Chapter 2
Ecological-Evolutionary Approaches to the Human–Environment Relationship: History and Concepts

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2.1 Introduction

Ethnobiology is characterized by a substantial diversity of theoretical frameworks and fields of knowledge. Insofar as this diversity makes ethnobiology a complex research area, it also expresses an important concern how can other fields of knowledge contribute to the strengthening of ethnobiology? In this chapter, we discuss how different theories concerning ecological and evolutionary understanding of social-ecological systems can be useful in studying or interpreting ethnobiological questions. The history and the concepts that we present are understood as part of the historical construction of disciplines such as ecological anthropology and human ecology. We do not present this history and these concepts as if they were part of a trajectory followed by ethnobiology but as a set of factors that influenced different researchers at various points in time.

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In the chapter's first part, we rehabilitate several historical concepts related to the contribution of ecological and evolutionary approaches to the understanding of the human–environment relationship, particularly those concepts that originate in ecological anthropology and human ecology. To better understand this relationship, we present examples of ethnobiological investigations and the respective philosophical currents adopted (even implicitly) by their authors. In the second part, we address the interactions of ethnobiology with other disciplines, particularly environmental psychology and evolutionary ecology.

We understand that an evaluation of the human–environment relationship in this manner implies the adoption of a materialistic outlook. However, in adopting this perspective, we remain unwilling to reduce the complexity of that relationship to explanations of a biological nature while neglecting the influence of cultural factors. In truth, this discussion has a long history and has been controversial. However, we believe that this materialistic outlook can improve our understanding of part of the phenomenon and contribute to the evolution of a theory of the human–environment relationship.

2.2 The Human–Environment Relationship and the Evolution of Ecological Anthropology

2.2.1 Determinism and Environmental Possibilism

Among the main discourses that attempt to explain the person–environment relationship, one finds environmental determinism (see Kormondy and Brown 1998; Hawley 1986). According to the determinist discourse, the environment is the primary force that defines human behavior[1] and possesses substantial power to modulate our cultural traits. This view discomfits the scientific community because, for example, it diminishes the importance of human choices. Therefore, over time, the determinist discourse has lost credibility and adherence in scientific circles.

Historically, within the humanities, social sciences, and ethnosciences, the term "determinism" has been distorted. It is not uncommon that studies that consider the environmental influence in any aspect of human life are labeled deterministic. When not provided with a scientific basis, this label can be dangerous because it typically marginalizes investigations that seek to understand the extent to which the environment can influence certain aspects of human behavior. Such marginalization can result in a lack of interest in the question of environmental influence, and consequently, reduce the çevel of knowledge generated regarding this topic.

[1] As Mesoudi (2011) emphasized, human behavior is the performance of information that is genetic or acquired through individual or social learning. Thus, strictly speaking, behavior is not necessarily related to cultural information, that is, learned socially. However, to facilitate the presentation of positions, in this paper, the term "behavior" is only linked to information of cultural origin.

For instance, in ethnobiology, it is customary to investigate the factors that influence the selection of useful plants. For example, a determinist discourse would consider environmental questions to be key modulators of such selection. However, although current research seeks explanatory environmental factors (e.g., the availability of species, as discussed in other chapters of this book), it also considers that other factors influence the selection of natural resources, such as historical, symbolic, and religious factors. Thus, to investigate the role of the environment as another variable of importance cannot be labeled a deterministic approach. On the contrary, the failure to consider this variable can make the understanding of reality, at some point, reductionist.

Accordingly, we agree with Carvalho-Júnior (2011) when he considers it "incorrect, imprecise and semantically invalid to label a theory as deterministic when in fact it only emphasizes the influence of environmental factors without negating the role of other factors or human activity."

In fact, several non-deterministic ethnobotanical studies have demonstrated that an environment can exert a powerful affect on human behavior (see Ladio et al. 2007; Albuquerque et al. 2008), which prevents us from disregarding such influence. Thus, what lesson for an ethnobiological investigation can we learn from this theoretical approach, without accepting the theory in all of its ramifications? The environment can be one of the factors that influence human behavior with respect to the foraging of natural resources. Although the environment plays a highly important role in human behavior, we cannot deny that human choices as well as cultural and genetic factors also influence behavior.

Environmental possibilism emerged as an attempt to overthrow deterministic thinking as the only explanation for human behavior. In this view, the environment appears as a factor that limits the options of human populations but without determining behavior (Kormondy and Brown 1998). For instance, with respect to the employment of useful plants, the environment acts such that only the plants to which a given population has access could be used. However, from this accessible set, cultural choices could be made during the selection process.

Therefore, environmental possibilism helps us better understand the relationship between human beings and natural resources by revealing that environmental factors cannot be viewed as the only explanation of human behavior. That is, the environment offers human population opportunities to choose. However, other factors should also be considered, such as the history of natural resource exploration, human migration events, and the mechanisms of cultural transmission.

2.2.2 The Insertion of Evolutionary Thought in the Understanding of Cultures

Despite the conflicts between determinism and environmental possibilism, both discourses share an understanding of a one-way relationship between humans and the environment based on their common view of the environment as a primordial

element in the construction of human behavior. Nevertheless, a number of schools of thought criticize this position and seek to understand culture as an active (not merely passive) element in the construction of social-ecological systems. Two exponents of this new approach were the Americans Leslie White (1900–1975) and Julian Steward (1902–1972), who were forerunners in the area of ecological anthropology. It is important to clarify that anthropologists had previously developed evolutionary explanations of culture. However, these explanations are based on an understanding of evolution as a continuous, unique, and linear progress (see Mesoudi 2011).

White was a student of Franz Boas (American, 1858–1942), one of the most important thinkers, who initially structured anthropology by developing historical particularism. According to Boas, cultures evolve in specific manners that are related to their history and environmental context. The same evolution does not occur in each society. Therefore, Boas proposed to understand each cultural system individually without the pretension of explaining general patterns. White rejected this proposal and sought to understand evolution as universal. White's ideas were essentially materialistic as a result of his exposure to the social theory of Karl Marx. Thus, he proposed a structured concept of culture according to which culture consists of three spheres: ideological, social, and technological. These spheres are not equally important: the third sphere is the driving force behind the creation of cultural patterns. As noted by Neves (2002), "life can be boiled down to the struggle for the capture of free energy. For him [White], culture is nothing more than a tool used by Homo sapiens to capture and to control energy available in systems and place it at the service of human societies." The universal law of cultural evolution can be reduced to the ability of cultural systems to transform energy into labor.

2.2.3 Cultural Ecology

Like White, Julian Steward was trained in historical particularism and was a materialist par excellence. However, he was influenced by physical geography. Steward's ideas contributed to the field of cultural ecology in which (as in White's view) certain cultural elements are considered to be the most important and most worthy of scientific attention. However, according to Steward, the cultural characteristics that require investigation are associated with production and thus reflect adjustments of a culture to the environment more than the culture's ability to transform energy. According to Neves (2002), "he [Steward] establishes a research focus, a "*cultural core*," cultural aspects more related to subsistence activities and to economic arrangements. The core is formed by all the religious, social, and political aspects that are more directly related to the support material bases of these societies." This component directly affects the environment, and the environment would be affected by it, whereas the other elements that constitute the culture of a social group, such as social elements, organization, beliefs, and ideologies, would be only indirectly influenced by the environment and vice versa. In this perspective, the

idea of mutual influence (i.e., a "two-way street") between the environment and the culture is introduced into scientific circles. Additionally, Steward selected other, relatively more important environmental characteristics for investigation, for example, the quantity, quality, and spatial distribution of food supplies.

In addition to this "cultural core," and perhaps more clearly, cultural ecology is differentiated by its use of a method in which (a) above all the forms of local production and the environment should be analyzed and (b) it is necessary to understand how the strategies of environmental production and exploitation influence other cultural aspects. Accordingly, Stewart introduces an important cultural reading from the evolutionary perspective: an adaptive understanding of cultures with respect to the environment.

To illustrate the contribution to ethnobiological approaches of the mutual influence between environment and culture that emerges from cultural ecology, we can think about a hypothetical situation in which a given community has a set of plants or animals that are considered sacred and thus excluded from use. What are the ecological implications of this scenario? Possibly, the distribution of these species will change because their persistence is favored at the expense of other species. Primate hunting exemplifies this situation, in which, for example, chimpanzees are not hunted by certain human populations because of the physical resemblance of the animals with human beings or because of folk beliefs regarding the ancestry of human beings (Silva et al. 2005; Putra et al. 2008; Alves 2012).

The use and preference for specific biological resources can also result in the depreciation and subsequent decrease in the availability of these species over time. A number of studies conducted in the semiarid region of Brazil on the use of firewood as a household fuel source demonstrate that the collection behavior of this resource is selective to the extent that it prioritizes the species perceived as locally preferred (Ramos et al. 2008; Ramos and Albuquerque 2012). Thus, as cultural ecology advocates, the forms of exploitation of the resource, i.e., the specificities in the local practices of production and lifestyle maintenance, reflect cultural adjustments and should be targeted for investigation. This type of relationship can result in structural modifications in the populations and plant communities.

Thus, the primary lesson that cultural ecology can teach ethnobiologists (without requiring the acceptance of all of its ramifications) is that the environment must be understood as the result of its historic relationship with human populations that over the course of their evolution have used natural resources to supplement their cultural and substantive needs. This relationship is capable of shaping natural landscapes inasmuch as certain species are tolerated and others are overexploited.

In addition to introducing cultural ecology, Steward theorized regarding cultural evolution, arguing that cultures evolve along several different lines. That is, they are multilinear. Thus, cultural changes do not progress on a single evolutionary path, and cultural similarities between distant populations may be the result of convergence[2] (Netting 1986) or information diffusion.

[2] In biological evolution, it is held that convergence occurs when natural selection favors the development of similar characteristics in certain organisms as solutions to problems created by similar environments (Freeman and Herron 2009).

An example of convergence applied to ethnobiological research relates to the botanical families that are primarily used as medicines in different parts of the world. The studies that perform this type of analysis seek to decrease the importance of family size because it is to be expected that large botanical families include more species of medicinal value than small families. Therefore, based on this idea of proportionality (and regardless of method) (see Bennett and Husby 2008; Weckerle et al. 2012), the fact that certain families, such as Asteraceae, Rosaceae, and Lamiaceae, are prominent in different parts of the world, whereas others, such as Poaceae, Cyperaceae, and Orchidaceae, are strongly underutilized (i.e., with apparently little medicinal use) becomes interesting (see Moerman 1979; Weckerle et al. 2012; Medeiros et al. 2013). These patterns converge in remote populations and can be related to the greater pharmacological efficiency of certain families compared with others. That is, this factor can influence human behavior and choices.

Thus, for ethnobiologists, multilinear evolution supports the understanding that certain human behaviors (which are often similar in distinct social groups that are isolated from one another) reflect general patterns and therefore can be predicted. However, in accepting this thesis, we must remember that the relationship between human beings and the environment involves highly complex processes that differ from culture to culture.

2.2.4 Systems Ecology and Neofunctionalism

The development of systems ecology has made new contributions to ecological anthropology (Kormondy and Brown 1998) by altering its focus from the study of culture to the study of populations. Systems ecology uses *cybernetics* to understand culture (i.e., traits, knowledge, behaviors, and social institutions) as self-regulatory and *homeostatic systems*, thus revealing a clear influence of the ecology of ecosystems. Cybernetics is a branch of systems theory that seeks to understand a series of systems with differing characteristics (i.e., mechanical, biological, and social systems). Cybernetic studies can examine the design and function of any system as well as analyze its forms of receiving, storing and processing stimuli or information. Homeostatic systems are systems that can maintain their state of equilibrium through self-regulation mechanisms. In this cybernetic context, the ideas of positive *feedback* (i.e., forces that catalyze changes in a culture) and negative *feedback* (i.e., forces that resist changes to domains of stability)[3] emerge (Marten 2001).

To illustrate several of these ideas, let us examine a hypothetical situation involving the medical system of Community X. Suppose that this community recognizes

[3] Stability exists when a system is found in (or near to) a state of equilibrium (Holling 1973). A strong variation can transform a system from one state of equilibrium to another. Accordingly, negative *feedback* refers to forces that operate for the self-correction and maintenance of a system's equilibrium, whereas positive *feedback* refers to the forces that cause disequilibrium and change in the domains of stability (Keesing 1974).

a wide repertoire of animals and plants for medicinal purposes. This community maintains its curative practices and is isolated. Therefore, external information is not introduced into its reality. In our view, these circumstances characterize a closed system (see Garro 1986). Then, a migrant community (Community Y) establishes itself near Community X. The migrant community brings with it a new set of medical knowledge and practices. The two communities have sporadic contact. However, although Community X receives the novel information, it does not adopt any aspect of Community Y's medical system. In this case, Community Y's information arrives at Community X, which is now an open system by virtue of its contact with another system. However, because of the strong effect of negative *feedback*, this information cannot be incorporated by Community X and therefore does not alter its dynamic.

Later, increasing contact between Communities Y and X introduces a disease to the latter group. The disease was previously unknown and is introduced by the migrants. Community X is unprepared to cure this unknown, or at least untested, disease. However, Community Y, which has a history of living with the disease, possesses a list of medicinal plants that can cure it. Community X incorporates this knowledge. However, it does not fully incorporate Community Y's medical system. Over time, a hybrid of the medical systems of the two communities may form, which would represent an example of intermedicality (Soldati and Albuquerque 2012a). In a study on Fulni-ô Indians, Soldati and Albuquerque found that the local pharmacopoeia represented the merging of different medical traditions.

In this case, there is a partial input of information into the system, which is catalyzed by the impairment of negative *feedback*. However, if we consider that this information did not replace the previous medical system but only added to it, theoretically, the social system's stability domain would remain unchanged. We illustrated these ideas using a simple hypothetical situation. However, we should remember that the exchanges that occur between communities depend on the individuals who are part of these communities and the nature of the relationship between individuals. The exchanges do not depend only on the efficiency and usefulness of the information that is transferred, which makes this process even more complex.

We imagine now another situation. At another time, an area near the two communities is the target of a large urbanization project. Soon, the communities begin to have access to external resources, such as television, cooking gas, and health centers. The presence of this last element can cause individuals to relinquish their traditional healing practices and replace medicinal plants with allopathic medicines. In this case, positive *feedback* acts substantially more forcefully than negative *feedback*, and all of the new information is assimilated by the system. Because the incorporated content can be competitive by nature and not complementary, a social system substitution could occur, which would encourage a transition toward another stability domain, in this case, from a traditional to a Western medical system. In this hypothetical example, the domain change can be irreversible because after a certain time the knowledge of the practices related to the first domain may be lost. However, according to the anthropological and ethnomedical literature, there are actual cases in which the two systems can coexist, creating a dynamic in which the medical system is not necessarily transferred to another stability domain (Soldati and Albuquerque 2012a).

What determines whether the external information will be accepted is the resistance ability of the negative *feedback*. Not all more "efficient" or "higher quality" information will replace the old system. What is replaced depends on circumstances. For instance, even if in a given location the allopathic remedies have can cure more effectively than the medicinal plants and animals, the population may not accept, for example, Western medicine because of a belief that the failure to use sacred plants from the region can result in bad luck. In these cases, the role of myth, beliefs, and tradition is clearly an important buttress for negative *feedback*.

The neofunctionalists emerge as a response to the structural functionalism of Radcliffe-Brown (Kormondy and Brown 1998), who notes that the social level is a level of reality that differs from the biological level, and thus, social phenomena must be explained only within the social domain. This view is shared by many ethnobiologists, who explain culture through culture. That is, they believe that the use of natural resources can only be explained by cultural phenomena. In turn, neofunctionalism seeks rational explanations for apparently irrational behaviors and asserts that beliefs, ritual acts, and symbols can be explained by environmental factors.

Let us consider another example: in a given community, small-sized fish are considered to be sacred and may not be consumed until they grow. This prohibition may suggest an adaptive trait that facilitates the sustainable maintenance of the fish population by safeguarding young individuals and ensuring that they reach the reproductive stage and can procreate. Often, after the passing of generations, the practical reason for maintaining a certain behavior becomes lost. Thus, what remains in the culture to be transmitted is the myth regarding a behavior, for example, that "eating young fish brings bad luck." Although in practice it is difficult to demonstrate that a given taboo had an ecological rather than a purely religious or social origin, it is clear that restrictions on the use of resources exist in various cultures around the world that can promote the conservation and sustainable use of plants and animals (see Colding and Folke 2001).

Despite their substantial contributions, the neofunctionalists are a target of criticism with respect to their subject matter. One criticism is based on the neofunctionalist view that all human behaviors and practices are adaptive. To a degree, this view is shared by many ethnobiologists who advocate for the complexity of the relationships between human beings and natural resources, which often involve adaptive responses to ecological and evolutionary forces (Hurrell and Albuquerque 2012). Concerning the adaptability of human behavior according to environmental influences, we can cite the hypothesis of climatic seasonality, which predicts that individuals in environments that undergo a marked seasonality tend to use native and perennial resources locally considered to possess equal efficiency (whether they are herbs or woody plants) that during certain periods of the year are more abundant and more easily accessible (Albuquerque et al. 2005). If this hypothesis is true, it has important implications for seasonal environments. That is, from the biological viewpoint (i.e., therapeutic activity), it is more important to guarantee that individuals have access to the resources than more efficient resources.

Still more researchers accept the possibility of maladaptive behaviors, as can be perceived, for example, in studies that analyze the ancient practices and beliefs of

certain social groups as elements that have no evolutionary rationale. In ethnobiology, direct empirical evidence that supports this affirmation seems not to exist. However, several studies reflect this opinion. For example, Tanaka et al. (2009) discussed the controversy regarding the use of complementary and traditional medicines, which are often practiced and shared between human populations without assurance of efficacy and safety in the treatment of disease. These authors noted examples of maladjusted and superstitious treatments that are curiously disseminated among human populations, such the use of drinks concocted from decomposing cobras to treat leprosy, the eating of vultures to treat syphilis, and the drinking of teas brewed from dog tails to heal victims bitten by these animals. Are these beliefs examples of maladaptive behaviors or does the use of resources without therapeutic proof hide evidence of adaptive traits that have not been identified by the research?

Another criticism of the neofunctionalists is that they consider the population rather than the individual to be the basic unit of study and disregard internal important variations in their analyses. The population was considered by the neofunctionalists to be an analytical unit because in their view the population, not the individual, adapts to the environment. This idea was criticized by other schools of thought, which believed that for adaptation to occur, changes must operate primarily individually. Applying this discussion to ethnobiology, we know that even the populations that share among themselves their practices and beliefs cannot be regarded as homogenous with respect to the adaptive behavior of their members. Individuals commonly exist who exhibit knowledge and practices not socialized with the social group in which they live.

In ethnobotany, the study of medicinal plants provides excellent evidence that the knowledge of a community cannot be viewed as homogeneous, particularly when we refer to the role of gender in the construction of this knowledge. Several studies have demonstrated the difference in knowledge between women and men by noting the exclusive use of certain plants by each of these groups. Typically, women rely on the richness of the noted plants, a practice that has been explained by the fact that women are more involved with the treatment of the illnesses of family members (Silva et al. 2011; Voeks and Leony 2004). Similarly, differences in knowledge between the genders do not occur only in terms of the diversity of recognized species. Often, these differences are expressed in terms of the specialization in the treatment systems used. For example, in Brunei Darussalam, in southeast Asia, women specialize in the treatment of spiritual diseases, whereas men specialize in diseases related to organic disorders (Voeks and Nyawa 2001).

2.2.5 Neo-Darwinism

The neo-Darwinist approaches reinforced the criticism of neofunctionalism regarding the unit of study. Neo-Darwinism is based on the theory of natural selection (see Dunbar 2012), according to which changes primarily act at the level of the individual

or the gene, not directly on the population. Such an approach strongly resembles that of ethnobiological investigations in the sense that the individual is considered to be the analytical unit. (Thus, most of ethnobiological studies perform individual interviews.) Subsequently, population patterns are assessed through the collective analysis of individual results.

The primary data analysis techniques of ethnobotany provide an idea of how individual responses can be combined to create a population profile. These techniques include use value, relative importance, and the informant consensus factor and consider that a plant is locally important when it is recognized (or used) by a considerable number of individuals in a population but not necessarily by all individuals (Silva et al. 2010). These techniques aim to establish the most important species based on the informant consensus, whereby it is acknowledged that not all local individuals consider a given species to be important.

2.2.6 The Processual Approach

With the advancing development of ecological anthropology, the processual approach emerged. Processual anthropology avoids the conventional approaches that are primarily linked to negative *feedback*, i.e., the population characteristics that are maintained. This approach (i.e., the processual approach) is interested in the changes (see Orlove 1980). Its focus is the understanding of the processes of transformation as a population responds to environmental changes or increasing urbanization, such that now more than ever populations are considered to be open systems.

Ethnobotanical studies tend to follow this approach when seeking to observe if factors such as urbanization, access to allopathic medicines, and access to the media interfere with the knowledge of plants and the use of plant resources. Previous investigations studied relatively isolated communities to identify peculiar traits of knowledge regarding plants, which characterizes the classic stage of ecological anthropology. In our view, the preoccupation with transformations (e.g., insertions, deletions, and additions of information and practices) in ecological anthropology and ethnobotany is not only a new trend but also a perceived need in recent decades because the process of urbanization has affected even the most isolated communities.

From this perspective, the processual approach addresses the need to reconstruct certain concepts used in ethnobiological studies, such as those that identify communities as isolated, untouchable, and pure systems. We understand that recent studies on the dynamics of social-ecological systems in the contexts of urbanization (Hurrell and Pochettino 2014) or migration (Medeiros et al. 2012) can supply information relevant to understanding certain processes because such contexts display substantially more rapid and thus more easily captured changes than more stable social-ecological systems.

2.2.7 *The Contribution of Other Disciplines to Understanding the Human–Environment Relationship*

Other disciplines have made important contributions to ecological anthropology and human ecology that can similarly enrich ethnobiological research. Environmental psychology primarily addresses the perceptions of individuals of their environment (Kormondy and Brown 1998). This focus is important because perception precedes the use of resources and can influence the relationship of individuals with resources. Such studies can facilitate understanding human behavior with respect to the use of natural resources. Here, perception's psychological component is only one of the aspects to be investigated because perception also includes physical, psychological, and cultural elements (Bell 2001; Silva et al. 2010).

An example of the interface between environmental psychology and ethnobiology can be found in Almeida et al. (2008). Examining the use of traditional bonfires in the June celebrations of a rural community, for which the collection of timber resources is prohibited, these researchers determined that the population is willing to sustain this custom because it believes that such a tradition cannot be broken. Thus, despite the recognition of the difficulties of obtaining wood to make the bonfires, which was noted by 90 % of the studied respondents, the behavior has been adjusted over time, and currently the species of disturbed and anthropogenic areas are prime targets for collection, although the native forest resources continue to be preferred.

Similarly, evolutionary ecology had a strong influence on human ecology and several current ethnobiological approaches. According to this proposal, to understand the interactions between organisms and the environment, it is necessary to analyze the reproductive success of species, which is governed by natural selection. Evolutionary ecology influenced a large number of ecological anthropological and ethnobiological that sought to understand the person–environment relationship through the evolutionary perspective. Evolutionary ecology also encompassed studies on models of the optimal use of resources, which were later adapted by human ecology. Among these models, optimal foraging is emphasized. This model's fundamental principle is that organisms are selected over generations to achieve an optimal level of resource acquisition and use (Kormondy and Brown 1998). This model includes cost-benefit relationships, in which the costs are the loss of energy through foraging and the exposure to predators and the benefits are the acquisition of food or other resources, such as wood or medicinal animals (see Soldati and Albuquerque 2012b).

2.3 Final Considerations

In this chapter, we have sought to demonstrate that the relationship between human beings and biological resources can be interpreted in light of different ecological and evolutionary approaches. Therefore, in the development of ethnobiological investigations, it is important to know which theoretical bases are involved in the explanation

of phenomena that ethnobiologists have registered. A single theory or discipline, evoked in isolation, cannot always afford the best explanation of a given phenomenon. Similarly, to adopt a theory in its entirety may not be useful in practical terms and may involve outdated scenarios.

Thus, what paths is one to follow if in developing an investigation one perceives that human behavior cannot be explained by environmental factors? The understanding of the role and the historical relationships within a group under study, of the mechanisms of cultural transmission and diffusion, and of the influence of issues of a genetic and cultural nature can be useful. There are multiple paths, and given ethnobiology's interdisciplinary character, one would not expect otherwise. Independent of the position that one adopts, one can drink at the fountain of all these theories, so to speak, and make conclusions that may be useful in developing an ethnobiological theory of ecological and evolutionary foundations (Hurrell and Albuquerque 2012):

1. "The relationship between human beings and nature is complex and often involves adaptive responses to ecological and evolutionary forces.
2. The behaviors and practices of human populations can be adaptive.
3. The environment can be assumed as a limiting factor but not as determinant of human behavior.
4. The perception of nature is a process with structural (i.e., biological/sensorial) and cognitive characteristics.
5. Traditional ecological knowledge emerges from the relationship between human beings and their surroundings and is manifested in acts and practices. This knowledge guides actions, which provide feedback regarding knowledge, which evolves".

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