



## Systematic Reviews and Meta-Analysis Applied to Ethnobiological Research

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### Abstract

We suggest the application of systematic reviews and meta-analysis to access biological resource selection and use patterns from a regional or global point of view. In this opinion paper, we discuss the importance of this approach to help advancing the comprehension of socio-ecological systems at broad temporal and spatial scales.

**Keywords:** *Ethnobiology – Traditional Biological Knowledge – Quantitative analysis*

## **Introduction**

Ethnobiology has grown considerably in the last 10 years, especially in developing countries, as evidenced by a number of publications in long-standing ethnobiological journals (Journal of Ethnobiology, also Economic Botany, Journal of Ethnopharmacology) and the addition of several new journals (including Ethnobiology Letters, Journal of Ethnobiology and Ethnomedicine, Ethnobotany Research & Applications and Ethnobiology and Conservation). Despite this growth, we have noticed that discussions focusing on theoretical and methodological aspects of the area are scarce (see discussion in Albuquerque and Hanazaki 2009; Albuquerque and Hurrell 2010; Alves and Albuquerque 2010). In a large number of ethnobiological scientific publications, the authors do not explicitly state the hypotheses or questions that guided the inquiry. Additionally, most of the hypothesis and theories cited in ethnobiological studies come from other disciplines, such as classic anthropology and ecology (see, for example, Soldati and Albuquerque 2012). Undoubtedly, this situation reflects the still incipient development of ethnobiology.

Several studies have repeated the same phrase, “each culture has its own unique relationship with natural resources,” without further evaluation. Though true, statements like this could lead to the misunderstanding that we cannot identify patterns in the relationship between people and plants, given that each experience is unique. Certainly, each culture has a particular relationship with its resources; however, that is not to say that such experiences do not reflect patterns and behaviors that are highly similar in different cultures and regions. In addition, the lack of a unifying theory and/or common inquiry goals makes it difficult to clearly recognize patterns if they do occur. Several studies in ethnobotany, for example, have tried to address broad comparisons (see Bletter 2007; Moerman et al. 1999), but in many cases such comparisons are difficult or even impossible given the diversity of the methods employed. Thus, it is not easy to make generalizations, even considering all available information on a certain topic.

We believe that ethnobiologists must discuss their common points of interest, identify the major themes of investigation, and generate strategies to make it possible to compare the research data collected from different regions. Meanwhile, we propose an investigation program based on the use of systematic reviews and meta-analysis to search for regional or global patterns. The approach defined here is directly influenced by an emergent subfield of ecology, namely, macroecology and, thus, might be termed “macroethnobiology”. Macroecology deals with the study of relationships between organisms and their environment, which involves characterizing and explaining statistical patterns of abundance, distribution, and diversity (Brown 2003). A macroecological approach, therefore, emphasizes description and explanation of processes that occur on global or regional spatial scales and on temporal scales that vary from decades to millennia (Brown 2003; Smith et al. 2008). Macroecology was originally framed in 1989 with a study of datasets encompassing several types of organisms that evaluated the assembly of continental biota to uncover how physical space and the nutritional resources are divided among resident species across large geographic areas (Brown and Maurer 1989).

Following this pioneering study, several investigations evaluated aspects of species distribution from a macroecological perspective (Jennins and Blanchard 2004; Kelt and Van Vurren 2001; Li 2002; Taylor and Gotelli 1994; Vaughn and Taylor 2000). Additionally, papers framing and evaluating macroecological methods,

tools, and principles have become available (Blackburn 2004; Gaston and Blackburn 1999; Isaac et al. 2004; Rangel et al. 2006), as well as textbooks on the theme (Brown 2003; Gaston and Blackburn 2000). Generally, macroecological studies analyze results from primary studies to discern global and regional profiles. This perspective, distinct from that of traditional ecology, was widely criticized, primarily for being a program of non-experimental investigation. These criticisms actually contributed to the growth of the area; that is, macroecologists worked at detailing the logic of the approach and showed that macroecology follows all the rules of Western science (Blackburn 2004; Brown 2003). Macroecology therefore, generates global strategies for issues such as biodiversity conservation (Brown 2003).

### **What are we suggesting?**

Following the tenets of macroecology, we propose an adaptation of macroscopic analysis to ethnobiology. Macroscopic analysis in ethnobiology does not disregard culture as one of the modulating agents of the relationship between people and biological resources nor consider that all human populations have identical behaviors regarding the knowledge and use of natural resources. Instead, such analysis focuses on phenomena that are the product of these interactions and characteristics that tend to be repeated in different places. Evidence of such patterns can be useful in generating strategies for conservation or bioprospecting, for example, on a regional scale, without disregarding the peculiarities and characteristics inherent to these regions.

With the goal of ascertaining possible regional patterns in the knowledge and use of plant resources, the macroscopic approach aims to extend analysis to areas much larger than those found on the local scale (e.g., a community, village or city). The analysis of secondary data is therefore one of the main tools for this type of approach. However, considering the scenario that we outlined, it is necessary to derive data of excellent quality to avoid biases in interpretation once aggregated datasets are assembled. We want to highlight three main points:

1. The macroscopic approach to ethnobiology is not an academic discipline, but a way to understand the complexity of the relationship between people and biological resources on a global or regional scale.
2. We are not only suggesting the compilation of secondary data or literature review; but rather a statistical analysis of secondary data from different studies.
3. As for any other study based on the hypothetic-deductive method, the questions that guide the investigation must be clear, objective, and designed to contribute to the understanding of a given phenomenon.

In fact, some previous works in ethnobiology can be considered precursors of this approach, as they seek to determine regional or global patterns concerning the relationship between people and living beings. However, they use different approaches which do not fit to our proposal of using systematic reviews and meta-analysis. The Berlinean classification (Berlin 1992), for example, has suggested patterns of plant and animal classification based on a hierarchical perception. Moerman (1979) compiled the North American medicinal flora and compared it to the total flora of the region. This work was an attempt to find overused and underused botanical families and to show that medicinal plant use performed by traditional societies is not randomly performed, but rather based on efficiency, what could explain the statistical underuse and overuse of certain families. This idea was followed by a number of further works (Amiguet et al. 2006; Bourbonnais-Spear et al.

2005; Douwes et al. 2008; Hernández et al. 2005; Kapur et al. 1992; Leonti et al. 2003; Moerman 1989; Moerman 1991; Moerman 1996; Moerman et al. 1999; Saslis-Lagoudakis et al. 2011). Some other studies compiled published information and treated them quantitatively in order to find plant use patterns (Albuquerque et al. 2007; Molares e Ladio 2009).

The difference between the approach suggested here and those cited above is mainly methodological. We suggest the use of systematic reviews (Cooper 2009) and meta-analysis to analyze plant use and selection patterns. This perspective has not been applied to ethnobiological works so far. Glass (1976) created the term meta-analysis to differentiate statistical analysis of the results of individual studies from the integration of such results. A relative lack of quantitative approaches and experimental design targeted at the questions and hypotheses may have contributed to the lack of interest in meta-analysis in the field of ethnobiology. Despite the limitations imposed by the nature of ethnobiological research, some of its areas can readily assimilate meta-analytical tools. Studies of the use patterns of medicinal plants and animals have great potential because a majority of such studies provide complete lists of useful animals and plants despite a lack of common questions and an absence of statistical analysis. These lists allow for later calculation of basic statistics and the secondary testing of hypotheses that are broader in temporal and geographic scale.

Possible studies might consider following suggestions:

1. The influence of migration on the selection and use of medicinal resources. Several studies have examined the use of medicinal plants by migrant groups (Balick et al. 2000; Capps 2009; Ceuterick et al. 2008; Medeiros et al. 2012; Nesheim et al. 2006; Pieroni and Gray 2008; Volpato et al. 2009). Systematic reviews can contribute to clarification of information such as the main strategy used by migrants (to obtain plants from their original habitat or to adapt themselves to new plants) or how migration results in the increase or reduction of medicinal plants available in the new habitat.
2. The influence of socioeconomic variables on the knowledge and use of plants or animals. Several studies have used correlation or regression analyses to evaluate whether variables such as income, age, gender, occupation or time of residence affect the knowledge or use of plants, among other resources (Cocks et al. 2008; Fisher 1999; Gavin and Anderson 2007; Monteiro et al. 2006; Tekleyhamanot et al. 2007). Macroscopic analysis can help us to understand the predictive power of these variables at larger scales.
3. Research on public markets has been frequent in ethnobotany (Monteiro et al. 2010). Several studies in this area are essentially descriptive and individual studies do not very reveal general patterns. Markets are an important source of research to ethnobiologists because several hypotheses can be tested there. How much does the biological diversity of markets reflect the biological diversity in the region? What is the predictive power of the demand (or supply and demand) on biological resources sold in the markets?
4. One hypothesis that has been tested often in ethnobotany is: plants that are used more frequently by local populations are available in greater numbers in the environment (Lucena et al. 2007; Phillips and Gentry 1993). The combination of data from different studies can answer how the abundance of a given resource influences its local importance for human populations.

## Final Remarks

The application of systematic reviews and meta-analysis to ethnobiology does not intend to be a new subfield or to supplant other approaches, but rather should incorporate additional ways to assess large-scale patterns. Considering that we are still advancing in ethnobiological researches, why is meta-analytical approach necessary? The proposed approach is “top-down” and it considers that macrogeographic ethnobiological patterns are not necessarily evident in the isolated case studies. The logic of this meta-analytical approach requires accepting the idea that previously unrecognized properties can emerge from the sum of parts. Conventional ethnobiological studies and those which were proposed here can be developed together in order to better understand the processes and patterns that explain the complex socio-ecological systems.

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