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Ethnobotany for Beginners

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Ulysses Paulino Albuquerque
Departamento de Biologia
Universidade Federal Rural de Pernambuco
Recife, Pernambuco, Brazil

Washington Soares Ferreira Júnior
Universidade de Pernambuco
Petrolina, Pernambuco, Brazil

Marcelo Alves Ramos
Universidade de Pernambuco
Recife, Pernambuco, Brazil

Patrícia Muniz de Medeiros
Universidade Federal de Alagoas
Maceió, Alagoas, Brazil

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Foreword

This book is a revised and expanded version of a work that has been lauded as an innovative book, as the first of its kind in Portuguese, and as a didactic guide that will be of interest to researchers and students. Students interested in ethnobotany are becoming increasingly numerous, as pointed out by Dr. José Geraldo W. Marques in the preface of the Portuguese editions. This new edition by Dr. Ulysses Paulino Albuquerque and his colleagues, Dr. Patrícia Muniz de Medeiros, Dr. Marcelo Alves Ramos, and Dr. Washington Soares Ferreira Júnior, is an effort to reiterate what has been said, while providing updates on issues of a progressing and diversifying science; that is, it is an *evolving* science. This book accompanies such evolution. The decision to follow this path reflects a commitment made by the authors.

Ethnobotany is a scientific discipline that, in the twenty-first century, faces the *challenge of complexity*. It is a field of observation that includes many topics of interest and different approaches, methods, and reformulations that feed into its own diversity. Therein lies its complexity, and the challenge is to provide adequate explanations for complex phenomena. In this context, this book is an important contribution to understanding this complexity. Its accessible language brings ethnobotany closer to a broad and diverse audience consisting of academics as well as the layman and acts as an effective incentive for students who see in this science an interesting opportunity for their future professional development.

One of the necessary and unavoidable steps on the way to formulating a complex ethnobotany is *reflection*. With reflection, ethnobotanists can begin to understand the relationship between people and plants (the object of study in this science, in the broadest sense) as a concept relating to *biocultural diversity*, which addresses the interaction of natural and cultural aspects. This conceptualization strives to overcome the old dichotomy of "nature vs. culture" and represents a bet on complexity.

The authors of this book demonstrate the need to reflect on a crucial aspect of ethnobotany: the work of ethnobotanists. What do we talk about? What do we do? What is our job? Further, how do we think about ethnobotany? For a book of this nature, these questions make up an epistemological foundation that invites reflection on the theory and practice of ethnobotany and the interactions between the two. Descriptive works are abundant, and this is a good thing. Of the theoretical and

methodological work in this field, however, we cannot say the same, since there is a lack of such investigations. Reflection should aim not to separate theory from practice, but to rethink how the results of descriptive work can generate innovations within theoretical and methodological perspectives. The theory guides the practice, which reorients the theory guiding the practice, and so on recursively. This generates a virtuous evolutionary circuit. I congratulate the authors for addressing these basic concepts of ethnobotanical work, because elucidating the role of the researcher in his or her research is one of the challenges of complexity.

Finally, I offer some words about the authors, because I have the conviction that it is impossible to dissociate the author from his work. This book is the book that it is precisely because it was written by these authors. Ulysses is a prominent figure of ethnobotany/ethnobiology in the international context. I had the privilege of working with him in different contexts and have come to know his inexhaustible capacity for work, passion for scientific research and teaching, ethical values, and generosity with colleagues and pupils, including the three coauthors of this book. Ulysses set up his laboratory at the Federal Rural University of Pernambuco, Recife, which today is a model laboratory and one of the innovative locales for studying ethnobotany in South America with evident global importance. Thank you, Ulysses, for your past, present, and future contributions and for your efforts and challenges. In particular, thank you for this book, which undoubtedly deserves to be read.

Laboratorio de Etnobotánica y Botánica Aplicada (LEBA) Julio Alberto Hurrell
Facultad de Ciencias Naturales y Museo
Universidad Nacional de La Plata, Investigador CONICET,
Buenos Aires, República Argentina

Preface

This book has been designed for beginners—the people interested in a quick and pleasant read containing an overview of ethnobotany and its major developments. Therefore, the language is clear, objective, and straightforward, structured to take the reader from the origins of this science to the present day. There are several books on ethnobotany, many dealing especially with methods, but the present one fills the gap of an introductory text that aims to prepare the reader for more dense and complex readings of the topic.

This book is intended for students and professionals from different areas of knowledge such as biology, botany, agronomy, and anthropology, but also to the student interested in ethnobotany. The idea of writing the first edition was born from a short course taught by the first author on the subject at the end of 1993, and since then, the proposal was to bring the reader into contact with ethnobotany clearly and objectively. For, despite its historical nature and its theoretical and practical importance, ethnobotany still requires greater promotion in academic circles.

We do not intend to exhaust the subject matter, nor could we, because of its complexity. Since the first edition, not only has the global outlook on this topic changed, but the viewpoints of this book's authors throughout their respective careers have also changed. This third edition, in fact, takes much of the structure and content of the previous editions, but incorporates new elements. No doubt the reader who is familiar with the previous texts may be surprised with the vision that the authors present in this new edition.

We preserved in the text the information that arose as answers to students' questions corresponding to virtually any scientific discipline: "What is it?" "What does it do?" "How does it do it?" "Where does it do it?" "What are its foundations?" We tried to answer these questions without major scrutiny, because besides being contrary to the objectives of an informative and general treatment of the subject, the exposure of many ideas, concepts, trends, and viewpoints would consume much of the reader's time.

A piece of friendly advice: take a deep breath and turn the page, because this book should be read in one breath.

Contents

About the Authors

Ulysses Paulino Albuquerque is a professor at Universidade Federal Rural de Pernambuco (UFRPE) in Recife, Brazil. Albuquerque earned a bachelor's degree (Biological Science), a master's degree (Plant Biology—Taxonomy and Ethnobotany), and a doctoral degree (Plant Biology—Ethnobotany) from Universidade Federal de Pernambuco (UFPE). His recent research activities focus on understanding the different dimensions of the interrelationship between humans and nature under an ecological and evolutionary perspective; research, development, and evaluation of plant drugs; scientometrics and science communication; and validation and development of research methods in ethnobiology and related sciences. Albuquerque serves on the editorial boards for *Economic Botany* (associate editor), *Journal of Ethnobiology and Ethnomedicine* (deputy editor), and *Ethnobiology and Conservation* (co-editor in chief).

Washington Soares Ferreira Júnior is a professor at Universidade de Pernambuco (UPE, Petrolina Campus) in Northeastern Brazil. Ferreira Júnior earned a bachelor's degree (Biological Science) from Universidade Federal de Alagoas, a master's degree (Plant Biology—Taxonomy and Ethnobotany) from Universidade Federal de Pernambuco, and a doctoral degree (Botany) from Universidade Federal Rural de Pernambuco. His research activities focus on understanding the structure, dynamics, and evolution of local medical systems emphasizing the use of medicinal plants. Ferreira Júnior has authored and coauthored chapters of important books on ethnobiology: *Methods and Techniques in Ethnobiology and Ethnoecology* (Springer, 2014), *Evolutionary Ethnobiology* (Springer, 2015), *Introduction to Ethnobiology* (Springer, 2016), and *Medicinal and Aromatic Plants of South America* (Springer, coming, 2017).

Patrícia Muniz de Medeiros is a professor at Universidade Federal de Alagoas (UFAL) in Rio Largo, Brazil. Medeiros holds a bachelor's degree (Biological Science) from Universidade Federal de Pernambuco (UFPE), a master's degree and a doctoral degree (Botany) from Universidade Federal Rural de Pernambuco (UFRPE). Her recent researches focus on plant knowledge and use in contexts of

environmental and cultural changes. She also uses plants as models to understand some aspects of human behavior. Medeiros co-edited with Ulysses Albuquerque the book *Evolutionary Ethnobiology* (Springer, 2015).

Marcelo Alves Ramos is a professor at Universidade de Pernambuco (UPE, Mata Norte Campus) in Northeastern Brazil. He is a biologist with a master's degree in Forest Sciences and a Ph.D. in Botany from Universidade Federal Rural de Pernambuco (UFRPE). He is currently a professor of the Graduate Program in Education (UPE) and the Graduate Program in Ethnobiology and Nature Conservation (UFRPE). His research interests mainly focus on the Ecology, Ethnobiology, and Education interface, evaluating how different human populations interact with natural resources available in their environment.

Chapter 1
History and Concepts

John William Harshberger, an American, formally designated the term "ethnobotany" in 1895. In an article published in 1896 (entitled *The purposes of ethnobotany*), Harshberger considered that ethnobotany could help to elucidate the cultural position of the tribes that use plants for food, shelter, or clothing, and that such elucidation, in turn, could clarify the problem of distribution of plants. Harshberger posited that it would be possible to understand an entire culture from how it made use of plants, but this idea has been rejected by many researchers, since the relationship with nature is only one component of a complex cultural system. Today we understand that the use and knowledge of plants as a part of complex social-ecological systems[1] can help us understand how we relate to nature and how this relationship evolves in time and space.

However, long before Harshberger, data on the use of plants for different cultures were employed in studies of the origin and distribution of cultivated plants. Here we can highlight the work of Alphonse De Candolle, published in 1886 (*Origin of cultivated plants*), an essential book for those interested in the issues of cultivated plants and ethnobotany. On that note, it must be said that the human being is—and was—an important agent of changing biodiversity, because it has always been dependent on nature for its survival. Manipulation of nature was historically employed not only to meet humans' most urgent needs but also to carry out other empirical or symbolic activities like magic, medicine, and rites that would manage their lives and maintain their social order. Many ethnobotanists try today to understand the implications of our use of nature on the ecology and evolution of species affected by this intervention.

[1] Here we understand social-ecological systems as a product of the intimate relationship between two systems: the sociocultural, formed by the knowledge, practices, and values of a human group; and the ecological, composed of living beings and their relationships. See: Berkes and Folke (1998).

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For a long time, under the influence of Harshberger's definition, ethnobotany was understood as encompassing the use of plants by aborigines. From the mid-twentieth century, it began to be understood as the study of the interrelations between primitive people and plants, adding a cultural component to its approach because of the increasing engagement of professionals in the human sciences. However, the idea of "primitive" peoples still suggested a strong component of ethnocentrism. Currently, the definition of ethnobotany has been expanded, extending its field of research to the study of both traditional populations as urban-industrial societies, and nontraditional populations as rural societies, concerning itself with the relationship between human populations and the botanical environment. With this expansion and with the collaboration of cultural anthropology and other sciences (phytochemistry, ecology, economics, linguistics, history, and agronomy), there was an even greater diversification of objectives and methods. Therefore, it no longer makes sense to say that ethnobotany is interested exclusively in so-called traditional peoples—an expression that, in fact, has generated much controversy among ethnobotanists, since the concept of "traditional" can evoke different interpretations. Among these interpretations, some researchers advocate that the term "traditional" refers to an idea of immutability as if such knowledge is not altered over time. In light of this interpretation, some scientists prefer to use the term "local" as a replacement for the term "traditional" (see Alves and Albuquerque 2010). However, this new term is not exempt from criticism, since, for some, the term "local" may give the impression that this knowledge is restricted to a location, when in fact elements of this knowledge are often distributed among various populations in scales larger than the local.

Ethnobotany is part of the broader field of ethnobiology, a discipline that includes the study of direct interrelations between humans and biota, among other things. That is to say, it is the study of knowledge and concepts developed by any culture on living organisms and biological phenomena. This field of study is vast, and ethnozoologists, ethnoecologists, ethnomycologists, ethnobotanists, and other professionals can operate within it.

It is very common to associate ethnobiology with the study of indigenous societies. However, as we have discussed, this historical limitation was imposed by early ethnographic and anthropological reports. Today, the amplitude of the field allows us to realize various other approaches, and we are armed with an appropriate theoretical framework. A good example is the cults of African origin in Brazil, which have also been targeted by ethnobiological investigations, particularly by ethnobotanists (see Voeks 1997, 2013). Another example of a field that is gaining prominence is urban ethnobotany, which includes ethnobotanical studies of urban gardens (Corlett et al. 2003), ethnobotany in the context of migration toward urban centers (Ceuterick et al. 2008, 2011; van Andel and Westers 2010), and ethnobotany in markets and fairs (Bussmann et al. 2016).

Ethnobotany has been given various definitions over time, each reflecting the academic background of its proponents. Being an interdisciplinary field (according to the vision of different authors), it is perfectly natural for this to happen. For the

American Richard E. Schultes (1995), ethnobotany has existed since the beginning of humanity's written history, being recognized as a scientific discipline only in the last 100 years. In recent decades, because of global conservation efforts, it has grown rapidly as a theoretical and practical branch of botany.

We agree in part with the idea of Schultes. Undoubtedly, the relationship between humans and plants is as old as humanity itself. However, we recognize that ethnobotany is a science of recent origin, since it was formally defined only in 1895, and that its recency affects our study of this relationship (see Harshberger 1896). Therefore, in our view, it makes no sense to speak of "ethnobotanical knowledge of the people x" since the person who produces ethnobotanical knowledge is a scientist or researcher who studies the relationship between a particular culture and the plants of its environment.

Leaving aside any debate about it, there is a tendency to consider ethnobotany as a natural ethnoscience that is still in the midst of progressing methods and theory. However, nothing could be more mistaken, since ethnobotany has proven over time that it is an independent science, like ethnobiology in general, and therefore can establish relationships with various disciplines. We will explain this in more detail later, but now the aim is to understand a little more of this relationship with ethnoscience.

Ethnoscience studies the way the world of experience is rated by a culture. We can mention, for example, the way people classify colors, objects, and nature. The first ethnoscientists had the pretension to understand a whole culture based on this study, an assertion that became the target of very harsh criticism from anthropologists. There is still a tendency for some researchers to include ethnobotany as a subspecialty of cultural anthropology. The fact is that ethnobotany has progressed to position itself well within the realm of botany, which lent it special characteristics, despite its interdisciplinary nature and its diversity of objectives that allows for the contributions of researchers with different backgrounds.

Albuquerque (2005) considers ethnobotany to be *the study of the interrelationship between people of* ***living cultures*** *and the plants of their environment*. Cultural and environmental factors, as well as any culture's concept of plants and the use that is made of them, combine with this definition. We believe that *indirect* interrelationships are also important for ethnobotanical research. For example, the use or management of useful species by a human group can indirectly affect the distribution of other species in the vegetation; the hunting of a seed dispersal animal by people could affect the dispersion of a plant species not useful for humans. These are some examples that demonstrate the importance of understanding also the indirect consequences of people's actions on plants (Fig. 1.1).[2]

The above definition, dear reader, although it is still not ideal, meets our current needs. We made a point of emphasizing living cultures for a theoretical and conceptual understanding. This is because the study of past cultures' interactions with the

[2] For the reader to better understand the consequences, see the theory of niche construction applied to ethnobiology by Albuquerque et al. (2015a, b).

Fig. 1.1 Ethnobotany focuses on studying how human beings interact with plants. Credits: Gustavo Soldati

world's plants becomes the domain of archaeoethnobotany (others prefer to use the term paleoethnobotany), which, besides using different analytical methods for interpretation, obtains its information from archaeobotanical[3] explorations (see Mercuri et al. 2010). In Brazil, there are few studies that deal with this subject, while in countries like Mexico and Argentina, archaeoethnobotany has developed considerably, using plant remains and other resources to reconstruct, for example, histories of food and food processing, old subsistence activities, rituals, and weaving, and also providing important information on the spread and domestication of plants. Such explorations allow the collection of extremely important data on the culture in question, since plants have always been important in the social and religious activities, agriculture, and mythology of any society. A review of the main approaches and methods used in paleoethnobotany and archeoethnobotany can be found in VanDerwarker et al. (2015).

[3] Archaeobotany is the study of the remains of plants from archaeological contexts. In a biological perspective, it can be defined as the study of plants in contexts affected by human factors.

Historical ethnobotany also addresses the knowledge and use of plants in the past; however, the analysis of written records acts as the main tool (Box 1.1).

Box 1.1: The Plants Used in the Nineteenth Century Recorded in Historical Documents

We selected an article by Medeiros and Albuquerque (2012), published in the *Journal of Ethnopharmacology,* to illustrate a study of historical ethnobotany. The study evaluated the prescriptions book of Dr. Joaquim Jerome Serpa containing information on medicine prescription to patients in the Monastery of St. Benedict (City of Olinda, State of Pernambuco, NE Brazil) between the years of 1823 and 1829. The abovementioned doctor was a surgeon who was directing the monastery hospital in the period in which he wrote the book and, as with several of the doctors of the time, had training in botany and gained important knowledge about medicinal plants.

Medeiros and Albuquerque transcribed Dr. Serpa's book and recorded the popular names of plants mentioned in it. This information was crosschecked with medical literature data of the time to identify the scientific names possibly related to the vernacular. The "possible species" were classified according to their origin in the Americas, whether native or exotic. The uses attributed to plants or plant parts that have been prescribed are also reported.

The survey found that 23% of prescriptions contained some plant material. Seventy-two species were identified in Dr. Serpa's manuscript. The vast majority of these species were not native to the Americas, considering that the doctors of the time usually studied in European universities and ended up incorporating the plants used there in their medical practice in Brazil.

The main applications of the plants described in the book were as tonics; stimulants or excitants; antipyretics, diaphoretics or sudorifics; laxatives; emollients; and antispasmodic. The authors also found that the roots, perhaps because of the longer storage potential, were the most prescribed part of the plants.

However, the inclusion of living cultures in the definition remains controversial because (1) many researchers believe that archeoethnobotany and historical ethnobotany are part of ethnobotany, and (2) even living cultures can be investigated under the perspective of archaeobotany, for example, if they are observed from an archaeological perspective. Cultures that are very old and still survive and can be targeted both by ethnobotanical and archeoethnobotanical investigations (Box 1.2) can stand out in this sense.

Box 1.3 offers other views on the relationship of ethnobotany with other sciences, from the understanding of Argentine researcher Julio Hurrell (1987).

Box 1.2: Plant Remains in Archaeological Research

The literature related to archaeoethnobotany is still not extensive. On the one hand, there are methodological and instrumental difficulties in conducting this type of study. On the other hand, there are studies with similar approaches, but that identify themselves "paleoethnobotany" or even "archaeobotany" (in the latter case the archeobotanists' studies on useful plants fit).

Among the works that directly use the term "archaeoethnobotany," it is possible to highlight the study of Kaplan (1963) published in *Economic Botany*. The study identifies the plant species found in the cave of Cordova (New Mexico, USA), a site of human habitation between 300 BC and 1100 AD. These are remaining fragments of plant material that were taken to the cave during the time it was inhabited.

Among the most common plant species in the cave, *Cucurbita foetidissima* Kunth, fragments of the exocarp of the fruit of this species were very common in the cave and there were indications in the literature that the fruits and seeds of *C. foetidissima* were eaten by US Southeast Indians.

Other species often found were *Lagenaria siceraria* (Molina) Standl. (calabash exocarp), *Juglans major* (Torr.) A. Heller (walnut), and *Zea mays* (cobs).

Box 1.3: Ethnobotany and Its Relationship with Other Sciences

Ethnobotany as a field of botany

The meeting of ethnobotany with botany began occurring since the first definitions of this field of study. The definition of ethnobotany given by J. W. Harshberger in 1895, as relevant to the study of plants used by Aborigines, for example, shows a strong component of botany. The focus is on the description of plants useful to human groups. In the first half of the twentieth century, this approach gains strength for having practical implications for the discovery of plant resources with economic potential (for pharmaceutical and timber industries, for example), which has characterized the field of economic botany. Even though other ethnobotanical approaches have emerged over time, currently this first approach can be found in studies that focus on a descriptive proposal where results are presented mainly as a list of plants known to a particular human group, along with their uses, parts used, application methods, and other characteristics. Some researchers consider that, although studies that only employ plants surveys are important, such an approach has contributed very little to the theoretical and methodological growth of ethnobotany.

Ethnobotany as a field of anthropology

The union of ethnobotany and anthropology occurred when the study of the relationship between people and plants captured the interest of anthropologists concerned with understanding cultural aspects of human groups. In this approach, the study of plants becomes important for understanding the role of these plants for a culture. Thus, this anthropological approach to ethnobotany would seek to use plants for describing a particular culture, since the use of plants is of great importance for many human groups. However, this approach has been criticized, because describing or understanding a culture on the basis of plants would be a particularly complicated task, given the difficulty of understanding the whole culture by studying useful plants, which represent only one of its parts.

Ethnobotany as an ethnoscientific discipline

This approach also consists of a union of ethnobotany with anthropology, but there is a difference. The aforementioned approaches study the relationships between people and plants without necessarily considering the minds of the people themselves about their culture. A study ruled by previous approaches, for example, could select useful plants within a human group and identify and classify these plants from a scientific point of view. However, a study using the ethnoscientific approach could verify the way the people of a culture themselves identify and classify the plant resources of the environment. Here, ethnobotany relates to the ethnosciences and can be described as a line of research that studies the understanding of people about their own culture. Thus, ethnobotanical studies from this approach seek to understand how people name and classify the plants in the environment from their own classificatory logic. This type of ethnobotanical study became known as studies of folk classification, ethnotaxonomy, or even folk taxonomy.[4]

Ethnobotany as an integrative or synthesis science

According to the three previous approaches, ethnobotany studies the relationship between people and plants. However, they differ in the sense that the research mainly focuses on one of these two components of the relationship (people or plants). In the first approach (of ethnobotany as a field of botany), for example, the focus of research is the useful plant; in the second approach (the meeting of ethnobotany with ethnography), the focus is on culture, that is, on the cultural aspects that can be described from the useful plants; in the third approach (the meeting of ethnobotany with ethnoscience), the focus is to understand the way the people belonging to a particular culture apprehend the plants they use.

(continued)

[4] Still, in this book, we present the folk taxonomy studies in the chapter on classical approaches in ethnobotany.

Box 1.3: (continued)

In this fourth approach, however, the focus is not directed on any of these parts, but on the relationship that is established between them. For example, the abundance of certain species of useful plants in a given landscape can be a product of the interaction of these plants with the human groups using them. Accordingly, the manner in which these relationships occur (such as management methods applied by individuals in the environment) leads to an increase or a decrease in the abundance of useful species. In summary, the focus here would not be plants or people, but the relationships between these components. Therefore, ethnobotany would be a science of synthesis that focuses on understanding these relationships, approaching theoretical scenarios of different disciplines, such as anthropology, ecology, pharmacology, and history, among others.

More recently, one of us and Dr. Julio Hurrell started to consider that ethnobotany could also be a part of ecology (Hurrell and Albuquerque 2012). From the epistemological point of view, when we study the relationship of the human species with the biota, we are trying to understand an ecological relationship. Over the years, many researchers have incorporated more ecological knowledge, whether theoretical or methodological, to understand these relationships.

Understand, therefore, that the way people relate to plants and the results of this relationship are things that ethnobotanical research can investigate, specifically by answering a few questions: what might plants indicate about the society that produced this knowledge? How do different cultures think about their biological world, especially the plants? And what does this world represent? What makes people select certain plants as useful to the detriment of others? And beyond these questions, from a historical and phytogeographical perspective, it becomes possible to recognize the distribution, origin, and diversity of plants that are affected by the human species.

In this sense, according to the concept of ethnobotany that we offer, we soon realize that this approach is an interactive analysis between two systems: the social (or cultural) and the ecological. The botanical knowledge developed by any society combines myths, divinities, spirits, chants, dances, and rites, so that the natural and the supernatural are part of a single reality. There are plant collection rites for medicinal or magical applications (Box 1.4); the designation and assignment of spirits or divinities to trees; divinatory practices; and propitiatory chants to, among other things, denote the healing or magic energy of the plant that is used for a particular purpose. A classic example is the mandrake (*Mandragora officinarum* L.), a plant species whose morphology (especially the root) resembles a human figure. In medieval societies, such similarity was responsible for a range of legends involving the species, among them that the mandrake screamed when it was removed from the soil, in a way to kill those who heard its scream. Thus, the mandrake was tied to a dog, so that the dog would die in place of the collector.

Box 1.4: The Use of Medicinal Plants in Healing Rituals in Northern Peru and Southern Ecuador

Researchers Rainer Bussmann and Douglas Sharon documented the use of medicinal plants by healers of northern Peru and southern Ecuador (Bussmann and Sharon 2009). The authors interviewed healers belonging to local groups and found that many plants indicated as medicinal are used in healing rituals. For example, about 40% of medicinal plants indicated by Peruvian healers are used in rituals for the treatment of "magic" diseases.

The authors observed that the main magical diseases that plants treat are (1) *mal aire*: a condition that is caused by spirits and affects mainly adults; (2) *mal viento*: disease caused by spirits, similar to the previous condition, but that affects mainly children; (3) *susto* or *espanto*, which occurs when a person is affected by a big scare; and (4) *inveja*: a condition that affects adults and is caused by envy of others.

Treatment of these conditions involves a set of practices with medicinal plants in healing rituals. Rituals occur mainly at the residence of the healer, which has healing altars (also called *mesas*) containing power objects such as stones, sticks, and other objects. In healing altars, one of the most important ceremonies involves spraying extracts of medicinal plants throughout the patient's body to achieve their purification. In ceremonies, the patient may also drink a juice containing the cactus 'San Pedro' [*Echinopsis pachanoi* (Britton & Rose) Friedrich & G.D. Rowley] in an attempt to "clean up" the patient.

Many investigations have encountered limitations related to the scientific researcher's mentality, perfectly in accordance with the prevailing thinking at the time they were developed: the primitivism and racial superiority. Note, reader, that some of the first notes about the interaction between people and plants came from ethnographic observations made by several researchers studying cultures considered to be "primitive." The great naturalist travelers also brought important reports of their explorations, highlighting, among other things, the habits and customs of the people they knew. In nineteenth-century Brazil, for example, the German Johann Baptist von Spix and Carl F. P. von Martius made notes of the use of plants by indigenous people. In seventeenth-century northeastern Brazil, the Dutch Guilherme Piso and Georg Marcgrave, long before the cited German naturalists, collected plants and recorded uses known by the Northeasterners, especially in Pernambuco and Paraíba (Medeiros and Albuquerque 2014).

At that time, therefore, the prevailing view was merely utilitarian, so that the interest was only to seek plants with potential applications for urban-industrial society. Thus, the study of how people were related to plants, as well as the symbols and local perceptions, was not part of the interest of ethnobotany.

In ethnobotany, researchers need to be shorn of the presumptions of cultural categories in order to better understand the culture that they observe. The emic and

its opposite (ethical) are derived concepts of anthropology. Such terms are adaptations of the terms "phonemic" and "phonetic" from sociolinguistics. In a simple way, an emic category is internal, produced and contemplated within the culture, that is, it is the view of the participants of that culture. The ethical, in turn, is external, that is, the scientist's point of view.[5] We discuss this because the speech that is passed from generation to generation through oral tradition is, among other things, a mechanism mobilized to rationalize and understand how all that is living (in our ethnobiological point of view) is sacred, along with food, medicine, and magic. The biological phenomena perceived by the ethnobotanist therefore often appear shrouded in mythological discourse and magical explanations. Because of this, many pieces of information have been discarded or neglected because they were considered naïve tales or legends. However, these legends may cover an experimentally verifiable biological reality. In medical preparations of folk medicine, there is an entire logic behind the local knowledge, which enables the effectiveness of the remedies that are used.

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It is possible to find some conceptual inconsistency in a good deal of research, especially in studies about medicinal plants based on data obtained from surveys of traditional communities. Generally, these works bring information such as species used, parts utilized, forms of use, indication, preparation methods, and dosage. There are numerous publications that label all these data within an ethnomedicine perspective. However, ethnomedicine studies lend themselves more properly to an anthropological perspective to understand the knowledge of and practices related to illness (Hughes 1968). Some researchers prefer therefore to use the anthropological expressions of the disease rather than the term ethnomedicine (Buchillet 1991). Therefore, it is possible to verify that this term is often used incorrectly, since work in ethnomedicine should be based on analyzing representations and practices associated with the disease, not just performing a simple collection of plants. In view of this, some researchers prefer to use the term "medical ethnobotany" when they want to specify that their ethnobotanical data refers exclusively to medicinal plants (Pake 1987). Moreover, ethnobiology faces a major challenge in this regard, because many researchers end up creating new terms by adding the "ethno" prefix, which leads to a great inflation of expressions, many of which are completely redundant and unnecessary (Alves and Albuquerque 2010).

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Returning to the conceptual question of ethnobotany, we should examine a point of view more widespread about this subject. Wade Davis (1986) explains that:

– *… I am an ethnobotanist.*
– *and what is it?*
– *something between an anthropologist and a biologist. We seek to discover new drugs from plants.*

[5] For a relevant and in-depth discussion of the distinction between emic and ethical, we strongly recommend the text of Batalha (1998).

Unquestionably, this is one of ethnobotany objectives: to study the use of plants for medicinal purposes in order also to offer practical elements for other researchers in the areas of phytochemistry and pharmacology, favoring the discovery of new drugs. For a long time, this goal guided ethnobotanical research, giving to science, in general, a great benefit. In the Amazon, the aforementioned researcher Richard E. Schultes could catalog hundreds of plants by coexisting with indigenous people for many years of research, bringing a valuable contribution especially with regard to hallucinogenic plants.

However, will it be just that, dear reader? No. The interactions or connections between people and plants do not occur only on the medical or therapeutic level. They also occur, for example, on the magical-religious level. In this case, the plants are useful for provoking visions of the spirit world, getting rid of bad luck, inducing well-being through various magic formulas, and embalming and mummifying corpses (as certain cultures used to do). Thus, ethnobotany is not limited to the study of medicinal plants, although this is the most studied subject in the field.[6]

We also highlight the role of psychotropics from plants in certain cultures. Within the network of beliefs that form the magic system, these plants, when properly used with all the necessary preparation and ritual handling, guide wizards or magicians in their advice and their divining practices. The plants guide them to perform their beneficent or maleficent magic, and all that concerns the individual and the community. The survival of the use of hallucinogenic plants, in the systems in which they operate, is only possible through a collective belief in the power of their plants and in the priest.

The plants integrate various situations from the utilitarian point of view. Wade Davis, for example, illustrates how some plants are used in West Africa. Many tribes used *Datura stramonium* L., such as the Hausa of Nigeria, who used the seeds to enhance the intoxicating effects of drinks used in rituals. It was also used in criminal poisonings, in which women fed this plant to beetles, harvesting their feces and using them to sacrifice unfaithful lovers. Many plants, either alone or in combination with other elements, may have played a role in the social regulation mechanisms of a society. This is because they begin to exercise some control over individuals, dictating norms and behavioral patterns, such as food taboos present in different cultures. That control was noted by Wade Davis in his ethnobiological studies in Haiti about the zombie poison.[7]

In Brazil, the use of "jurema" is notable as the ritual drink of some indigenous tribes, as well as the liquid concoctions of African-Brazilian cults. Despite the known presence of substances that can cause hallucinogenic effects in some plants, cultural factors may influence the feelings and perceptions according to the cultural and psychological expectations of those who use the plant. It was from the observation of the use of plants by indigenous people from the backlands of Pernambuco that the researcher Oswaldo Gonçalves Lima managed to isolate from the roots of

[6] See Oliveira et al. (2009) and Albuquerque et al. (2013).

[7] Recently we reviewed this interesting work of Wade Davis. See Albuquerque et al. (2012).

Mimosa tenuiflora (Willd.) Poir. (Synonym: *Mimosa hostilis* Benth.) ("jurema-preta") the DMT (*N*,*N*-dimethyltryptamine) responsible for the plant's psychopharmacological effects.

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The reader, by now, may have realized that to fully achieve their goals, ethnobotanical studies require an interdisciplinary approach, which allows for an understanding of all observed phenomena. Obviously, an inside view of the observed reality is necessary, integrating it without interfering with the dogmatized concepts carried by the researcher. In botany developed by other cultures, starting from the premise of the existence of a folk (or traditional) botanical knowledge, there is a visible effort to classify and record the plant domain for their rational use, that is, to achieve ordination of their plant community. In addition to the attention given to these factors, the ethnobotanist also records the popular names and ethnic denominations (any term given by a particular ethnic group) that make up the vernacular systems of which we will speak further.

Besides all this, in most cases, it is essential to collect the plant for its scientific determination and to assign the scientific name. In our view, when the intention of the study is, for example, to identify priority species for conservation or for new drugs, one study alone constitutes a significant contribution when, among other things, it provides taxonomic information.

Some available reports that specify the co-participation of people and plants in a given cultural, social, and historical context were not sufficiently complete, neglecting the scientific determination of the plant or making it invariably incorrect. This has limited the scope of the investigations, particularly those wishing to contribute to the discovery of new drugs (Bennett and Balick 2014; Albuquerque et al. 2014).

However, depending on the purpose of the work, the lack of taxonomic identification may not cause major problems. For example, it is not especially problematic if the topic of interest of the ethnobotanist is how the transmission of knowledge about medicinal plants occurs. In this case, plants are no longer the focus; instead, the most important component would be the process and not the plant itself.

The correct definition of the scientific name provides more data than would be imagined at first glance, allowing you to check the cross-cultural influences and underlying issues. This deeper understanding is the result of the predictive value of the binomial nomenclature, which allows for the recovery of all the information that has been linked to that species over the years. The coupling of a popular name to a species and a set of information that, decoded, expresses cultural or biological peculiarities cannot be conducted in a mistaken manner (Box 1.5).

Box 1.5: Problems Found in Ethnobotanical Studies Some studies assess possible biases in ethnobotanical research arising from problems in species identification. Ethnobotanical studies often fail to strictly follow the standard procedures to identify botanical material, which includes an adequate collection protocol, herborization, identification with the help of experts and reference material, and incorporation into an herbarium.

The study by Medeiros et al. (2013), published in the *Journal of Ethnopharmacology*, for example, used botanical identification as one of the criteria for classifying 126 Brazilian studies of medicinal plants according to their risk of bias (high, moderate, or low). In other words, they were classified according to their likelihood of presenting methodological problems that could compromise the reliability of the research results. The authors considered, for this particular criterion, that the lack of information about an identification process of the botanical material would cause the study to present at least a moderate risk of bias.

Furthermore, the percentage of plants identified to the species level was also used as a criterion for risk so that the study was classified as having a high risk of bias when fewer than 60% of the plants were identified, a moderate risk of bias when 60–80% of the plants were identified, and a low risk of bias when more than 80% of the plants were identified.

This factor, combined with sampling problems also evaluated in the study, meant that of the 126 studies considered, only 6 presented a low risk of bias and 28 presented a moderate risk, while the remaining were classified as presenting a high risk of bias.

Another study by Łuczaj (2010) sought to estimate the percentage of inadequacy identified in 45 Polish ethnobotanical studies. The errors of identification for studies that have not incorporated plant material in herbariums were accessed by: (1) observing whether the assessments made in the studies refer to the species that do in fact occur in the studied region and (2) paying attention to plants that have been assigned scientific names that diverge from the description that the study presents of the plant in question. The studies for which there was an incorporation of herbarium specimens were evaluated by observing the herbarium specimens themselves, in order to check whether they in fact corresponded to the scientific name attributed to them.

Although most studies have shown no detectable errors, there were cases in which, for example, 8 out of 85 taxa of a study were misidentified. In studies without incorporation of herbarium specimens an average of 6.2 taxa with identification problems was observed, while this average reached 9.2% for studies that deposited specimens in an herbarium (possibly because it is easier to detect misidentification once it is possible to access the material incorporated in the herbarium).

The result of this investigation is alarming, since for most of the studies included (for which there was no deposit in herbarium) the errors found may only represent the tip of the iceberg. Thus, other errors may exist that are not detectable by the method used in this investigation, which could reveal strong bias in ethnobotanical studies.

Let us see some examples. It has happened very frequently that, in conducting ethnobotanical inventories, some researchers collect many common names without taking care to collect the plant itself and carry out its scientific determination by an expert like a botanical taxonomist. Desiring to attribute a scientific name to the common name that was obtained, they might then seek out bibliographical sources (or more commonly, on the Internet) offering a name for the species. However, the same species can possess several common names, and the same common name can designate several species, depending on the region. Thus, the true species being studied is then obscured. What are the possible consequences of these inaccuracies? First, laboratory studies that are based on ethnobotanical inventories of plant material with identification problems may be wasting time that would be better applied to research on a plant that is in fact related to a local medicinal indication. Also, when the mistake of the scientific name is made under laboratory research, there is the risk of spreading false information about a plant when it is confused with the species that was studied in fact. In this case, it is possible that a species with a great medicinal potential is confused, for example, with another plant that has the same common name, but without the biological activity in question, which may lead to health problems ranging from the wrong treatment of a disease to serious cases of poisoning.

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Before we move forward, we would like to return to the definition presented by Wade Davis about what constitutes an ethnobotanist: *something between an anthropologist and a biologist. We seek to discover new drugs from plants.* Well, this definition may contain some truth, but it is not always so. This idea mistakenly generated the notion that the ethnobotanist will necessarily have classical training in anthropology or that all work in ethnobotany should include anthropology as a theoretical component. Today, at least in Latin America, most of the professionals who conduct research in this field come from the biological sciences. Few studies incorporate strong theoretical components of anthropology. The methodological tools used are essentially those from anthropology, combined with those from botany. However, theoretically, ethnobotanical research does not necessarily need anthropology, since it can make use of theoretical references from other sciences, such as ecology and evolution.

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Chapter 2
Approaches and Interests of Ethnobotanical Research

Traditionally ethnobotanists around the world have been engaged in recording plants and the ways they are used by human populations (including therapeutic forms in the case of medicinal plants). This type of procedure has provided enormous progress in basic and applied research in the phytochemical and pharmacological fields, since ethnobotanists provided the resources for researchers in related fields and the set of data required for the intended analysis. In practice, the study of the interrelations between cultures and plants has received this kind of treatment. However, as already noted, the scenario has changed completely, and today we are interested in understanding additional aspects of these relations (see Pieroni et al. 2004; Vandebroek and Balick 2012; Reyes-García et al. 2013; Wolverton 2013; Wolverton et al. 2014). For example, what happens to the botanical knowledge of a cultural group when it migrates to other regions of its country or even to other countries? How does the knowledge of plant resources change in relation to socioeconomic variables (such as gender and age)? What can explain this variation? Who are the members of the community more likely to spread new information about useful plants or to have their information assimilated by the community? (Box 2.1, Fig. 2.1)

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Box 2.1: Intercultural Variation on the Traditional Botanical Knowledge

It has long been understood that the traditional knowledge of useful plants is not distributed evenly among the members of a community. There are people who know more about useful plants than others do and, for a particular domain (e.g., medicinal plants) it is possible that, even for individuals knowing about a similar number of plants, the repertoire of known species may be very different from one person to another.

What causes this heterogeneity in the traditional knowledge within a community? Some socioeconomic factors have shown to interfere significantly with the knowledge of useful plants. In this sense, the book *Introduction to Ethnobiology* (Albuquerque and Alves 2016) includes seven chapters that list factors responsible for the differences in traditional ecological knowledge, and the majority of the examples cited in the book are about plants.

Most studies on socioeconomic factors that interfere with traditional knowledge were concerned with medicinal plants; however, it is also possible to find works that cover general purposes, food plants, or timber uses.

Some of the most commonly studied factors are gender, age, and income (other factors can be found in Albuquerque and Alves 2016). The differences in social roles of men and women in different communities around the world often lead to certain specialization and differentiation in the body of knowledge acquired, for example, on medicinal plants.A meta-analysis by Torres-Avilez et al. (2016) on the effect of gender on the number of plants known as medicinal revealed that there is not an overall pattern of greater knowledge by men or women. However, it is possible to detect some differences according to the country where the research was conducted. In Brazil, for example, the majority of studies point to women as the greatest knowledge holders in the number of medicinal plants, but in Ethiopia, most of the evaluated studies show men as greater knowledge holders.

Many studies have also shown that the older the people are, the greater the number of useful plants they know. Some researchers tend to attribute this result to a process of acculturation or loss of interest of young people for local ecological knowledge. However, in a certain way, it is expected that the elderly have been able to accumulate more knowledge throughout their lives, so that the lesser knowledge on plants from the younger generations may merely be a product of their stage in the learning process. Therefore, we should not use the number of plants known as an indicator of disinterest and loss of knowledge among young people.

Regarding income, studies with different categories of plant use have shown that lower income increases dependence upon and knowledge of plant resources. In a community, we can find, for example, people with higher income who can buy bottled gas and therefore consume less firewood, while there may also be people of lower income who cannot afford to buy cooking gas often, thus consuming more firewood. In these cases, the relationship between the use and knowledge is quite intimate, given that a greater consumption and contact with certain plants typically also lead to a better understanding of them.

Fig. 2.1 People interact with plants in different ways, such as plant harvesting them to feed domestic animals. Credits: Flávia Santoro

The wide range of ethnobotanical research allows us to delineate a framework that, if not completely conceptual, is at least somewhat practical, as presented in the second edition of this work. To discuss this situation, we will adopt a classification that, we want to make it clear, is just practice. According to the methods employed and the epistemological orientation, the research can be qualitative or quantitative. The adoption of these terms has, above all, a didactic purpose, but that in no way serves to qualify any one approach as better than another. What makes a study serious is the rigor and quality with which a scientific problem is addressed.

In the qualitative approach, there is a concern to clarify how the culture in question understands and interprets the plant domain, what the nature of this relationship is, and what levels it reaches. There is the search for a deeper understanding of aspects of people-plant relations through participant observation and development of commonly open interviews. We can illustrate this approach with the case of the indigenous people Kayapo, from the village Gorotire, in southern Para (Brazil). Anthony Anderson and Darrell Posey found that the Kayapo have a harmonious system of management and interaction with the environment, and their system employs simple practices with an environmental conception very different from our own conception. They grow many varieties of plants apparently without harming the ecosystem. Currently, there is a great interest in research that takes into account this ecological dimension, so that the so-called "civilized" people could learn from the so-called "primitive" people to conserve and manage their natural resources. The study of the horticultural techniques and traditional agriculture has occupied many ethnobotanists, who see these as alternatives to the environmentally aggressive

"Western" techniques. The indigenous people, or the farmer, knowing their environment, appear to employ traditional techniques that harmonize the need for management and conservation of resources. However, this is not always true. It is a mistake to sustain the belief that all the so-called traditional cultures have harmonious relationships with nature, because there are studies that definitely suggest the opposite.

We can also focus on the role that a particular plant exerts in a culture. Let us take the case of the "African oil palm" (*Elaeis guineensis* Jacq.) used in the African-Brazilian cults. The ethnographer Raul Lody emphasizes that, in addition to the multiple uses and meanings, the palm oil is a symbol of the religious life in the *terreiros*. The act of preparing the food offered to the orishas with the palm oil is intended to unite the participants to the deities in the act of communal repast. In public festivals in the *terreiros*, such as in Olubajé, it is above all a strongly socializing act, reinforcing beliefs and ethical standards. Other plants in the African-Brazilian religions play important roles, which construct the identity of the believer, especially in initiation rites, where the use of plants is essential.

Another type of treatment that sometimes appears as qualitative is the interpretation of historical documents on the use of plants (usually medicinal plants) of past centuries, one of the occupations of historical ethnobotany. Historical ethnobotany is a relatively new approach that has gained a strong impulse and recent systematization. Some very good examples of this approach can be found in the publications of Dr. Alain Touwaide, many of them about the use and prescription of herbal medicine in the past. Historical ethnobotany usually comprises case studies, i.e., works that deal with particular social and historical contexts (see Pardo-de-Santayana et al. 2006). Historical ethnobotany can also clarify the role of certain plants from documentary sources. We can cite the case of "jurema." This vernacular of many meanings is derived from the Tupi "Yu-rema," a name that collectively includes plants in the backlands of the northeastern Brazil and the cult of jurema practiced by indigenous people in northeast Brazil and in some African-Brazilian tribes. Although the ritual structure reveals differences between the groups above, it is common to find the use of a liquid concoction prepared with the plant to which hallucinogenic properties are attributed. Researchers José M.T. de Andrade and Ming Anthony (1994) report that in the first phase of colonization there was no documentation of plant use, due to foreign settlers' lack of interest along with the resistance of the natives for this task of documentation. In another phase, the documentation began, but for the purpose of repressing practices with the plant. However, "jurema" also served the interest of the colonizers, who tolerated its use when they integrated the indigenous people to their war lines in colonial Brazil, since they became stronger and more willing after ingesting a liquid concoction made from the plant.

Some scientists argue that the qualitative treatment, although valuable, has limitations when it intends to make generalizations that are more robust. Over time, or rather, more recently, works with different methodological proposals lent a new vision to the problem, and by making use of quantitative tools, ethnobotany gained a new direction along with the usual compilations and plants listings. From the 1990s it began to represent a growing share of publications particularly from the application of quantitative techniques for direct analysis of data on the use of plants (Phillips and Gentry 1993a, b) (Box 2.2).

Box 2.2: Quantification in Ethnobotany and Hypothesis Testing

The first attempts to use quantitative tools in ethnobotanical studies aimed to test hypotheses to allow a theoretical advance of the discipline. However, the theoretical issues do not appear to have been the focus of subsequent publications. Ramos et al. (2012) investigated the citation performance of two highly popular articles in ethnobotany, important from both the theoretical and methodological point of views. The first article selected was Phillips and Gentry (1993a, b), in which the authors proposed a quantitative tool (use value index) to test hypotheses related to the use of plants by people in the Department of Madre de Dios, Peru. The main intention of the authors reinforced the need for hypotheses in the theoretical development of ethnobotany. Bennett and Prance (2000) was the second selected article, and the authors presented the relative importance index to estimate the importance of plants introduced in human groups in order to understand the reasons why the exotic plants are present in several human pharmacopoeia.

Ramos et al. analyzed a set of articles that were published after Phillips and Gentry (1993a, b) and Bennett and Prance (2000) that cited these two popular references. The authors classified the set of articles in three categories of citation by relevance levels. The most relevant citations were those that took into account the main idea of Phillips and Gentry (1993a, b) or Bennett and Prance (2000), that is, the theoretical issues in those references. Citations of intermediate relevance highlighted the indices produced by these works, but did not mention the theoretical issues. Citations of low relevance were those that did not mention the main idea (theoretical issues) and the indexes developed, which are related to the methodological advancement of the two references.

In the results, the authors found that most of the articles evaluated presented citations of lower relevance (42.3% of the articles that cited Phillips and Gentry (1993a, b) and 56.5% of the articles that cited Bennett and Prance (2000)), followed by articles that presented citations of intermediate relevance, mentioning or using the indexes developed by the references (28.7% of the articles that cited Phillips and Gentry (1993a, b) and 38.5% of the articles that cited Bennett and Prance (2000)). There were few works that highlighted the theoretical contributions of the references, comprising only 14.8% of the works that cited Phillips and Gentry (1993a, b) and 19.2% of the works that cited Bennett and Prance (2000). For Ramos et al. (2012), two explanations are possible for these findings: that the authors of the work superficially read the two sources, or that authors did not read those sources.These data are surprising since they show that only a small portion of the works that cited the two selected references were interested in highlighting the theoretical issues produced. This may suggest that the development of quantitative tools does not seem to have been accompanied by an advancement in hypotheses testing, which is important for the theoretical development of the discipline.

The application of quantitative techniques provided important contributions to ethnobotany, enabling comparisons between plants to what concerns their cultural significance and evaluations of this significance for a particular human group, as well as providing data for the conservation of natural resources. We believe that, in practice, the union of qualitative and quantitative approaches will bring greater benefits to ethnobotany, determining a rapid progress of more efficient methods and techniques. Currently, there are several established criteria for quantitative analysis, with a considerable number of publications that propose them.

Let us start from the following example: a certain ethnobotanist, investigating the use of plants by a certain group, found that the plant known by the ethnic denomination X was, for a number of reasons, the most known and constantly mentioned. After applying mathematical models, he concluded that X is more significant for having many applications in everyday life. Asked by other experts as the reason for his statement, he stated categorically, "it is the most significant because the tests prove it to be so." However, as his own answer did not satisfy him, he decided to continue the research. After exhaustive talks with his informants and having shared occasional experiences, he found that plant X appeared to be related to the mythology of the people. Through the collection of oral texts, he noted that this plant plays an important role in the culture and that it had been planted in the earth by a god of war for use by the community, according to their views. This example illustrates the fact that the numbers tell nothing without a proper interpretative context. In this sense, the union of qualitative and quantitative approaches is important to understanding the phenomena studied in ethnobotany.

Many plants play important roles in different human groups. Gonçalves de Lima (1975) points out that plants that mitigate thirst played great function for certain ethnic groups. The use of bromeliads (a family of plants commonly known as "gravatá" in some regions of Brazil) by indigenous groups as plants intended for relieving thirst is very common in South America. Such plants, due to the peculiar arrangement of leaves in rosettes, are capable of storing water, consequently allowing the formation of micro-habitats which are occupied by insects and reptiles.

> *Even in the rainforest in the Northeastern (Brazil), the hunters often serve themselves from water of stored by gravatás, and to drink them, use as pipettes straws made of "taquari" (*Panicum *spp.), suctioning, thus, a clear and limpid liquid, that we also had the opportunity to observe. The importance of this plant resource must have been extraordinary for Gê and Cariri in their expeditions across the vast territory of the hinterland, as was the "ravenala" in Madagascar (*Ravenala madagascariensis*), also called "traveler tree," which accumulates as the gravatá in their leaf sheaths, enough water to provide thirst relief (Gonçalves de Lima* 1975*).*

It is expected that certain plants will be culturally significant in a given context. Some ethnobotanical investigations have been carried out to precisely estimate the **cultural significance** of a plant, that is, the importance a plant has in a culture. In some ethnobotanical inventories, the study of cultural significance appears to be very helpful, providing objective parameters as a source of interpretation. The first quantitative model evaluating cultural significance was developed by Nancy Turner (1988), who studied indigenous groups in North America. Subsequently, the model has undergone some modifications by Stoffle et al. (1990), who made substantial changes to some aspects criticized and considered fragile in Turner's model. However, many considerations about these models should be discussed, mainly concerning an accurate understanding of the term "**cultural significance"** (Box 2.3, Fig. 2.2).

Box 2.3: Analysis and Evaluation of Cultural Significance: The Case of Cultural Keystone Species

Some plants may be more important than others for a given culture. Among important plants, some may stand out in such a way that is essential to the structure and function of social-ecological systems, being named cultural keystone species (CKS) (see Platten and Henfrey 2009). Scientists have attempted to identify these species using a selected set of indicators. However, it has been a great challenge to define these species in a cultural system. Some of the criticisms indicate that (1) the distinction between cultural keystone species and species that are only important culturally and economically has not been clearly established, (2) the selected indicators need to be contextualized in social-ecological systems that are studied (Platten and Henfrey 2009), and (3) the indicators used to identify CKS should also include an emic perspective (Sousa 2014).

In order to answer some of the criticisms, Sousa (2014) sought to identify the cultural keystone species of two local communities located adjacent to Araripe National Forest in northeastern Brazil, aiming, for example, to distinguish the cultural keystone species from other locally important species. The author has used the perspective of local residents to separate species that are potentially keystones, interpreted as being essentially important according to the residents, and species that are important to people, but are not essential to them (and are not necessarily keystone species).

It was observed in the two communities that there is a clear separation between the species that are CKS and those that are culturally important species, but are not keystones. In addition, there was no clear difference between species of economic importance and cultural keystone species. According to Sousa (2014), this can be explained by the extraction profile of the communities studied, where species important for the local economy tend to be critically important to the residents. For example, for the two communities studied, the species *Caryocar coriaceum* Wittm. was considered a cultural key species and is a highly economically important species in the region. The *Attalea speciosa* Mart. ex Spreng. species was considered a cultural keystone species in one of the communities and has a high economic importance to the community. In this sense, for extractive communities, economic factors may make it important to structure social-ecological systems around certain species to the detriment of others, leading to the formation of cultural keystone species.

It must be said that not all the plants used for the greatest number of uses (medicine, food, construction, etc.) will be the most important for a society. Moreover, it is not possible to say a priori that some uses are more important than others from the cultural point of view. We need to investigate the context of the plant and its uses. Certain ritualistic situations require the immolation of animals in order to receive divine intervention required for a good harvest and efficacy of medicines,

Fig. 2.2 Plants, whether cultivated or spontaneous, acquire a great importance to some cultures. Maize, for example, is a plant of great cultural relevance to different populations. Credits: Margarita Paloma Cruz

for example. The same is true for some plants that, although they do not have many applications in certain cultural realities, are structuring and maintaining a social order and an "ethos," that is, are necessary for the life of a people both in biological and social aspects, and are recognized as important for those who use them. "Ethos" in a people is understood as

> *the tone, character, and quality of their life, its moral and aesthetic style and mood—and their world view—the picture they have of the way things in sheer actuality are, their most comprehensive ideas of order (Geertz* 1973*).*

All explained, we insist on saying that quantitative approaches brought a considerable advance to ethnobotany. However, without the guiding force of extremism, research is primarily directed by the goals and limitations of researcher. These limitations are easily overcome when the researcher establishes cooperative efforts, gaining a team of interested professionals from other areas. We can now summarize, in general terms, the characteristic approach of some current lines of research in ethnobotany, according to its thematic interest:

- Origin, domestication, and conservation of cultivated and wild plants
- Traditional agricultures (horticultural techniques, farm managements, diseases, pests, etc.)
- Traditional markets (where there is a perfect convergence of folk botany with plant products, and the dissemination of this knowledge can be verified)

Fig. 2.3 Humans collect a wide variety of natural products in different parts of the world. In the photos above, we have the fruits of pequi, which are of great economic and cultural importance in Chapada do Araripe, Ceara State, NE Brazil. Credits: Rafael Silva

- Ethnobotanical inventories in general (magical, medicinal, food, hallucinogenic, fuel plants, etc., used by human populations)
- Botanical folk taxonomies (these will be discussed later)
- History (historical ethnobotany)
- Use, perception, and manipulation of plant resources (we include here the plant domestication studies)
- Extraction of plant resources and its implications for biodiversity conservation
- Factors that affect the knowledge, use, and preference of resources by human populations
- Local criteria for the selection and use of plant resources by human populations (Fig. 2.3)

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Chapter 3
Investigation Methods

Understanding the relationships between people and plants is not an easy task, since many variables can interfere with this relationship. In order to handle this complexity, ethnobotany has used a variety of methods from different scientific disciplines, such as anthropology, botany, ecology, and economics. The vast experience of researchers in ethnobotany has favored the use of methods from other disciplines, considering that the definition of the methods of any science depends on the theoretical conceptions defended by it, as well as the goals of the research.

At first, this diversity of methods and techniques might frighten the reader; however, there are already several published books that compile such methods (see, for example, Alexiades 1996; Martin 1995; Cotton 1996; Cunningham 2001; Albuquerque et al. 2014), which may be important for you to understand the situations where they are typically applied and the advantages and disadvantages of each method. In addition, if you are starting your research in ethnobotany, some basic information about the methods of investigation may be valuable, such as the link between the problem that the research aims to solve and the choice of the most appropriate methods. We want to remind the reader that before choosing the methods, it is necessary to clearly define what you want to investigate and make appropriate, relevant, and meaningful questions, so that the research contributes to scientific knowledge, and not just more data on the same thing. Thus, the reader should keep in mind that instead of designing a survey from the method, it should be designed based on the question it seeks to answer, so that the method chosen will be the one that has the greatest potential to answer the question.

In order to adapt the method to the main problem of a study, for example, the following question should be asked: what is the best way to analyze the problem addressed? This reasoning is fundamental for conducting any scientific research and offers the freedom to use methods compatible with the aims to be achieved, either by giving a quantitative or qualitative emphasis on the research, or by combining both approaches. Thus, novel questions may require new methods. Ethnobotany, due to its potential to encompass a range of research problems, still has great scope for theoretical and methodological innovation. However, one must be cautious in

U.P. Albuquerque et al., *Ethnobotany for Beginners*, SpringerBriefs in Plant Science, DOI 10.1007/978-3-319-52872-4_3

suggesting new methods of data collection and analysis, as they are often scarcely different from methods previously used, only contributing to inflate procedures.

After considering this basic information, we now intend to present some methods of research used in ethnobotany as a basic introduction to the reader who is beginning in the area. Before presenting the main methods of research, we emphasize two points that, regardless of the methodological tool chosen by the researcher, are crucial for the success of the work: the researcher must (1) establish a relationship of trust with his informants (or partners, collaborators in field) and (2) study the relationship between people and nature from the perspective of those being investigated. The quality of the data collected will depend on the good relationship established with people and the ability of the researcher to become free from judgments when facing the facts observed in the survey.

We will not consider the methodological diversity used in ethnobotany or extend the definitions of these methods, because, as already mentioned, there are specific manuals that fulfill this purpose.

Individual Interviews

Individual interviews are the most common data collection technique in ethnobotanical work. However, it is often mistakenly conceived as an easy application tool. When poorly designed, interviews restrict obtaining reliable data, generating misinformation.

When preparing an interview, the researcher must have knowledge to propose appropriate questions that do not induce answers and are not difficult to answer authentically by people. It is recommended that more open-ended questions are used in which the informant has the freedom to respond according to his or her own logic and concepts, when this is appropriate to the aims of the research. More open-ended questions are especially important in the exploratory stages of research, when the researcher is still unclear about what should be the most important aspects to study on a particular topic. In this case, the respondents' answers may provide *insights* into useful issues to be addressed in the study. In many cases, however, there are situations in which it is appropriate to use closed questions of the dichotomous type (yes/no) or of multiple choice. It is appropriate particularly when the options granted to respondents are the only possible options within a particular scenario (e.g., "have you ever used the plant X" can easily be reduced to "yes" or "no," although a contextualization of this use is recommended in many cases).

Interviews consist mainly of three types: structured, semi-structured, and unstructured. The difference between these interview types is related to the level of flexibility of the questions asked. Thus, in structured interviews, questions are immutable, so you cannot add any new questioning during the search. In semi-structured interviews, there are a series of pre-established questions (guiding), but new questions may arise according to the answers given to the guiding questions. Finally, the unstructured interviews do not have a prior script. Thus, different questions that revolve around a particular theme are asked depending on the context (Figs. 3.1 and 3.2).

Fig. 3.1 The interview is one of the most common techniques of data collection, although not the only one. Credits: Juliana Campos

Fig. 3.2 Dr. Ferreira Júnior (*right*) applying the checklist-interview technique to collect information on medicinal plants. This technique consists on showing images to elicit certain information. Credits: Margarita Paloma Cruz

Participant Observation

In participant observation, a method developed by the Polish anthropologist Bronislaw Malinowski, the researcher needs to be integrated into the study group without being considered an intruder or a stranger. The researcher must share the same habits, including the same foods, to be seen as similar and therefore trustworthy.

However, it is possible to observe that, in many cases, the researcher is never quite seen as "similar," despite having the intention to absorb the ways of life of a given community. This depends, among other things, on the cultural logic of each community and the personal characteristics of the researcher.

In ethnobotanical inventories, participant observation has the advantage of recording details not made explicit during formal interviews and allows us to catalog the use of species not recorded by forms and questionnaires, especially those that are little used and that end up being forgotten by informants in interview events. However, not many ethnobotanical studies actually apply the technique as it should in fact be applied. Many researchers actually make specific observations and mistakenly call it participant observation.

This method allows an "inside" analysis of the observed reality, allowing us to realize how an individual from a particular culture develops knowledge about the plants of their environment. Thus, any situation in which plants and people find themselves involved can be scrutinized in search of meaning and logic.

In this regard, we recommend reading the Ethnography Manual by Marcel Mauss (1993), one of the first theorists of anthropology. This is an extremely useful work combining ethnographic techniques, and the reader can reap important information from its contents (Fig. 3.3).

Free Listing

The free list is considered by some authors as a form of structured interview, with the main goal of recording very specific information about the knowledge of the informants. It consists in asking the informants to list all known items within a cultural domain of research, such as the names of all known medicinal plants. The principle adopted in the analysis of data collected through this technique is that the most culturally important elements will appear more frequently in different lists and will be mentioned in descending order of importance.

Another important aspect of the free list is that, in addition to registering the most important items in a cultural domain, it can be used to determine who the local experts of the studied community are by analyzing the richness of the elements mentioned by each informant, such as the number of useful species mentioned. Like any methodological tool, it presents some limitations, such as forgetting information that is no longer a part of everyday life. Because of this, it is suggested that the

Fig. 3.3 The field observation techniques allow the ethnographic record of activities related to the use of natural resources. In the picture, pequi fruit oil is prepared in the Chapada do Araripe, State of Ceara, NE Brazil. Credits: Juliana Campos

researcher use complementary techniques to enrich the free listings, such as: *new reading*, which is used when a person claims not to remember any more items, and the researcher reads again all that has been said, stimulating the thoughts of items not mentioned above; and *nonspecific induction*, consisting of formulating positive phrases that encourage people to add new plants to the free list when they declare they do not remember any other plant.

One must keep in mind that, even as detailed as the free list is, it is very unlikely that it will be able to capture all the knowledge of the informant on the topic in question. A common example is when we seek to record the known plants to an X domain (e.g., medicinal plants). Even using the common techniques mentioned above to stimulate the informant's memory it is common that, hours or days after the interview, the informants tell us things like "after you left my house I remembered another ten plants or so."

While this may be seen as a limitation, in practice, free lists serve as "indicators" of knowledge or use of resources, in this case of plants, without claiming to capture the knowledge or use in its entirety. Such a full capture would be very difficult to achieve, regardless of the method used. A recent study of our research group (Sousa et al. 2016) has indicated some important limitations of the free listing, which shall be considered by researchers.

Participatory Methodologies

In ethnobotanical studies, it is not always appropriate to choose a data collection method that records people's individual knowledge in isolation. Depending on the type of problem that is to be responded to with the survey, it is better to adopt methodological procedures that record the knowledge and perceptions of different social actors collectively.

Participatory methods consist of collective meetings held with the different social actors involved in the research, thus enabling the sharing of experiences and moments of self-reflection. The role of the researcher in this process is to act as a facilitator. Based on the theme to be addressed in a participatory workshop,[1] for example, the researcher must didactically organize activities and discussions, contributing to the participation and reflection of all involved.

The use of participatory methodologies is of great importance, because as the participants present their views on an issue of interest to the researcher, they have the opportunity to reflect and get the opinion of other participating members of the activity on the subject. They may thus reformulate concepts that would be informed in a limited way or even wrong in an individual interview event. However, some caution must be taken by intermediaries in participatory methods, since some people tend to be more emphatic than others, which may cause the result to not necessarily reflect the opinion of the majority of the group. Box 3.1 shows an example of an ethnobotanical research that used participatory tools for collecting data (Fig. 3.4).

Triangulation of Methods

Studying the relationship between people and plants is not an easy task. It involves a complexity of factors that place the researcher before a major challenge, still in the initial research planning stage—to choose the most appropriate data collection method.

[1] Participatory workshops should be held in collective spaces that allow dialogue to occur between the different social actors and researchers. Its realization should be well-planned, all informants must receive prior call, and the location of the workshop should be easily accessible to all.

Box 3.1: The Use of the Participatory Method in Ethnobotanical Research: An Example of Research with Rural Communities in Northeastern Brazil

Two rural communities located on the margins of the São Francisco River in Northeast Brazil were studied: Community Ouro Verde (Municipality of Curaçá, Bahia) and Community Jatobá (Municipality of Lagoa Grande, Pernambuco) (Silva et al. 2014). The study raised the following questions: How does the local population perceive the possible changes to riparian vegetation over time? What are the historical events responsible for these changes?

The historical graph was used to record the representations of the population on the possible changes in the abundance of the ten most important plants for the community. Each focal group was encouraged to think about the decline or increase in the availability of plants over three periods: the last 20 years, the last 10 years, and the current period. To represent abundance, ten cards were distributed to be placed in each time period, where ten was the number that represented the maximum abundance of the species.

The timeline was used to capture the historical events perceived in the communities that contributed to landscape modification. The informants were encouraged to discuss the key events responsible for landscape changes in the region in different periods, using the community foundation date as a starting point, to the present time. Within the focal groups, informants were also asked about the changes that occurred in the landscape in each key event and what the consequences were.

Focal groups recognized the occurrence of changes in the availability of most plant species over the last 20 years, indicating plants that increased their availability, either because it was a species with little timber use in the community (*Inga vera* subsp. *affinis*. (DC.) T. D. Penn.), because of its high capacity for regrowth (*Albizia inundata* Mart.) or for being commercially valuable species in the region, where there were incentives for its spread in recent years (*Prosopis juliflora* (Sw.) DC., *Mangifera indica* L.). Additionally, they indicated the occurrence of species that were experiencing population decline in the region, while pointing out those that have always had restricted distribution in the community and that remained with the same abundance of the past. Regarding the timeline, it was possible to record different historical events that occurred in the community and that, according to residents, were responsible for changes in the local landscape, such as the occurrence of floods, large projects of irrigation and mechanization of agriculture, and access to electric energy. All these events were identified as being causes for the decline of riparian vegetation. The population also recognized that local training courses were being offered, which was promoting public awareness and therefore the conservation of species of riparian vegetation.

Fig. 3.4 The picture illustrates the participatory technique of community mapping. The researcher examines a map produced by the community. Credits: Juliana Campos

This step requires time and reflection, because the method chosen determines how precise the data will be in answering the research questions.

More than the task of choosing the research method to be used, ethnobotanists must also make an effort to combine different methods. That's right! It is appropriate that in the same ethnobotanical research, different methods of data collection and analysis are used. This combination is called methodological triangulation.

Why combine more than one methodological tool to answer the same question? We employ this strategy in order to recognize the virtues and weaknesses of each technique. When we use triangulation, we place each method in comparison with another, which maximizes the validity of the results in case they lead to the same conclusions. In turn, if the data obtained by different methods are contradictory, it may be interpreted as a sign that one or both of the methods used have problems. Moreover, the differences in results between the methods employed may mean that such methods are capturing different things, so that the researcher needs to examine which of them is capturing what they actually want to register in the research (Fig. 3.5).

The Importance of Formulating Questions and Hypotheses in Ethnobotanical Research

We have observed that the growth of ethnobotany depends not only on the proper use of methods but also on reflecting upon the hypotheses to be tested and on the theoretical scenarios that the research contributes. Since the 1990s, we have noticed

Fig. 3.5 Sometimes ethnobotanists need to collect ecological data. For this purpose they adopt usual plant ecology procedures. Credits: Juliana Campos

an increase in the number of ethnobotanical studies that use indexes to quantify the knowledge of people in relation to plants. However, the increase in the number of works that apply this quantitative approach has not led to the theoretical growth of the discipline. Many studies mistakenly use such quantitative methods without rigor. It is common to hear from beginners in ethnobotany, or even from experienced researchers, questions such as "What index should I use to value my work?" Notice, readers, that the initial question should be "What is/are my question(s) and hypothesis(es) of research?" and then to ask "What method(s) best fit my question(s) and hypothesis(es)?".

However, why is the formulation of questions and hypotheses important for the development of ethnobotany? The hypothesis is a statement that indicates a provisional response to the problem or question to be investigated. Whereas the hypothesis is a "temporary" response to a question, it is likely to be overturned (disproved) when the research indicates that it is not valid. Therefore, good hypotheses are those that "resist" the numerous tests (researches), remaining useful to explain certain phenomena.

Both the question and the hypothesis should be connected with the current scientific knowledge. This means that first it is necessary to have knowledge of existing theoretical scenarios in the scientific literature, then to identify possible gaps in these scenarios, that is, problems that science has not answered yet or that need

more information. Thus, from the identification of these gaps, it is possible to identify by means of research questions which of the gaps the research aims to fill.

Based on the question raised, different hypotheses can be formulated. The confirmation or refutation of the hypotheses occurs by conducting a survey that employs a set of appropriate methods to test them. Realize, dear reader, that in this way, the research contributes to the advancement of scientific knowledge by seeking to fill clear knowledge gaps or to solve problems that science has not yet solved. This reasoning should not be different for ethnobotany.

We will provide an example for you to understand the importance of asking questions and hypothesis testing for the development of ethnobotany. However, we are not saying that this is the only path, because the hypothetico-deductive method is just one of the scientific methods employed by scientists to direct their research programs. In 1993, Oliver Phillips and Alwin Gentry published a paper in which they used quantitative techniques to test a set of hypotheses in ethnobotany. Among the hypotheses, the authors sought to test whether the availability of a plant in the environment explains its utilitarian importance, measured by the number of known uses for the species. Testing this hypothesis is important to fill a gap that surrounds our understanding of the relationships between people and plants, and can be expressed by the following question: what factors explain the importance of plants to human groups? To test the mentioned hypothesis, the authors used methods linked to interviews with people from Tambopata, in the Peruvian Amazon, and vegetation sampling methods to access parameters of the vegetation.

Although the work of Phillips and Gentry punctuated the need for hypothesis testing for the theoretical development of the discipline in 1993, much of ethnobotanical studies mentioning the ideas of that work do not contribute to this theoretical necessity (Ramos et al. 2012). This situation corroborates the idea that there are few studies in ethnobotany reflecting on theoretical scenarios and/or performing hypothesis testing.

Thus, dear reader, we leave here the following suggestion: before starting research in ethnobotany consider the theoretical scenario, formulate questions and hypotheses from these scenarios and only after this, define the appropriate methods to test the hypotheses. Consequently, together we will contribute to the theoretical development of this discipline.

Closing this chapter, we present the main rules of ethnobotanical research, making our own the words of Darell Posey (1987) and adding something from our part:

- One should study botany developed by other cultures, bearing in mind that these strive to classify, catalog, and rationally use the plant world
- One should treat informants as experts on the subject, as they truly are, since they possess knowledge of phenomena that are unknown to us and that we only try to understand
- It is necessary to establish friendly and receptive contact with informants, leaving them to be the guides of the research on the identification of cultural categories and the acquisition of theoretical and practical elements

- Data or information should not be rejected, even if at first glance they seem absurd or insignificant, because they may *"contain encodings of evolutionary relationships, or mythological animals, whose function is to protect natural resources and preserve the ecological balance"* (Posey 1987)
- It is always necessary to consult the informants on the permission for the use of equipment (cameras, video cameras and recorders) for the registration of objects, sacred plants, or rituals
- It is necessary to participate without changing the normal course of activities and the behavior of informants, although the presence of the researcher is itself "disturbing"
- One should not impose their own ideas and cultural categories onto informants
- It is necessary to remember that questioning just for the sake of it produces inhibition in the flow of information and that some questions restrict obtaining reliable data—the more open the question, the better, because the informants will be free to respond according to their own logic and their own concepts, which should be taken into consideration when questionnaires, forms, and interviews are used

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Chapter 4
The Classic Approaches

Throughout its development, there have been different approaches bringing ethnobotany closer to other scientific disciplines. Our goal in this chapter is to present to you the classic approaches of this field of study. Although we indicate that the approaches presented herein are classic, it is important to make clear that they are not temporally delimited (or with a scheduled completion).

To start, let us recall the proposal of Dr. Julio Hurrell, who sought to classify the different approaches undertaken in ethnobotanical studies in an article published in the late 1980s. As we mentioned earlier (Box 1.1), Hurrell (1987) classified the existing approaches to that point into four main types, considering ethnobotany (1) as a field of botany, (2) as a field of anthropology, (3) as an ethnoscientific discipline, and (4) as an integrative or synthetic discipline.

Of all the classical approaches presented, two (ethnobotany as a field of botany and as an ethnoscientific discipline) have been quite widespread. Due to their importance for the development of ethnobotany and the large volume of studies from these two perspectives, we present below some of their most important ideas. In the approach that understands ethnobotany as an ethnoscientific discipline, we highlight the folk taxonomy, particularly based on the proposals of Brent Berlin (1992), one of the greatest proponents of these studies.[1] Among the studies that understand ethnobotany as a discipline of botany, we highlight the inventories of useful plants in order to identify products with potential for inclusion in urban-industrial society.

One of the first research approaches in ethnobotany was the focus on the use of plants by human populations, particularly by indigenous people, leading to a considerable range of studies. In this approach, ethnobotany research was meant to describe the uses of plants, methods of use by human groups, and the parts of the plants used, among other characteristics (Fig. 4.1).

[1] For a better understanding of the contribution of the folk taxonomy studies in ethnobiology, we suggest Alves et al. (2016) and Ferreira Júnior et al. (2016). See also the classic works of Conklin (1954a, b).

U.P. Albuquerque et al., *Ethnobotany for Beginners*, SpringerBriefs in Plant Science, DOI 10.1007/978-3-319-52872-4_4

Fig. 4.1 People can make use of plants in different ways. In Northeastern Brazil it is common to use some Cactaceae cladodes in order to produce sweets. Credits: Margarita Paloma Cruz

These researches met (and still meet) a need to search for potential plant species to benefit pharmaceutical industries, cosmetics, food, and timber. An investigation about the plant's uses by an indigenous community, for example, could find species with great potential in the treatment of diseases or useful species that produce highly durable wood. This type of research is very important in the early twentieth century and influenced the emergence of a discipline called economic botany, in which the studies sought to find potential species from an economic point of view.

The Folk Classifications in Ethnobotanical Studies

Different cultures or societies have a great ability to observe and recognize the living beings in their environment, to perceive the similarities and differences between them, and to name these beings from that evaluation. We can say that this exercise constructs a classification that human beings use to organize the complexity of the environment. These are the classifications called folk taxonomies.

Levi-Strauss, in his important work entitled *The Savage Mind*, wrote that whatever the classification, even taking into account sensitive properties, the classification will exceed the phenomenal chaos of things, representing a direction to a rational order. Thus, we can think of classifying as a need and as a reflection of the entire worldview of the classifier, whether he or she is a scientist or a traditional farmer, for example. On one occasion, an interesting class in which one of us (Ulysses Albuquerque) participated, an expert taxonomist (Dr. Simon Mayo) in the

Araceae family (a family that includes plants commonly known as philodendron, dumbcane, and Heart of Jesus) directed us to separate and group the plants (fruits and vegetables) that he brought according to their affinities. Our team grabbed eight fruits and, according to the peel, taste, and shape, grouped them to better understand their differences and individualize each one. We did so, and as it has been done by different cultures, the biological world can be classified according to the perceived characteristics, either intrinsic (substances produced that emit odors, for example) or extrinsic (morphology, for example). Differently from the way we did, however, other cultures do not eat their exercise at the end of the class!

The classifications may take into account morphological and symbolic attributes. This allows a distinction that can be located at the level of natural or symbolic discontinuities—both are interrelated and stand out in terms of culture. In the first case, distinctions may be established based on morphological or organoleptic attributes, as in the previous example. We have a great friend who studied, for a time, four plants known as "Anador," possibly all of the same genus (*Justicia*) belonging to the family Acanthaceae. Over time, he could distinguish them based on the odor emanating from the leaves when they were macerated with fingers, due to the particular substances they present, some of the group of coumarins. We will discuss the symbolic and natural discontinuities later when we mention the case of African-Brazilian cults and the Mayas and Tzeltales.

Studies investigating the classification of the plant world by man usually employ linguistic and anthropological approaches, without which the data would become extremely precarious. An ethnosemantic analysis is employed in order to understand what the name of the plant means in the studied culture. This approach can be collectively called ethnotaxonomy, in which the named categories are recorded that reveal a classification system subordinating reality categories, hierarchically ordered, as some studies have shown.

Thus, from the linguistic and semantic analysis that allows us to elucidate the classification logic, the researchers dedicated to this branch of ethnobotany explore the vernacular classification systems (some prefer to say "native" or prescientific) and can confront them with the scientific taxonomy. No wonder these systems are, in some cases, similar to the scientific taxonomy and compatible with the binomial nomenclature system of Linnaean classification. An example of these similarities of folk taxonomy with scientific taxonomy is narrated by Tlhouson (cited by Levi-Strauss in the book *Savage mind,* 1966) when reporting to the indigenous people case. The name *mai'watti'yi* designates the species *Dioscorea transversa*, while *maikä'arra* designates *Dioscorea sativa* var. *rotunda*—a simple example of binomial classification.

From these studies, some researchers have grasped certain principles involving folk taxonomic systems (Box 4.1). Among these researchers, we highlight the studies of Brent Berlin and collaborators from the 1960s onwards. The principles proposed by Brent Berlin assume that in all cultures, people develop strategies that ensure the organization and classification of the natural world, based on a hierarchy. It is a system especially developed by those cultures that take their cosmogony into account on the basis of mythical and magical-religious influence, besides the natural discontinuities easily observable in classified organisms.

Box 4.1: Principles of Folk Taxonomic Systems

The principles are the following[2]:

1. All cultures recognize natural groups of organisms and treat them as disconnected units in nature. These discontinuities are the taxa.

   These taxa are grouped into classes of similar traits (categories) and can constitute up to five hierarchically organized levels, described below: absolute initiator, *ethnoclasses*, ethnogenera, ethnospecies, and ethno-subspecies.

   (a) **Absolute initiator** (unique beginner)—*is the highest level of the hierarchy. Most cultures do not have this level (making no distinction, for own terms, between the plant and animal).*
   (b) **Ethnoclasses** (life-form)—*most cultures have this classification level, and usually the ethnoclasses are few in number (5–10). These are linguistically recognized by main lexemes (uncompounded) and always present subordinate taxa. Examples of popular names of ethnoclasses in English could be: tree, fish, snake, insect, and weed.*
   (c) **Ethnogenera** (generic)—*in a language, the majority of the classificatory lexicon is included in this level. Furthermore, most of the lexicon fits into one or two categories of "life-form". This may be the final level of some taxa and is also the level that the child learns. Normally, the generic level is distinguished by main lexemes. Examples of generic names in English could be: toucan, jaguar, palm tree, beetle, pine, and bee.*

      The concept of genus or ethnogenera is crucial in ethnobiology and generally is perceived as the smallest grouping that needs a distinctive name. Usually the ethnogenera is considered the basic reference point in a classification system.
   (d) **Ethnospecies** (specific)—*in general, the members of this level are less numerous than those of the generic. When this level exists, it usually represents a group of organisms of great cultural significance. It usually also specifies the terminal level and is distinguished by secondary lexemes. An example of a specific name in English could be the channel-billed toucan.*
   (e) **Ethno-subspecies** (variety)—*this level is rare among the indigenous cultures and is only used for the species seen as extremely important. The ethno-subspecies is characterized by secondary lexemes.*

2. The categories are organized hierarchically, and the taxa of any level are mutually exclusive.
3. Taxa in the same category usually occur in the same taxonomic level. The ethnoclasses, for example, occur at level 1, while ethnogenera occur at level 2 and sometimes also at level 1.
4. *Intermediate taxa are included in one of the life-form ethnoclasses and include ethnogenera taxa. This category is rare and generally does not have an explicit name. Overall, unnamed taxa are always defined by morphological criteria and not by function.*

[2] Reproduced and slightly modified from Jensen (1988).

Symbolic Discontinuities: The Case of African-Brazilian Cults

The classification of plants in African-Brazilian cults constitutes a broad system of world ordination that favors inductive reasoning by analogy, a feature that interests many researchers. This principle of analogy underlies the cosmogonic classification system, whose base is composed of òrisà (orisha) divinities. A study on the classification of plants in *jêje-nagô* candomblés was conducted by the anthropologist Jose Flavio Pessoa de Barros (1993).

The *Povo do Santo* (People of the Saint)[3] groups the plant world according to an eminently symbolic logic (the symbolic discontinuities we have mentioned) that is the conception of the classification. Plants are categorized into four main compartments: *ewé afééfé* (air/wind leaves), *ewé inón* (fire leaves), *ewé omi* (water leaves), *ewé ilé* or *ewé igbó* (land and forest leaves). These categories were grasped when named or when evident in the chanted texts. The divinities worshiped in the cults are linked to these categories by a mythological logic. Without having a necessary utilitarian factor, system congruity allows the classification of the plant by placing it in the divine order of things.

Devotees' identification schemes take into account morphological characters of leaves, flavors, aromas, colors, and habitats, but also aspects related to cosmovision. We emphasize that the categorization of habitat in the large compartments relates to a discontinuity of "ecological and symbolic niches." For example, a terrestrial plant or a plant that is not even related "naturally" to the aquatic habitat can be included in the category *ewé omi* (water leaves), for being associated with a divinity linked to the aquatic environment, such as Oxum and Yemanjá.

The classification that takes natural discontinuities into account is not a prominent one, but it is not absent either. *Igi* name collectively the trees; *Kekeré* designate plants exhibiting creeping behaviors or shrubs; for example, *àfòmon* is the denomination for parasites, epiphytes, and creepers. These designations corresponding to plant behavior explain the existence of three ethnoclasses (or life-forms).

The ethnic denominations assigned to the species may refer directly to the Orisha (*abèbè òsún*, Osun's hand fan); to parts of the plant and/or its characteristics (*igi-òpè*, palm tree); to animals (*ewé àkúko*, rooster leaf); to the taste and aroma (*ewé àmún*, we drink); and to the action assigned to the species (*ipésan,* thunder caller).

Natural Discontinuities: An Example of the Mayas and Tzeltales

We have said that some folk taxonomies have similarities with scientific taxonomies. Let us take the example of the formation of the specific names among Tzeltales in Mexico, studied by Brent Berlin and collaborators in 1973. Tzeltales use the generic name *Sc'ul* to designate the genus *Amaranthus*: *Sajuk sc'ul* (*Amaranthus*

[3] Reference to devotees of African-Brazilian cults.

hybridus), *Cahal sc'ul* (*Amaranthus cruentus*), and *C'is sc'ul* (*Amaranthus spinosus*). It is mainly based on natural discontinuities (e.g., color) that this binomial structure is developed. Among the Mayas, as noted by Jorge L. Bousquets (1990), it is possible to recognize a classification scheme by color. The name *abal* designates the genus *Spondias* (a genus that includes the plants known as "umbu," "caja," and "ciriguela"): *Chak-abal* (*Spondias purpurea*), *ek'abal* (*Spondias* sp.), *y'na-abal* (*Spondias lutea*), and a fourth species *k'an k'an-abal* (*Spondias monbim*), in which the *k'an* is doubled to mark the high intensity of the yellow color in the fruit. Thus, the terms and *sc'ul* and *abal* correspond to ethnogenera of these classification systems.

We conclude this topic summarizing the ideas of Jorge L. Bouquets (*La busqueda del método natural*), published in 1990, on the relationship between traditional or "folk" taxonomies and the scientific taxonomy: (1) Congruence to recognize the discontinuities between groups of organisms (taxa) by similarities and differences; (2) Linguistic equivalence to designate species with a binomial name formed by a generic name (a noun) and a specific name (an adjective); (3) Both taxonomies aim to be consistent with a more universal system of knowledge—in the scientific biological taxonomy, it is intended that the classification reflects the evolutionary history of organisms. Conversely, the folk taxonomies are based on magic-religious ideas integrated into the cosmovision of those who formulate it; and (4) Both taxonomies are hierarchical classifications.

Some Alternative Views to the Idea of the Universality of Folk Taxonomy

Brent Berlin's ideas assume a universality in folk classification of different cultures, presenting a pattern in the classification of living beings of the environment, following the hierarchical system previously presented. However, this idea is not shared by all researchers. Eugene Hunn, in an article published in 1982, launches an alternative proposal indicating that the folk classification does not necessarily follow universal principles. Hunn argues that the classification is strongly influenced by the utilitarian importance of resources. In this sense, people direct the classification for resources of utilitarian importance, while the less important resources are not targeted in the folk classification. This can lead to differences in classifications between and within different cultures.

A study carried out with an indigenous group in Peru on the folk classification of cassava (*Manihot esculenta* Crantz), for example, showed that women had a higher refinement of the species classification, citing a greater number of varieties or different types of cassava. The men, however, showed a less refined classification since they mentioned a smaller number of cassava's varieties. Boster (1986) explains that the difference between men and women may be related to the division of labor in relation to the management of the species, in which men only open areas for planta-

tions and women plant cassava, care for it, and select varieties. This distinction in the division of labor may have led to differences in the refinement of the folk classification among people in the group. This example shows that within a human group, we would not necessarily have a standard classification, which leads us to question the idea of the universality of classificatory principles (Ferreira Júnior et al. 2016).

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Chapter 5
Reflecting on Research in Ethnobotany

What ethnobotanists have thought about ethnobotany today? After more than 100 years of formal definition in this area of knowledge, it is possible to imagine that some things have changed in this way. Thus, in this chapter, we will seek to address some of the current thinking about the path that ethnobotany has taken or will still have to go on to consolidate its identity as a science. Of course, such thoughts do not necessarily correspond to a consensus among ethnobotanists but instead emerge from concerns presented by some research groups, particularly the authors of this book.

In recent decades, research in this area has undergone a process of popularization, illustrating the interest that the subject has aroused in the scientific community. Such popularity has been justified by the recognition of the social, ethical, and biological implications that this kind of work can generate, placing ethnobotany in a privileged position in the search for solutions to many problems of social and environmental concern.

Despite the significant growth of this discipline, especially in Latin America (Albuquerque et al. 2013), there is a current concern regarding the ability of this research to give accurate and novel answers to scientific questions. This field of knowledge is relatively new in their theoretical aspects and has not been systematized and formalized as other established sciences. In this sense, we present in this chapter some reflections and suggestions[1] that seek to improve the theory and practice of ethnobotany and the understanding that self-criticism is necessary for the progress of any field of knowledge that wishes to acquire maturity. It will also present the theoretical and epistemological assumptions of this scientific field of knowledge.

[1] For more details on the current challenges of ethnobotany, we recommend reading the article of Albuquerque and Hanazaki (2009), entitled *Five Problems in Current Ethnobotanical Research and Some Suggestions for Strengthening Them*.

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In Order to Be an Ethnobotanist, It Is Necessary to Have Specific Training

Ethnobotany brings together researchers whose backgrounds include a variety of theoretical and epistemological orientations. This variety is a positive trait of the discipline, as it establishes a foundation of different perspectives. However, the fact that this field uses theories and methods from different scientific perspectives, such as anthropology, botany, ecology, genetics, evolution, and economics, might contribute in part to the opinion that to be an ethnobotanist does not require specific training. We do not want to belittle the contribution that scientists from various fields of knowledge have given to ethnobotany; however, as in any area of scientific knowledge, it is necessary that the researchers have good training and a theoretical and methodological maturity to question their own bases and premises. Unfortunately, it seems that there is still the thought that, to carry out ethnobotanical studies, it is not necessary to possess basic training in the area.

This thought is linked to a supposed intellectual and financial "easiness" of conducting an ethnobotanical study, which attracts researchers with other scientific careers who often do not seek specific training in the area. This idea of easiness, especially from an intellectual point of view, must be discouraged, considering that the formulation of hypotheses, data collection, and analysis in ethnobotany needs to follow the same scientific rigor of any other science. The most basic tool of ethnobotany, the interview, is a good example of this false sense of easiness. Some people imagine that interviewing is easy and that it is possible to conduct an ethnobotanical study of quality only by talking to some people about useful plants in their area. This is a clear mistake, since a "simple" interview often requires thorough knowledge and great experience of the researcher to be carried out satisfactorily.

Despite the criticism presented here, it is true that we could not expect a very different scenario. There are few learning opportunities that the academy offers directed to this field of knowledge, whether at undergraduate or graduate levels—in the latter case, there are a few courses to train human resources. A popular MSc program in ethnobotany can be found in the University of Kent (United Kingdom). This university also holds an MSc and PhD in Ethnobiology.

The first specific doctoral and master's degrees in this field of study in Latin America (Post-Graduation Program in Ethnobiology and Nature Conservation, a course offered by an association between the Federal Rural University of Pernambuco, Paraiba State University, and the Regional University of Cariri), for example, was launched in 2012 in NE Brazil. Besides the lack of training opportunities, basic textbooks dealing with this subject are also scarce, although recently some studies have been published slowly changing this scenario (see Albuquerque and Alves 2016; Anderson et al. 2011).

Ethnobotanical Research Lacks Novelty

Most current work focuses on three lines of evidence: (a) descriptive studies, usually aiming to define the set of useful plants in a particular region, along with the categories of use identified for the investigated human group; (b) causality studies, which try to determine, through hypothetico-deductive[2] reasoning to test the hypothesis, the factors that can explain the use, the knowledge, or the popularity of plants, allowing an accurate assessment of the variables selected by the researcher; and (c) diagnostic studies, which are relatively new in ethnobotany and seek to test the efficiency and validity of certain techniques and methods, such as the influence of the sampling type selected by the researcher (e.g., interviews with the entire community or just with key informants, use of different data collection methods).

Despite these different paths, descriptive studies remain the most common, indicating the useful flora from different locations. Although its importance is unquestionable, these works tend to have little theoretical basis. Perhaps this occurs because most of the scientists who publish in ethnobotany do not have training in the area and continue reproducing the research model that has been deemed appropriate, without making the necessary critical reflections about the necessary advances for the area.

Well, we just talked about taking ownership of theories. Are they scarce in ethnobotany? Surely not! Quite the opposite. There are a variety of theories derived from different disciplines that are used by some research groups (Phillips and Gentry 1993a, b; Albuquerque et al. 2015). However, collective efforts seeking to investigate innovative proposals for this area of expertise are unfortunately still insufficient. What are the consequences of this? Such "novelties" cannot be used to identify patterns because they are not targets of systematic research and thus we advance slowly in the scientific knowledge in ethnobotany.

Ethnobotanists Need a Better Relationship with the Literature

This is a problem common to all science, and in ethnobotany could not be different. The lack of existing literature knowledge is identified as a major weakness of many published works currently. The authors are not doing a thorough review of the literature and therefore are failing to access the most important texts on the subject they are researching.

What are the implications of this scenario? We believe that: (a) many researchers label their own researches as if they were pioneers, when actually their ideas have

[2] The hypothetico-deductive method (HDM) is one of the most basic and common to many scientific disciplines. This reasoning involves a general theory and all possible factors that can affect a result, so the researchers make deductions from hypotheses that will predict what can happen in a given situation.

been addressed in previous articles; (b) there is a strong terminological inflation in ethnobotany research, since the lack of knowledge of previous literature leads to the creation of terms with meanings for which other terms have already been suggested; (c) many studies have important data, but because they are not constructed and discussed in the available literature their quality is compromised, reflecting on the type of periodical chosen for publication; (d) the lack of consultation with relevant sources may contribute to the reproduction of serious scientific errors, such as when an author makes a citation and distorts the original information, causing a reproduction of this distortion by other authors who do not consult the original document.[3]

We know that retrieving older literature is a difficult task, since researchers in many countries have no means to access these publications, and even when they have access to databases, some publications are only offered during certain periods. However, the researcher should not surrender to this difficulty; after all, literature access restrictions have always existed, especially in the past, and were never a barrier to the development of well-reasoned and informed research. In Brazil, the federal government provides free access to global scientific production through the *Portal de Periódicos da Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (Capes).*[4]

The Continuous Search for More Efficient Methods Should Be the Focus of Ethnobotanists

A basic question that every scientist must ask is about the techniques and methods used in their research: *are the tools I selected the most appropriate to address the issues that I want to answer?*

Among ethnobotanists, the methods most frequently used to assess the complex relationship between cultures and plants are interviews. Despite their importance, little has been discussed about the potential difficulties of their use, nor the weight that should be applied to this tool to answer such diverse scientific questions.

Questionnaires and forms used in interviews may limit the flow, inventiveness, and creativity of the people who need to adapt their considerations to the question formulated by the researcher. In addition, for some cultural contexts, it is not the most appropriate method. There are situations in which the use of this technique causes an affront to the people investigated, especially when the knowledge to be registered is identified locally as secret information. Similarly, the use of questionnaires and forms may cause an imbalance in the researcher's relationship with the

[3] In this regard, we suggest reading an article of Ramos et al. (2012), entitled *Citation behavior in popular scientific papers: what is behind obscure citations? The case of ethnobotany*.

[4] Access to *Portal de Periódicos* is free for users linked to institutions that meet the funding criteria for research and post-graduation defined by Capes. The website for access is: http://www.periodicos.capes.gov.br/.

interviewee, because they may perceive themselves as an "object of study" and not as a research partner who occupies the same level as the researcher.

In addition to these problems, interviews should be carefully conducted, since they can result in information that does not always match the reality of the studied populations. A very common example of this problem is encountered when we use this tool to obtain the list of species effectively used by a population. In this case, people can name the most common species that are remembered during the interview event, forgetting other equally important species, or mentioning plants that are part only of their repertoire of knowledge and that are no longer used nowadays. There are many factors involved in this matter, such as the fear of exposure, for example, in areas where collection is prohibited or even the need to "get rid" of the interviewer, which motivates the informant to present a short list of plants.

Therefore, we can start to think of methodological triangulation, as we have mentioned earlier. Triangulation combines different methodological procedures in the study of the same research problem. Thus, if I want to know which species are used, instead of using only interviews, why should I not also do an inventory at the locations where the resource is stored or used?

It seems clear that whatever the thinking is that guides the investigator, the subject that is explored, or the methodology applied, the research should be directed constantly toward the search for more efficient methods and more relevant research questions. The lack of accuracy in data acquisition hinders the comparison between studies and, consequently, impedes the identification of patterns. Moreover, in terms of data analysis, it is quite common that the unfamiliarity of ethnobotanists with mathematics and statistics leads to an incorrect use of indexes and statistical tests, camouflaging weak assumptions as valid or discarding good hypotheses. Thus, it is necessary that the young ethnobotanist who wants to follow a quantitative approach direct their training so that they can master, at least superficially, the statistical tools most relevant to ethnobotany.

Thus, it is necessary to develop standardized methodological protocols that allow data collected in different regions to be easily compared and the results obtained to be more susceptible to generalizations (see Cámara-Leret et al. 2014 for an interesting example). These protocols can be extremely useful because as we accumulate information from different parts of the world on the same topic, we advance the understanding of the complex phenomena present in the relationship between people and plants.

It Is Necessary to Have Ethical Principles

Ethnobotanists need to be ready to meet all existing ethical aspects in the different stages of their research, which are not few in number. These principles can be divided into two major groups: (a) legal ethical principles, used in research that accesses the knowledge of the people; and (b) moral ethical principles in face of the informants, related to the type of relationship established between researcher and interviewee, and return actions (Fig. 5.1).

Fig. 5.1 Return actions may be very diverse. In the picture, our research team, as part of its activities, designed a documentary for the community involved in their studies, which was produced with their participation. Credits: Juliana Campos

Regarding the ethical and legal aspects, we do not intend to expand upon this matter; however, we cannot avoid commenting on it. From the Resolution no. 466, of December 12, 2012, of the National Health Council (Conselho Nacional de Saúde—CNS), some steps have been established to be followed in research involving humans in Brazil, as an example. The first is the requirement to submit the project to the Research Ethics Committee (Comitê de Ética em Pesquisa—CEP) of the institution; only after receiving this approval the research should be initiated. The second step is to obtain the informed consent form, which is intended to inform the participants of the research of the nature and purpose of the study and the methods to be used, as well as the benefits, rights, and risks the informants will be exposed to, ensuring their privacy and identity. At this time, if the informant confirms his or her interest in participating in the study, a formal agreement should be established, ratified by signing the informed consent form (ICF).

Currently, legal issues involving research accessing traditional knowledge have been going through some discussion and reformulations (Brasil 2015) in order to protect such knowledge and ensure the sharing of benefits in the case of studies that have the potential to produce them. It is important to be updated on the subject, because depending on the group studied, there can be a number of additional legal requirements. In addition to all that has been mentioned, we cannot fail to mention

the ethnobotanical studies that aim to identify the economic potential of the genetic heritage resources, with the perspective of commercial use. In this case, in addition to the steps already discussed here, we need to establish a benefit-sharing agreement with all parties, including the community that owns the knowledge. In this sense, we realized that to ensure the ethics and legality of an ethnobotanical research, it is necessary to be very attentive to the recommendations imposed by the Brazilian legislation.

As for the ethical principles, we can emphasize here the researcher's commitment to the return actions (giving back) with the investigated community and to relating with informants throughout the study. This last point can be summarized in one sentence: "An ethnobotanist should seek to stay away from the preconceived ideas and prejudices that he or she carries." It is difficult, almost impossible, for a researcher to study the botany of a particular group if all that is processed is encoded as "primitive" and "inferior." The reader knows that the use of the term "primitive" or "devoluted" has very questionable ethnocentric connotations. It is not up to us to make such qualifications, but only to understand how the members of the studied group think, classify, manage, and enjoy their botanical environment. We have already mentioned that "local people discourse" may indicate verifiable biological phenomena, such as evolutionary and ecological relationships that are actually observed, and interpreted facts with the support of different ways of thinking about the world.

Just associate the first of botanical classification systems based on plant habits with the prescientific traditional systems that may take the same factors into account. As an example, the Italian Andrea Caesalpino (1519–1603), the first plant taxonomist, classified the plants as trees, shrubs, subshrubs, and herbs. In this classification, we can recognize the ethnoclasses present in classification systems of some cultures.

Regarding the return actions, it shall be an ethical and moral commitment of the researcher to the community studied, since such actions are not always legally established. However, what are return actions? Why should an ethnobotanist assume this commitment? Because this action is:

> *a political and ethical activity that should be inherent to all researchers in this area; […] an activity that aims to contribute to the local development, that is, emancipation or empowering of the social group associated with the research; […] a constant activity that is performed on a daily basis and not just at the end of the research* (Albuquerque *et al.* 2014).

If on the one hand the ethnobotanical research involves economic benefits, it should include the community in the sharing of benefits generated by a legal agreement; on the other hand, numerous studies do not aim to generate this kind of benefit. In this case, it is a moral responsibility of the researcher to "give back" to the community the data and benefits generated by the research.

One of the simplest ways to put this into practice and that depends exclusively on the research initiative is the presentation of the products that were developed (articles, dissertations, theses, etc.) to the social group. The care that the researcher should have at this stage is to worry about the presentation of the information, opting for a language that is understood by the target population of the action. Numerous other return options are possible and should be incorporated in the planning of ethnobiological research.

Now let us pause, reader, on these considerations and arguments. You may have noticed that in our discourse since the beginning of this book, some implicit assumptions about ethnobotanical research were present. We appropriated no formulated assumptions for a definition of the field. Now, how can we go about performing this formulation (Box 5.1)?

Box 5.1: Theoretical and Epistemological Assumptions of Ethnobotanical Research

Theoretical assumptions

The ethnobotanist believes that:

- People have been dependent on plants as a necessary resource for their survival.
- Different societies or cultures in their respective environments hold knowledge about the use of plants in their environment.
- Different cultures are able to recognize and realize their botanical environment, producing a classification system.
- Different cultures have techniques tested by tradition that enable the use and management of natural resources.
- Different cultures with different viewpoints and cosmological perspectives rationalize their botanical world based on their own thinking, or cognitive systems.

The traditional botanical knowledge, obtained from relations and observations of natural phenomena, is the product of the human intellect as a direct response to their real needs in the face of diverse stimuli.

Epistemological assumptions

- Neutrality[5] is dispensable in the acquisition of knowledge by the researcher.
- The techniques and traditional botanical knowledge are not primitive or inferior.

All forms of knowledge, as distinct ways of learning, have value in their respective production contexts.

[5] The principle of neutrality can be found in the argument that science and the form of knowledge production are not neutral, since only a privileged minority enjoys its results, which are used as a tool to maintain inequality. Thus, it is desirable that the researcher gets involved with the investigated with a participatory emphasis, producing knowledge by the interaction of traditional knowledge with scientific knowledge.

It is the appreciation for traditional knowledge that gives the ethnobotany a "subversive" character—as Toledo (1992) advocates for ethnoecology—for example, reducing the differences between popular and scientific knowledge—because both are useful forms of knowledge that respond to the needs of specific groups. The reader will notice in the next chapter that, from the approach proposed by many researchers in the field, scientific knowledge should benefit all of humanity and not just a select few.

> *Science could not escape between the epistemology artifices. Remained before entangled in the events of traditional politics. The concept of truth is no longer a fixed quality, being conditioned by a junction of power which formalizes and justifies what is acceptable. And this acceptance is conditional on concrete views of the political society and its development. For this reason, being a scientist today, means being committed to something that affects the present and the future of humanity. Therefore, the substance of science is both qualitative and cultural; not just a statistical quantification, but the understanding of realities. The real and active scientist today puts up questions such as: what kind of knowledge do we want and need? Who is the scientific knowledge intended to and who it will benefit?* (Borda 1988).

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Chapter 6
Ethnobotany, Science and Society

Within the dynamic in which the relationship between people and plants is developed along with the multitude of issues and interactive levels that surround it forms a complex of ethical, social, philosophical, ideological, biological, and practical implications that ensure to qualify ethnobotany as a science that aims for human progress. Thus, the results of an ethnobotanical research can and should return, elaborately and systematically, to the social environment from which the information was collected. This type of engagement is very common when we associate it with phytotherapy and folk medicine programs in which, at the end of the project, a fusion of folk and scientific knowledge occurs. This fusion can return to the community in the form of booklets or brochures with updated and systematized knowledge about the plants that are commonly used, and their cultivation, collection, and preparation.

However, the proposals and implications of ethnobotany are even more comprehensive. It is just to note, as pointed out by the Belém Letter elaborated during the International Congress of Ethnobiology held in Belém, Pará state, in 1998, that tropical forests and other fragile ecosystems are disappearing, that many species of animals and plants are going extinct, that indigenous cultures around the world are disappearing or being destroyed, that the economy, agriculture, and health of people depend on these resources, that native peoples have been responsible for about 99% of the world's genetic resources, and that there is a close link between biological and cultural diversity. It is thus easy to make sure that with the disappearance of tropical forests and other important ecosystems, humanity will no longer know the drugs for many of today's ills, as well as the food and nutritional value of many plants that will disappear along with their respective environments.

Native populations around the world are responsible for a large list of the plants currently cultivated to supply food, industrial, or medical needs, as well as cultivars used by these populations that are still unknown. The ethnobotanical research conducted over the past 100 years has shown this clearly. From these investigations, concrete measures may be taken to remedy the problems we focused on above and

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ensure, as Posey (1999) pointed out, that "*fair compensation of indigenous peoples for their full knowledge and guarantee the rights of intellectual property for traditional knowledge.*"

Ethnobotanical research breaks away from the contemporary discourse of science. The distinction is especially apparent when we consider that ethnobotany regards traditional techniques and folk botanical knowledge not as primitive and inferior, but that traditional botanical knowledge is a distinct way of learning and is a valid form of knowledge. These are the propositions that ethnoecology also assumes, challenging the paradigms of contemporary science, as noted by Toledo (1992).

Ethnobotany has ethical, social, and ideological commitments to science and society, breaking away from existing vertical relationships (when decisions and policies are performed by some and merely "obeyed" by others) and consolidating a type of scientific thought shared by other natural ethnosciences. Ethnobotany acts as a mediator between different cultures, bringing them closer socially, and is guided by the "understanding and mutual respect among peoples," as mentioned by Posey (1999) when addressing ethnobiology.

This means that in practical and biological terms, the accumulation of knowledge from ethnobotanical research, with its innovative, constructive, creative, and motivational spirit, enables:

- The discovery of substances of plant origin with medical and industrial applications, due to the growing interest in natural chemical compounds.
- The knowledge of new applications for substances already known.
- The study of plant drugs and their effects on the individual and collective behavior of users against certain cultural or environmental stimuli.
- Recognition and preservation of potentially important plants in their ecosystems.
- Documentation of traditional knowledge and the complex systems of management and conservation of the natural resources of traditional peoples, as well as the promotion of programs for the development and preservation of natural resources of tropical ecosystems.
- The discovery of important cultivars traditionally manipulated and unknown to our science.
- Mediation between local and scientific knowledge.

Ethnobotanical studies can provide valuable contributions to bioprospecting, that is, the search for plants and animals that may contain compounds for the treatment of diseases (Box 6.1). The discovery of the therapeutic potential of these compounds can bring benefits to the pharmaceutical industry interested in new alternatives, as well as for society in general. For example, Quinimax® used for the treatment of malaria is formed by a combination of the compounds of quinine, quinidine, and cinchonine present in the bark of species belonging to the genus *Cinchona* (Ferreira Júnior et al. 2012). In Brazil, the phytotherapy medicine Acheflan® is produced from a plant known as medicinal by many human groups, the whaling herb (*Cordia verbenacea* DC), another example of ethnobotany's contributions to medicine.

Box 6.1: Pharmacological Potential of the Selection of Medicinal Plants in Bioprospecting

In search of new potential possibilities of therapeutic importance, researchers have used some approaches to bioprospecting such as random and ethnodirected approaches. The first approach is associated with a random selection of plants or other resources for pharmacological research. From the ethnodirected approach, the researchers select the plant resources that may have pharmacological potential based on popular knowledge on the use of medicinal resources. In this case, which approach is more effective in selecting plants with therapeutic potential? To answer this question, Silva et al. (2013) conducted a study to compare the antimicrobial potential of plants randomly selected (random approach) and plants obtained from two types of selection based on popular knowledge (ethnodirected approach). The authors selected three groups of herbaceous plants in northeastern Brazil, based on three types of selection: (1) a set of plants presenting popular indication for treatment of parasitic and infectious diseases (direct ethnopharmacological selection); (2) a second set of plants presenting popular indication for the treatment of conditions not related to parasitic and infectious diseases (indirect ethnopharmacological selection); and (3) a third set of herbaceous plants that did not have popular indication in the treatment of diseases (random selection).

The three sets of plants were evaluated for their antimicrobial potential by investigating the effect of methanolic extracts from the leaves of the species in inhibiting the growth of a group of microorganisms. Silva et al. (2013) observed that the group of ethnopharmacological plants from direct selection presented the greatest number of active plants with higher levels of activity against the tested microorganisms compared with groups of plants from indirect and random selections. Furthermore, the group of plants from direct selection presented activity for a large number of microorganisms compared with the other groups of plants. These results show that ethnodirected selection, particularly direct selection (directed to the possible activity of the plant), has greater potential for the search of plants with antimicrobial activity. The findings also suggest that improving the ethnodirected approach could ensure the successful selection of plants with pharmacological potential for certain diseases of interest.

Bioprospecting uses a set of strategies that guide the search for new plant candidates with therapeutic potential. The use of plants for the treatment of diseases has occurred since our evolutionary past, and different human groups present a long history of using such medicinal resources, leading to local knowledge and practices that can be very important for bioprospecting strategies. In these cases, the long period of testing plants can lead to the perception that some of them show greater efficacy in the treatment of diseases. This type of information, when verified in an ethnobotanical study, may require a series of phytochemical and pharmacological studies that investigate the potential of these plants that people perceive as being very effective (Table 6.1).

Table 6.1 Some plants popularly used for medicinal purposes that present pharmacological activity observed in laboratory[a]

Family	Species	Common names	Pharmacological activity
Anacardiaceae	*Schinus molle* L.	Peruvian pepper, American pepper, Peruvian peppertree, escobilla, false pepper, molle del Peru, pepper tree, peppercorn tree, Californian pepper tree, pirul, and Peruvian mastic	Antifungal activity
Apiaceae	*Foeniculum vulgare* Mill.	Fennel	Antioxidant, hepatoprotective, antibacterial, antifungal, analgesic, and antipyretic activities
Arecaceae	*Copernicia cerifera* (Arruda) Mart.	Carnaúba, carnaúba palm or carnaubeira palm	Antioxidant activity
Asphodelaceae	*Aloe arborescens* Mill.	Aloe	Laxative, anti-inflammatory, antibacterial, antifungal, and hypoglycemic activities
Asteraceae	*Bidens pilosa* L.	Black-jack, beggar-ticks, cobbler's pegs, and Spanish needle	Antimicrobial activity
Asteraceae	*Achyrocline satureioides* (Lam.) DC.	Macela, marcela	Anti-inflammatory, antispasmodic, analgesic, choleretic, immunostimulant, antiviral, antimicrobial, hypoglycemic, and antioxidant activities
Combretaceae	*Terminalia brasiliensis* (Cambess.) Eichler	Amêndoa brava, cerne amarelo, capitão do campo, catinga de porco, mussambê	Antioxidant activity
Euphorbiaceae	*Croton cajucara* Benth.	Sacaca	Hypoglycemic, hypolipidemic, anti-inflammatory, antinociceptive, and anti-ulcer activities
Fabaceae	*Copaifera multijuga* Hayne	Copaíba	Anti-inflammatory activity
Fabaceae	*Copaifera cearensis* Huber ex Ducke	Copaíba	Anti-inflammatory, analgesic, and antiparasitic activities

Fabaceae	*Copaifera langsdorffii* Desf.	Copaíba	Antitumor, anti-inflammatory, and antiparasitic activities
Fabaceae	*Copaifera reticulata* Ducke	Copaíba	Antioxidant and antiparasitic activities
Fabaceae	*Cenostigma macrophyllum* Tul.	Caneleiro, canela de velho	Antioxidant activity
Lamiaceae	*Rosmarinus officinalis* L.	Rosemary, anthos	Antifungal and antimicrobial activities
Lamiaceae	*Origanum majorana* L.	Marjoram, sweet marjoram, knotted marjoram, and pot marjoram	Antimicrobial activity
Lamiaceae	*Salvia officinalis* L.	Sage, common sage, garden sage	Antimicrobial activity
Lamiaceae	*Plectranthus barbatus* Andrews	Indian coleus, forskohlii	Antibacterial, anti-inflammatory, and hypotensive activities and a relaxant of tracheal smooth muscle
Myrtaceae	*Eugenia uniflora* L.	Pitanga, Suriname cherry, Brazilian cherry, Cayenne cherry, or Cerisier Carré	Diuretic, hypotensive, antimalarial, and antimicrobial activities
Myrtaceae	*Psidium guajava* L.	Common guava, yellow guava, lemon guava	Antidiarrheal, antipyretic, anti-inflammatory, antibacterial, antifungal, and antinociceptive activities
Nyctaginaceae	*Mirabilis jalapa* L.	Marvel of Peru, four o'clock flower	Antifungal activity
Phytolaccaceae	*Phytolacca americana* L.	American pokeweed, pokeweed	Antifungal activity
Poaceae	*Cymbopogon citratus* (DC.) Stapf	Lemon grass, oil grass	Antinociceptive, hypotensive, diuretic, anti-inflammatory, anxiolytic, antipyretic, anticonvulsant, neuroleptic, antioxidant, antibacterial, and antifungal activities
Rutaceae	*Citrus* × *aurantium* L.	Bitter orange, Seville orange, sour orange, bigarade orange, or marmalade orange	Antispasmodic and antimicrobial activities and acts on the treatment of diarrhea
Rutaceae	*Citrus* × *limon* (L.) Osbeck	Rangpur, Citrus × limonia, lemandarin, mandarin lime	Antifungal activity

[a]Compiled information from Maciel et al. (2002), Vendruscolo et al. (2005), Fenner et al. (2006), Haida et al. (2007), and Sousa et al. (2007)

Box 6.2 Reflecting on the Selection of Plants for Pharmacological Investigations

It is quite common that in ethnodirected approaches, medicinal plants selected for phytochemical and pharmacological studies are the most popular in a community, that is, they are known to a larger number of people. However, some researchers wonder about the almost unrestricted adoption of this criterion.

Thus, we begin with the following question: are unpopular plants necessarily less relevant in terms of bioprospecting? Studies have suggested that natural selection favored the emergence of psychological biases that lead people to learn from those individuals most likely to have adaptive information (Henrich and Broesch 2011). Factors such as the prestige of the individual owner of the new information (e.g., medicinal plants to treat high blood pressure) may influence on whether the information in question will be or not effectively disseminated in a community (see, for example, Henrich and Broesch 2011). Therefore, sometimes it is possible that information about a medicinal plant cannot be spread simply by the fact that the individual possessing such information does not have enough prestige to have their behavior copied by others.

In addition, the unpopularity of certain plants may be due to their recent incorporation in local medical systems, so that there was not enough time for the information to be disseminated. Thus, such a group of plants may be important from the point of view of bioprospecting and disregarding them may lead to the loss of useful information for drug discovery of commercial interest.

Over time, ethnobotanists have developed a set of criteria that are important for selecting potential plants for pharmacological studies based on popular knowledge. One criterion is the consensus about the knowledge of a plant, suggesting that the more consensus people have on the uses of a plant, the higher its pharmacological potential. Thus, the plants presenting more consensus can be used in phytochemical and pharmacological studies. For example, if a plant is mentioned for treating a disease by a large proportion of people in the community, it means that it can present interesting compounds for the treatment of the mentioned disease.

Another criterion has been the therapeutic versatility of plants. The versatility of a plant in medicinal use relates to the number of diseases it can treat according to some human group. Accordingly, a highly versatile plant may be interesting for further pharmacological and phytochemical studies because it may have important compounds for treating a broad spectrum of diseases, for example (Box 6.2).

Despite these contributions, some researchers have encountered the following difficulties: even with a large number of ethnobotanical studies, little progress has been made from this approach to discovering new pharmaceutical drugs. This means

that we still face many challenges ahead in order to develop new strategies and improve the existing ones to search for new possibilities for discovering new drugs. Currently, the major problem in starting from the most popular plants in a community to conduct laboratory studies is that the most popular plants are often repeated in different areas, being exotic plants and native plants that are generally available. Thus, new bioprospecting strategies should be designed in order to use other criteria, in addition to popularity and versatility, to identify plants with medicinal potential from local knowledge.

In addition to bioprospecting, ethnobotany can contribute to public policies that promote the health of local communities. Thus, ethnobotanical studies may signal issues concerning healthcare, such as the shortage of medicinal plants that may be locally important for the treatment of various diseases.

Another direct contribution of ethnobotanical studies consists of biodiversity conservation strategies. When we speak of the relationship between human beings and natural resources, we generally have a tendency to associate this relationship with negative effects such as the loss of biodiversity, habitat modification, and changes to ecosystem functioning. This is natural, because we have increasingly started to realize that the lifestyles of human populations threaten biodiversity conservation. However, in ethnobotany, we cannot accept this as a rule, but neither can we begin our studies from the perspective that people live in harmony with the environment.

Thus, ethnobotanical studies arise bringing scientific evidence regarding the use of plant resources, the criteria used by human populations for species selection, the collection practices employed, and whether these factors may or nor relate to the decline of plants in a particular ecosystem. Local populations can provide valuable information on the extraction of forest resources and the vegetation dynamics, which are fundamental components of management strategies for achieving sustainable use and conservation of native vegetation (Albuquerque 2010).

For example, during 4 years of ethnobotanical research in a Caatinga (seasonal dry forest) area in Pernambuco State, northeastern Brazil, researchers from our research group established a ranking of priority plant species for conservation in the studied region. The ranking used an index that considered the number of indicated uses for each species, its status in the local vegetation, and the degree of attention given by the population in the management and cultivation of these species in agroforestry homegardens (Albuquerque et al. 2009). This type of research has provided a series of recommendations to be adopted by local resource managers, such as (a) creating reforestation programs in areas where resources have been heavily exploited in order to ensure their future availability; (b) encouraging people to use agroforestry homegardens with native species, thus reducing the need for people to move to the forest areas to collect resources; and (c) replacing the use of dead cuttings, used as hedges by the population, with the use of hedges made from native species.

Another practical example of the contribution of ethnobotanical research to the conservation of biodiversity consists of a study conducted on the northern coast of Rio Grande do Sul on the extraction activity of the black fern (*Rumohra adiantiformis* (G. Forst.) Ching), a species whose fronds are collected to make floral arrangements.

Although this activity comprises the main source of income of farmers in the studied region, its extraction was illegal. It was through a series of studies carried out with this species that the ecological and social viability of this activity was discovered, enabling the formulation of public policies for legalizing its extractive activity (Souza 2003; Baldauf 2006).

When we speak of conservation we cannot limit ourselves to purely technical issues related to ecological research: we need to identify the ways in which different social actors think and feel about nature, that is, how they deal with the duality of both using and enjoying *x* preserving. Traditional knowledge should be taken into account in decision-making aimed at the conservation of biodiversity, and when ethnobotanists detect that populations develop unsustainable practices, they should seek ways to help in this process through return actions that do not cause even greater conflict with the populations.

Another key issue is that we must not only consider the conservation of biodiversity to be important, but also the set of knowledge and symbols related to it. Thus, the concepts of diversity and biocultural conservation are gaining importance in modern ethnobotany, so that conservation strategies should ensure that, along with plants, animals, etc., the "cultural creativity" involving it is also maintained. Therefore, whenever possible, it is preferable to think of conservation strategies involving sustainable use rather than strategies that involve drastic substitutions of cultural practices related to certain natural resources.

Finally, the intersection of ethnobotany and conservation, in terms of strategies and policies, must be done with great caution. It is common for the young researcher, enthusiastic about the findings of his or her research, to want to show the community the most appropriate ways to manage certain resources or the maximum amount of resources that can be exploited. However, we must not forget two things:

1. Environmental problems are usually associated with socioeconomic problems. Sometimes, knowing that a practice is unsustainable is not enough to stop doing it. Some studies have shown an inverse relationship between income and use of plant resources (Dahdouh-Guebas et al. 2000; Medeiros et al. 2012). Thus, people with lower incomes who depend on the use of these resources for their livelihoods will often not stop using them even knowing the negative implications for biodiversity. This shows that the resource utilization issues are complex and conservation actions cannot be summarized to *educate community residents about the ecological importance of species X, Y, and Z.*
2. Conservation strategies cannot be designed from the top down. Even though we have innovative and efficient solutions to conservation problems, such solutions need to be discussed and agreed to in the communities. Moreover, it is necessary to present the conservation problems identified in the research and to have open discussions so that the communities can participate in suggesting strategies. You, reader, have probably heard that it is much easier to engage in something that you helped to build. This is perfectly valid in the context of local communities. Conservation strategies created from the top down tend not to rely on the commitment of the communities, which in most cases is essential for their effective progress.

All that was discussed, dear reader, consists of direct information, naturally enriched by parallel or subsequent investigations, inside or outside the field of ethnobotany. After having examined these aspects—theoretical, methodological, epistemological, and practical—we remain with a poetic reflection:

> *Cultures have come and gone during the historical-evolutionary path of humanity; they manipulated and met their botanical world precisely as it was possible to them. Unquestionable truth: people have much to say of plants, and the plants—from the most modest cryptogam to the phanerogams trailblazer of heights, from the living photosynthetic cells to the reproductive remnants amalgamated in archaeological sites—what do they have to say of people? Who we are or were then, what we eat or cultivated them; finally, everything that relates to our relationship with plants, our lives or their lives* (Albuquerque 2005).

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