tolerate a wide range of environmental conditions (i.e., we are a generalist species).

The development of the field of evolutionary ecology has been particularly vigorous since the 1980s (e.g., Boyd and Richerson 1985; Durham 1990; Smith 1991; Winterhalder and Smith 1981). The attention that it gives to the great complexity of the environment distinguishes it from earlier approaches. However, if one is interested in the exceptional plasticity and diversity of behavior within a species, an evolutionary ecological approach is more appropriate. It is more concerned with why diversity of behavioral outcomes occurs and less with how such adaptations effectively address the needs of species or individuals. For the latter, an adaptationist or functional approach is still more appropriate.

Steward's early writings broke with both environmental and cultural determinism by emphasizing the use of the comparative method to test causal connections between social structure and modes of subsistence. Steward's approach was a functionalist one, concerned with the operation of a variable in relation to a limited set of variables, not in relation to an entire social system. The cultural ecological approach proposed by Steward involves both a problem and a method. The problem is to test whether the adjustments of human societies to their environments require specific types of behavior or whether there is considerable latitude in human responses (Steward 1955: 36). The method consists of three procedures: (1) to analyze the relationship between subsistence system and environment, (2) to analyze the behavior patterns associated with a given subsistence technology, and (3) to ascertain the extent to which the behavior pattern entailed in a given subsistence system affects other aspects of culture (Steward 1955: 40–41). In short, the cultural ecological approach postulates a relationship between environmental resources, subsistence technology, and the behavior required to bring technology to bear upon resources.

The crucial element in Steward's approach is neither nature nor culture but, rather, the process of resource utilization, that is, the interaction between people and their resources. The reasons for the priority he gave to subsistence are clear: Obtaining food and shelter is an immediate and urgent problem in all societies, and patterns of work at a given level of technology are limited in their ability to exploit resources. The approach is best illustrated by his study of the Western Shoshone. The Shoshone inhabited the Great Basin of North America, a semiarid land with widely dispersed resources. The Shoshone were hunter/gatherers with simple tools and relied heavily on the collection of grass seeds, roots, and berries. Steward showed how almost every resource could best be exploited by individuals—except rabbits and antelope, which required seasonal group hunting. Each fall, the Shoshone gathered pine nuts that were stored for the long, cold winter. Although in winter they formed larger population concentrations, they did not form stable social units because pine nuts were not available in the same places each year, and groups therefore had to remain fluid to adequately exploit the basin. Thus, the requirements of subsistence produced fluid and fragmentary social units. To Steward, the Shoshone presented an extreme case of the limitations placed by environment on the workable options available to a culture. Steward hypothesized that the immediate impact of environment upon behavior decreased as technological complexity improved the human capacity to modify the environment. He suggested that in complex societies, social factors may be more important in explaining change than subsistence technology or environment (Steward 1938: 262). The research strategy proposed by Steward is all the more striking if one considers its historical backdrop. Until Steward's time, human-environment theories either dealt in broad generalities lacking a firm grounding in empirical research or emphasized lists of cultural traits. Cultural ecology put the emphasis on careful analysis of social interaction, recording of movement, timing of work activity, and so forth. Through such research, it was possible to more effectively delimit the field of study and arrive at cause-and-effect relationships. Another, although less developed and popularized component of his theory, was a concern with levels of cultural and social integration. Steward stressed the importance of understanding complex social systems not as the average of behavioral norms. He focused on understanding levels of social-cultural integration with the idea that in any society there is a succession of horizontal and vertical organizational types along a continuum representing emergent social and political forms.

Steward has been criticized by some scholars because his approach is difficult to operationalize in the field and because it assigns primacy to subsistence behaviors. The focus on subsistence is essential to the cultural ecological approach. There are cases when other factors may have far greater control over a social system, and over the years, Steward (1955: 93) expanded the scope of cultural ecology to include political, religious, military, and aesthetic features of culture. Clifford Geertz (1963) concluded in his study of Indonesian agriculture that historical and political factors are part of the total environment to which populations adapt and must not be dismissed as secondary. A few years later, Rappaport (1968) showed how ritual could play a central role in the maintenance of a society's balance with

resources. The contribution of Steward was to delimit, more than anyone before him, the field of human-environment interaction. He did so by emphasizing behavior, subsistence, and technology. The weaknesses of such an approach became apparent within a decade and spawned other research strategies.

Dissatisfaction with the research approach of cultural ecology led some scholars to search for new theories, new data-collecting techniques, and new analytical tools. The major influence on this new research approach came from general, or biological, ecology. The ecosystem concept provided a conceptual framework more satisfactory to some scientists than the behavior/social structure equation stressed by Steward. Michael Little and George Morren (1976: 5) succinctly expressed the strategy: “We are concerned with those cultural and biological responses, factors, processes and cycles that affect or are directly connected with the survival, reproduction, development, longevity, or spatial positions of people. This set of questions rather than the traditional division of scientific labor defines the subject matter.”

Rappaport and Andrew Vayda gave the strongest impetus to an ecosystem approach in the field of anthropology. In fact, they preferred the term *ecological anthropology* because they felt that the emphasis on “culture” suggested by the term *cultural ecology* obscures the applicability of principles from biological ecology to the study of human adaptation (Vayda and Rappaport 1976: 20–21). Given that humans are but one species in nature, subject to the same laws as other species, use of the principles, methods, and analytical tools of the ecological sciences would greatly add to our understanding of our own species. Vayda and Rappaport believed that anthropologists should not hesitate to adopt biological units such as population, community, and ecosystem as units of study since it allows a more comprehensive approach to ecological studies. Even the topics of research can be couched in terms that make sense across both disciplines. Vayda and Rappaport pointed out that ecologists have shared various areas of interest with anthropology: ways of defining territorial rights, ways of establishing group identity, and mechanisms for establishing buffer zones. All these can be viewed “ecologically” as regulating behavior or serving a homeostasis function. To test ecological hypotheses properly, a wealth of information is required, and no single researcher can expect to succeed in gathering it all—and it is no surprise that their own experience of field work in Papua New Guinea as part of a large interdisciplinary team studying war in that region led them to see the value of ecosystem as an integrator of work across ecology, geography, and anthropology (Vayda and Rappaport 1976: 23).

Vayda’s study of how warfare in New Guinea is related to population fluctuations, changes in man/resource ratios, and the competition of different highland clans for gardens and pigs is a notable example of the ecological approach (Vayda 1974, 1976). Rappaport, working with the Tsembaga Maring in the same region, was more concerned with how ritual serves to regulate: (1) the size of the pig herd, (2) the frequency of warfare, (3) the availability of horticultural land within reasonable walking distance of the village, (4) the length of the fallow cycle, and (5) the military strength and alliances of a tribe and the likelihood that it will hold

on to its claimed territory.² Rappaport is not really concerned with the individual decisions of the Tsembaga Maring as they see their pig herd increase to the point that they become a threat to the human ecological system. Rather, he finds that the system “senses” the increased burden of having too many pigs. When a system threshold is reached, the elders call for a ritual pig slaughter. The ritual reduces the number of pigs and facilitates the creation of alliances between neighboring groups. Warfare follows, and its occurrence serves to distribute the population over the landscape and to return the system to “initial conditions” or a state of equilibrium.

An important issue raised by Rappaport’s study (1968) is the utility of the concept of homeostasis. As used by Rappaport, the concept was equivalent to equilibrium—a view shared by some biological ecologists and reminiscent of the Greco-Roman search for order in nature. In equilibrium models, attention is paid to how cultural practices help maintain human populations in a stable relationship with their environment. This view is the prototype of neofunctionalism, and it has its drawbacks. It views the current state of the system as the norm and overemphasizes the functions of negative feedback to the neglect of the dynamics of change accelerated by positive feedback. This viewpoint tends to preclude the possibility that behaviors might be maladaptive, which they surely are in certain situations (Alland 1975; Eder 1987).

Adaptation to environment is, however, not a simple matter of negative feedback. System correction through negative feedback operates most effectively at lower levels in a system. Higher levels operate at a more general level wherein ambiguity and vagueness permit constant reinterpretation and restructuring of system properties as responses to perturbations. Homeostasis and dynamic equilibrium do not imply changelessness. On the contrary, they require constant adjustment of system parts and even some change in structure in response to perturbations (Rappaport 1977: 169). In other words, while systems have lower-order mechanisms geared to the maintenance of stability, they also have higher-level, less specialized responses that can reorder the system to assure its survival—a view echoed in more sophisticated ways today in terms of emergent properties of systems.

A number of problems must be recognized in how the ecosystem concept was used: a tendency to reify the ecosystem and to give it properties of a biological organism, an overemphasis on energetic flows and measurement of calories, a tendency for models to ignore time and structural change (and to overemphasize homeostasis), a tendency to neglect the role of the individual, a lack of clear criteria for defining boundaries of systems, and level shifting between field study and analysis of data (see review in Moran 1990). Problems of reification have been addressed in recent years by an emphasis on how individuals modify the environment and not simply adapt to a reified nature (Balée 1998; Boster 1983, 1984; Crumley 1994). Today, few scholars would suggest that measurement of energy flow ought to be a central concern of ecosystem studies. Concerns have

²More details on the Tsembaga Maring studies by Rappaport can be found in Rappaport’s ethnographic account (1968, 1984).

shifted to nutrient cycling, decision making, complexity in systems, and loss of biodiversity (Jordan 1987; Lansing 2003; Levin 1998; NRC 1999; NSB 1989). Studies show increasing attention to historical factors and even whole “schools of thought” on historical ecology, environmental history, environmental geography, and other spinoffs. The role of individuals and households has also blossomed (Lees and Bates 1990; Rindfuss et al. 2003; Roy Chowdhury and Turner 2006; Wilk 1990).

In the future, studies are likely to be most fruitful when they integrate a general systems approach with the study of how actors develop individual strategies. There is no reason why both perspectives cannot be used, and there is evidence that researchers have already begun to balance a concern for the individual with a concern for the population. One way to overcome the tendency toward static equilibrium models might be to study how populations adapt to certain kinds of stress. By studying the response of individuals to hazards, we can answer such questions as the following: Who responds? Does stress lead to changes in the structuring of the population? Are cultural patterns changed? How do people perceive the severity of the stress to which they are responding? How does the human population adjust to termination of the stress? These questions are more likely to be productive in outlining systemic interrelations in populations experiencing changing situations than in those with stable situations (cf. Lees and Bates 1990; McCabe 2004; Vayda 1983).

Historical ecology offers valuable insights to scholars from all disciplines interested in global environmental change, as well as a bridge between the social sciences and the humanities. History represents the recent record of what we know as the longer record of evolution, except that the historical record tends to be more detailed, more nuanced, and closer to contemporary conditions and offers provocative insights into alternatives to our current environmental dilemma. Global models tend to be coarse in scale and lack anything like an adequate representation of human variability and real biotic differences. One of the current and most exciting areas of research is the collaboration of paleoclimatologists, archaeologists, and historians in reconstructing the record of the past 300 years and eventually of the past 6,000 years (Johnson et al. 2005). Landscape history (Crumley 1994: 6) refers to the study of changing landscapes over time and in space. Human beings adapt to and bring about modifications in ecosystems—and have done so for thousands, if not millions, of years. Historically informed environmental analysis is a necessity if for no other reason than to correct the misperception that past environments were “pristine” and that only recently have humans begun to have an impact on the earth (Jacobsen and Firor 1992). Hardly any spot on earth is unaffected by human action, and humans have brought about changes, both positive and negative, in all landscapes. This record of human impact on environment offers a rich menu of choices we have made and their consequences, providing a view of alternatives much richer than a focus on the present would ever provide—choices to avoid and alternatives to be taken. Historical ecology brings together the approaches of ethnography, archaeology, history, and paleoscience to address environmental issues at regional and global scales (Crumley 1994), but the marriage of environmental history with historical ecology has not been consummated (Winterhalder 1994).

The differences between these two approaches come from the former coming from the discipline of history and therefore being reluctant to theorize, while the latter sees itself as a research program that emphasizes agency and historical context. It is not an insurmountable problem and is one that could be resolved by more interaction, given the desire of some environmental historians to ally themselves with ecological anthropological theory (Wooster 1984). To focus together on a given historical problem or landscape is likely to be the way forward.

In a recent and important volume, William Balée and Clark Erickson (2006) present historical ecology as a research program distinct from previous approaches. They suggest that their strategy is distinct from that of landscape ecology because they focus on how human beings bring about changes in landscapes. They take a strong position that there are no pristine environments but, rather, as soon as humans enter into an environment, it is made into a human landscape and modified by human actions for human objectives. They argue that human beings do not adapt to the physical conditions of the environment by adjusting their population size and settlement size to initial environmental conditions. Rather, they propose that humans transform those constraints into negligible analytical phenomena (Balée and Erickson 2006: 4) through transformation of soils, drainage, cropping practices, and so on. Further, they dismiss cultural ecology, ecosystem ecology, adaptationist approaches, and systems ecology because they “ultimately deny human agency” in positively changing the environment over time (*ibid.*). While there is value in emphasizing how local populations modify an environment to achieve their goals (Balée 1998), it is an overstatement to say that the adaptation approaches deny human agency (Rival 2006).

One current and popular theoretical approach used by environmentally oriented anthropologists and geographers is that of political ecology. Recently, the section on cultural ecology of the Association of American Geographers, for example, was renamed the section on cultural and political ecology (*cf.* Jarosz 2004). Human ecologists have become increasingly aware that power relations affect human uses of the environment. We are now aware of the role of environmental movements in exerting pressure on political bodies, corporations, and institutions. There is a renewed awareness of the potential value of human ecology in influencing policy and understanding the future of how humans impact the environment (Brosius 1999; Greenberg and Park 1994).

Few if any places in the world today are untouched by global forces such as climate change, capitalism, media, and the reach of the United Nations (Blaikie and Brookfield 1987; Braudel 1973; Rappaport 1993; Wolf 1982, 1999). We cannot ignore in environmental analysis the ways these relationships of local to global systems lead to particular outcomes (Moran 1982).

Political ecology bears great affinity with political economy, as both explore the role of power relations in affecting human uses of the environment, particularly the impact of capitalism on developing societies (Brosius 1997, 1999; Gezon 1999; Kottak 1999). Unlike political economy (with its central interest on class relations), political ecology is centered on the ravages that capitalism brings upon the environment and on human-habitat relations (Johnson 1995; Lansing 1991; Peet

and Watts 1994; Rappaport 1993). It has been noted that political ecology has a tendency to privilege the local scale as more desirable than other scales, often viewing larger scales as oppressive of the local, and that this “local trap” can lead to major analytical errors (Brown and Purcell 2005). As a relatively new approach, political ecology still lacks a robust theory or a settled paradigm (Biersack 1999). The scale preference noted above is just one of several philosophical and theoretical traps that remain to be solved. As it matures, one sees some trends developing closer to the concerns of the environmental social sciences (Bates and Lees 1996; Crumley 1994) while others develop closer to so-called critical theory and cultural studies (Biersack 1999; Peet and Watts 1996).

At present, the bulk of political ecological analysis has stayed well within the concerns of the social sciences and distant from the physical and biological sciences in its data collection and methods of research. It has been more concerned with cultural and political critique and has only rarely presented a substantive body of environmental data as part of the analysis of political ecology. In short, it has been stimulating on the politics but less substantive on the environmental side. Vayda and Bradley Walters (1999) take issue with what they consider to be the dominant role claimed for political and political-economic influences in advance of the research (Bryant and Bailey 1997) instead of empirically examining a broader set of factors in which the outcome of what is most important is not known in advance. Lisa Gezon (1997, 1999), among others espousing political ecology, focuses on examining how people engage politically in contesting access to resources but only rarely presents environmental data on the resource being contested. Vayda and Walters (1999: 170) argue that ignoring the biological data can lead to unwarranted conclusions about the primacy of political influences. This may be a sign of political ecology’s need to address the valid concerns of environmentalism and other political causes. But if its results cannot be integrated with the enormous efforts at understanding human dimensions of global change, conservation biology, environmental NGOs, and other local and regional agencies engaged in environmental protection, it may grow marginal to the very policy world it wishes to influence. It is important for political ecologists to join biophysical scientists in examining together the complex forces at play. As any other complex adaptive system, human ecosystem outcomes are nonlinear, have emergent properties, and can be remarkably counterintuitive. Political ecology and other ecologies used by environmental social scientists need to seek ever new ways to integrate knowledge and advance understanding of the complexities inherent in ecological systems.

One of the fields that expanded in reaction to environmental problems was institutional analysis. The field of institutional analysis has been interdisciplinary from the beginning, drawing on anthropology, sociology, political sciences, economics, and geography, among other disciplines, but fundamentally concerned with the management of common-pool resources (Acheson 2006; Agrawal 2003). There is significant overlap between political ecology and institutional analysis but enough differences in terms of intellectual community, research framework, and design to treat their development as distinct.

During the 1960s and the early 1970s debates on the catastrophic effects of human behavior, the uncontrolled increase in population and pollution, in addition to the dangers of irreversible environmental damages caused by overexploitation of natural resources at local and global scales, triggered the development of a variety of government regulations and policies to reduce and control the impact of human activities on the earth's resources (McCay and Acheson 1987). The drive to regulate through government intervention was made even more urgent by an extremely influential paper by Garrett Hardin (1968) published in the journal *Science*. Based on this work, "The Tragedy of the Commons," the unsustainable exploitation of natural resources and environmental services, caused by an increase in population and maximization of per capita consumption in the absence of rules of use, could be controlled only through privatization or centralized government. This oversimplification of common-pool resource management (Dietz et al. 2003; Ostrom et al. 1999) stimulated an extremely fertile area of investigation, focused on institutional arrangements to function as mediator between population and natural resources.

Institutional analysis of empirical case studies based on ethnographic work carried out by anthropologists soon uncovered the existence of a variety of successful institutional arrangements for the management of natural resources (McCay and Acheson 1987; Ostrom 1990). This analysis not only revealed that humans were not inherently destructive of their environment but also showed that what can be characterized as rational behavior (i.e., individuals maximizing some objective function) does not necessarily result in the negative outcomes Hardin suggested (Ostrom 1990). Research efforts within the largely interdisciplinary community involved with institutional analysis helped to identify two nodes that could contribute to solve the problem of common-pool resource management: restricting access to resources and creative incentives for responsible use. They also recognized several challenges facing the global commons (e.g., oceans, atmosphere, fisheries), among them the problems involved in expanding local- and national-level arrangements to manage global environmental resources, the effect of cultural differences in defining common rules, the primacy of national political and economic interests, understanding the complexity introduced by the interaction of various resources, and the rapid rate of environmental and social change (Brondízio et al. 2009; Ostrom et al. 1999).

Attention to common-pool resources occurred parallel to and in connection with the rise of indigenous and local social movements and reclamation of access to resources. This occurred as a reaction to expanding agrarian systems into land held under various institutional arrangements, a boom in the creation of parks in previously occupied forests, and a looming crisis for global fisheries. Building upon the now classic work of political scientist Elinor Ostrom (*Governing the Commons*, 1990), this field has developed with a rare combination of theoretical concern (e.g., collective action, game theory) and applied contributions. It arrived at a consensus about several elements significant to the successful management of common-pool resources at least at the local level. Thomas Dietz et al. (2003) discussed some of the key elements for effective management of common-pool resources: (1) effective, clear, and low-cost monitoring of resources; (2) moderate

rates of change in resources and social settings; (3) intense communication and dense social networks within communities (also defined as high social capital); (4) the possibility of excluding outsiders from the resource at low cost; and (5) common agreement and support for the institutions in place.

A combination of “actor”- and “community”-centered approaches was particularly suitable for framing and testing the environmental outcomes of specific institutional arrangements. This line of investigation was formalized, for instance, in the institutional analysis and development (IAD) framework (Tucker and Ostrom 2005). In the words of Catherine Tucker and Ostrom (2005: 87), IAD depends on “theories of rational choice, collective action, common property, and social capital,” and it focuses on “the action situation, which is composed of participants, positions, actions that respond to information and relate to potential outcomes, and the costs of benefits associated with actions and outcomes.” Environmental conditions were important in this approach since they influenced the actors’ choices and defined part of the single actor’s assets and information.

Research on institutional analysis has also centered attention on scaling up lessons learned at the local level to larger scales (Berkes 2006), which is indicative of the strong presence of institutional perspectives within interdisciplinary research programs concerned with human dimensions of global environmental change (Young et al. 2008). Several examples illustrate the productive engagement of anthropology with institutional research, such as studying the intersection of community management and policy intervention in irrigation (Trawick 2001), fisheries and markets (Acheson 2003; McCay 1998), comanagement systems (Castro and McGrath 2003), and commodity markets (Brondizio 2008; Tucker 2008), among others. This research community continues to grow in an interdisciplinary manner, taking a less dogmatic approach toward the determinants of change in human and environmental systems. Recent efforts in institutional analysis have focused on developing a social-ecological system (SES) framework to support multilevel interdisciplinary research (Ostrom 2009). The basic structure of Ostrom’s SES framework is organized in four main domains of analysis (resource systems, resource services and units, governance systems, and actors), each of which has a nested set of tiers of level-specific variables (McGinnis 2011; Ostrom 2009; Nagendra and Ostrom, submitted to *Ecology & Society*). An SES allows for the development of a shared lexicon of variables at different levels, data types and code systems, and integration, and as such it represents a promising tool to support collaborative research and cumulative knowledge on human-environment interaction.

1.4 A Road Map to the Chapters

Chapters in this volume embody the challenges of linking disciplinary expertise and interdisciplinary approaches to the practice of HEI research. In different degrees, chapters contribute ways of overcoming deterministic explanations (cultural,

environmental, technological, or otherwise) in favor of historically and politically situated human interactions with the environment. We are aware that this coverage is not exhaustive, but it offers a microcosm of contemporary HEI research in terms of thematic, theory and methodology, level of analysis, and regional coverage. Drawing on research from eleven countries across four continents, chapters bring perspective from various specialties in anthropology and human ecology, institutional analysis, historical and political ecology, geography, archaeology, and land change sciences.

The ensemble of chapters in this volume also aimed at providing, although not all inclusive, a comprehensive sample of theoretical approaches and levels of analysis, regional problems, methodological design, and data collection tools, lending themselves useful to comparative research and to the training of graduate and undergraduate students. The rich array of methods deployed across chapters includes various applications of remote-sensing data (illustrating various forms of fusion of data with different spatial resolution); standard and participatory GIS; statistical, archival, and policy analyses; market surveys; and institutional analysis tools (e.g., IAD), in all cases informed by field research. This is perhaps the hallmark feature of contemporary HEI, that is, the imperative of understanding issues from both a bottom-up perspective informed by the empirical reality of people and localities, analyzed however within a regional framework. Chapters break away from reductionists' disciplinary confines to illustrate cross-sectional, longitudinal, and comparative approaches applied to indigenous, rural, peri-urban, and urban contexts. Field research techniques include a range of ethnographic and standard survey tools used to collect sociodemographic, health, and nutritional data; household- and community-level organization; institutional analysis; experimental economics; vegetation ecology; land-use/cover change (LUCC) inventories; and not least archaeological techniques.

The four parts are organized to reflect approaches to four dimensions of HEI research: health and adaptation approaches, land change and landscape management approaches, institutional and political-ecology approaches, and historical and archaeological approaches. These parts reflect not only attention to different societal problems but illustrate the complementarity of different analytical foci to these problems. While the book is organized in four thematic parts, one will find significant cross-sectional overlap in research approaches and underlying concepts across chapters. This indicates the shared conceptual and methodological basis and shared terminology within the interdisciplinary HEI research community. It is a recognition that the issues at hand cannot (and should not) be approached in isolation, that is, as contained within the domains of either social or physical science. It is this shared understanding of theory, concepts, and methods that offers a metalanguage for collaborative and comparative research addressing problems of societal interest. We see common underlying themes and factors intrinsic to HEI being analyzed across chapters, such as local livelihoods, the impacts of development and policy making, trajectories of urbanization, community and household change, changes in property regimes, conflicts between people and protected areas, and the pressure of globalization on resource systems. One of the underlying crosscutting themes is LUCC. This is not surprising, as it represents an integrative theme in HEI that

links external pressures, human behavior and decision making, institutions, and biophysical process from local to global scales. Chapters ground the analyses of these themes in historical and institutional contexts, paying attention to trajectories of change and the interplay between sociodemographic, cultural, environmental, and political-economic variables; in other words, they approach problems by avoiding deterministic interpretations or decontextualized analysis.

The first part of the book brings together three dimensions of research on population health and adaptation, which capture, on one hand, the long-term impact of national development projects and regional transformations on indigenous people, and, on the other hand, emerging infectious diseases. The latter is a growing field of research that opens new interdisciplinary bridges between social, environmental, biological, and medical sciences in HEI research.

These chapters illustrate applications of several theories relevant to HEI research, while placing particular studies within broader trends of fertility, nutritional, and epidemiological transitions. The first and second chapters are unique for their rich longitudinal ethnographic perspectives capturing the ways development programs and major sociocultural transformations around and within indigenous areas have contributed to change the lives and livelihoods of indigenous people in lowland South America and the highlands of Tibet. By placing cases within broader comparative trends, these chapters speak to issues relevant throughout the world. The third chapter, on the other hand, benefits from a case study approach to reveal relationships between environmental and socioeconomic change in the spread of important global diseases such as SARS, Nipah virus, Ebola, malaria, and Lyme disease. Placing infectious diseases within the context of different forms of people-wildlife interaction, the chapter reviews pathways related to wildlife consumption, different forms of LUCC, and primate-based ecotourism. In discussing these pathways, it calls attention to the ways human behaviors act as direct or indirect drivers of change facilitating the spread of infectious diseases. This analysis is particularly relevant to inform our understanding of current and future trends in infectious diseases and possible mitigation pathways.

Chapters in Part II offer a rich array of studies on land change and landscape management across four continents, addressing problems of wildlife management, people and protected areas, and forest conservation across a range of private, public, and common-property regimes. As other chapters in this volume, it contributes to the emerging literature on landscape management and ecosystem services, in particular, by bringing attention to institutional arrangements, policy and economic incentive systems, and sociodemographic and cultural dimensions influencing decision making. The range of research approaches is equally informative to HEI research as it combines participatory GIS and qualitative methodologies, meta-analysis of case studies, institutional analysis, and a variety of remote-sensing techniques coupled with field assessments. Chapter 5 uses a participatory GIS and qualitative approaches to integrate the views of different stakeholders involved with red deer management in Scotland. It focuses on understanding (and finding solutions to) the mismatches between deer ecology and the institutional organization of landscapes bounded by different property and management regimes. Chapter 6,

on the other hand, reveals a gradient of sociodemographic and economic conditions surrounding protected areas throughout India. Reviewing the drivers and pressures on 15 protected areas, four of which are studied in detail, it calls attention to the challenges of conservation in areas of high population pressure. As the previous chapter, it calls attention to the importance of considering conservation within a landscape perspective and the limits of conserving islands of resources in an increasingly interconnected world. Chapter 7 provides a comprehensive overview of forest protection in private areas in the United States; it highlights different forms of interactions between private and public decisions regarding the use of forest resources. Using an institutional perspective, it offers a useful approach to examine forests as bundles of property rights and bundles of ecosystem services interacting differently at different scales. Finally, Chap. 8 focuses on the challenges of monitoring landscapes representing a gradient of land-cover types in the African continent. Three case studies (Uganda, Botswana, and Namibia) are examined in detail to review the overlap between vegetation gradients and institutional arrangements representing different types of management areas.

Expanding on approaches to institutional analysis illustrated in the preceding part, Part III brings together five cases discussing the role of local histories, national policies, infrastructure change, and economic pressures and opportunities upon the evolution of institutional arrangements affecting natural resource management and urbanization. Chapters provide analysis representative of different social groups—from farmers and fishery communities to urban residents—living along a gradient of rural-urban settlements across the Americas. They illustrate the sophistication of institutional approaches in incorporating multiple methodologies and research tools, including longitudinal and cross-sectional approaches, experimental economics, remote sensing and GIS, surveys, and institutional analysis frameworks (i.e., IAD). Benefiting from longitudinal ethnography and historical research, Chap. 9 provides a long-term perspective to the evolution of institutional arrangements in the Amazonian floodplains. It examines the roles of federal agencies, NGOs, local fisheries unions, and local residents and reviews the advances and pitfalls of efforts to regularize and regulate land tenure and local resource management systems. Chapter 10 brings an experimental economics perspective to examine the role of incentives and sanctions on rural populations' behaviors toward natural resources in Colombia. It calls attention to the limits and potentially counterproductive results of penalty systems on small farmers' land-use decisions. Chapter 11 takes a comparative perspective to examine small farmers living within and around national forests in two contrasting regional realities of Brazil, that is, the Atlantic Forest in the state of São Paulo and the lower Amazon in the state of Pará. It pays particular attention to the role of national policies affecting small farmers in protected areas, some of which encourage production while others restrict their ability to make land-use decisions in areas of national forests. Building upon long-term ethnographic research, Chap. 12 provides a careful review of phases of institutional evolution in rural Honduras and its implications for local well-being and the forest environment. Integrating remote-sensing analysis and local socioeconomic indicators, it points to the mixed outcomes of economic and institutional changes to the local population.

Closing this part, Chap. 13 focuses on the fast process of urbanization in the United States and the differential roles of federal, state, and local land-use policies in shaping the directions of urbanization and exurbanization. Contextualized within a broader literature review, it examines in detail urbanization cases in the states of Ohio, Indiana, and Arizona and integrates institutional and policy analysis within a spatial framework, which allows the authors to compare the outcomes of different land-use policies and their regional particularities.

Finally, Part IV is dedicated to studies highlighting the value of historical and archaeological approaches to HEI. Ranging from decadal to centennial to millennial, these cases employ a range of methods to study trajectories of land-use intensification resulting from demographic and economic pressures and mediated by institutional arrangements and property systems. Chapters illustrate the influence of colonial policies in Uganda, discuss a unique group of colonists from Japan in post-WWII Brazil, and suggest the expansion of manioc-based agriculture in the Amazon resulting from European conquest. As in previous parts, one finds a diverse set of methodologies and evidence supporting historical approaches to HEI. Together, these chapters illustrate the integration of archival research, institutional analysis, meta-analysis of published studies, remote sensing of various time depths, vegetation ecology, and archaeological field investigation. Chapter 14 describes the fascinating history of Japanese colonization in the Amazon and their trajectories toward a leading position in global black-pepper production following WWII. After a crash in the black-pepper economy, the community pioneered intensive agroforestry using local and exotic fruit crops. The study goes further in examining the consequences of agroforestry intensification for land-cover change, carbon sequestration, and other ecosystem services vis-à-vis a growing tendency toward conversion to pasture in the region. Chapter 15 extends the time scale to the late nineteenth century to examine the impact of English colonial policies on land tenure in the West Mingo region of Uganda. Using aerial photographs, satellite imagery, archival research, and several fieldwork methods to assess land use and institutional arrangements, it reveals that contrary to dominant narratives of degradation by smallholders, the area has experienced increased tree cover since WWII concomitant with increased pressure for natural resources from urban and rural areas. The closing chapter of the volume takes us back to fundamental questions about the intensification of agriculture in pre-Colombian South America and the rise of sociopolitical complexity. It offers a fascinating account of the connection between language dispersal and diversity and plant and agricultural domestication in the region. It flips traditional theories of environmental determinism explaining the structure and distribution of pre-Colombian Amazon societies. It argues for the lack of evidence indicating intensive agriculture as the basis for large pre-Colombian populations in the region's floodplains and proposes a provocative hypothesis suggesting that diverse forms of intensive agroforestry, water resource management, and trade and regional resource acquisition as central to the economy of the region until the arrival of Europeans.

In the concluding chapter, authors review some of the underlying themes of the book and call attention to the recurrent challenges of developing cross-scale analysis

and integrative frameworks to overcome deterministic approaches to HEI. We invite the reader to enjoy the richness of each localized chapter while exploring the various thematic, theoretical, and methodological threads connecting them independent of temporal and spatial scale or region of the world. Together, they are representative of a broader “epistemic community” concerned with advancing understanding of the interdependence of social and environmental problems through a network of interdisciplinary collaboration build upon the complementarity with disciplinary knowledge.

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