Making friends in the field: How to become an ethnobotanist. - A personal reflection

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Editorial

Abstract

The focus of ethnobiological studies, their methods and the participation of local counterparts in these have changed substantially during the last decades. From the scientific point of view, ethnobotanical research has gone from simple inventories or lists of useful plants to detailed quantitative studies, backed by solid methods and analysis. However, one of the changes that stands out most is the incorporation of the guidelines set forth in the Nagoya Protocol, which has allowed this science to develop research in which the participation of local counterparts is much more active, going from being only the sources of information to be the main actors developing the investigations, and to be only mentioned in the acknowledgments to be authors of the publications that are the product of the investigation. All this process has been an apprenticeship, that I personally reflect in the process that my training as an ethnobotanist has followed.

Keywords: conservation, ethnobiology, ethnobotany, Nagoya Protocol, plant use

In Memory of "Mr. Mathenge" - (Simon Gikuyu Mathenge 1938-2017) (Fig. 1).

"How does one become an ethnobotanist?" This is one of the most common questions that students who try to discover what direction to give to their professional career ask me. Working in remote places studying "natives" certainly sounds exciting and reaching "there" seems simple enough. Commonly it is assumed that the "natives" will be happy to work with an "investigator", after all, why should they not be happy and totally willing to share their knowledge with someone who "knows more"?

Fig. 1. "Mr. Mathenge" - Simon Gikuyu Mathenge, Mt. Kenya 1994

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But in reality, the road to the "remote place", and what is more important, the way to the "people" who live there, is almost never direct (straight), and certainly not easy (it has many curves). And recognizing that it is really "us" who know very little can be a hard blow to our scientific ego.

My experience working in "the field" began as a vegetation ecologist, studying the floristic composition and regeneration ecology of the tropical montane forests of East Africa. The objective was to establish a classification system for the forests of the region and study their functioning as ecosystems. In 1994, my narrow conservationist vision considered local people as one of the main "disturbing agents" of "my mountain" (Fig. 2) and its "pristine" forests. My relationship with people was limited to finding the means to get them away from these ecosystems (Fig. 3).

Fig. 2. The summits of Mt. Kenya, 5199m.

Finding a way to germinate and propagate the species of trees used locally, and thus avoid the dependence that the local people had on the forest as a source of resources, was the only objective that related me to the people of the region. The results of my research were published in a colorful map that showed the "new types" of vegetation that we had found and described in detail (Bussmann & Beck 1995a). However, this was obsolete at the same time it was published, since very soon after a large part of these forests were illegally cut down to establish marijuana crops (Bussmann 1996). The little useful information of this investigation was the regeneration patterns that we identified in the different types of forests (Bussmann & Beck 1995 b,c; Lange et al. 1997), and the first data on the growth and germination of tree species. native, and that had not been generated by the local forest administration until then (Bussmann 1999, Bussmann & Lange 2000). Time did not prove me right, and this helped me to understand that my conservationist point of view excluding the local population was totally wrong, and that in reality the local population was the "key agent" for the conservation of these ecosystems. And this understanding began with the relationship I established with Simon G. Mathenge (1938-2017) (Fig. 1). "Mr. Mathenge," as everyone knew him, was a para-taxonomist and curator of the Herbarium of the University of Nairobi. Without any academic training, but with an incredible knowledge of the local flora, he was the main collaborator in all the botanical researches carried out between the decade of the `70s and 2015 in the University. Unfortunately, none of the publications in which he collaborated recognize his participation as a co-author, including mine. Even when the publication included local knowledge, only the researcher appears as the sole author (Bussmann 2006).

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Fig. 3. The tea (*Camelia sinensis*) and heavily used agricultural zone surrounding Mt. Kenya.

In April of 1994, while writing my thesis and recovering from a severe attack of Tick fever in a remote camp in northern Kenya, I met "Ivan G." Ivan G. was an American, he was visiting Africa for the first time, and was part of the board of trustees of the San Diego Museum of Man (USA), and he had his own vision of what to do to save the planet. At that time none of that meant anything to me. He was interested in the study of the use of plants in traditional medicine, looking for possible applications for the discovery of medicines, and in this way generate income derived from the sale of these medicines to support efforts in sustainable development and conservation. To this end, he had planned an interdisciplinary trip to the city of Loja located south of the Equator. His team already had an anthropologist, a pharmacologist, and he needed a botanist. Young, about to finish my thesis, and without a job in sight, I was interested in his approach. Inexperienced in relation to working with local communities, I thought that my experience as a botanist would be enough, and that having an anthropologist on the team would mean that I myself certainly would not have to work with people. I casually mention that I knew Ecuador (I had been traveling as a backpacker in 1990), that I was a botanist (although I did not mention my very limited knowledge of the Neotropical flora) and my interest in collaborating (I needed a job). This led to an invitation to visit him in San Diego (USA) and discuss the possibilities of participating. In December of 1994, I finished my PhD and organized a vacation in New York (USA), with a visit to Ivan G. included in the plan.

Getting to San Diego was easy but finding Ivan G. was harder. Within a week of celebrating Christmas, he had forgotten about my visit, planned his Christmas vacation, and was leaving the night of my arrival. But this did not mean any problem for him, he left me the keys to his house and his car and returned a week later. A lesson of confidence for me.

The following week I met Douglas Sharon, the anthropologist and director of the San Diego Museum of Man, who had worked for decades studying "Shamanism" in northern Peru but had never collected a plant. I also met Ezra Bejar, the pharmacologist, who was a specialist in active compounds used to treat diabetes and heart problems, but he was a laboratory researcher who had never really been in the field. They, and I as botanist, in September of 1995 we started what would be known as the "Vilcabamba Project".

In Loja, a small town in the south of Ecuador, our main collaborator, Don Cruz Roa (Fig. 4), the healer with whom we would work and a small space that would be our "field laboratory", with a small test kit to identify the secondary compounds of medicinal

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plants awaited us. And then we started our investigation. Laboratory tests to identify compounds in plants were tedious but being mechanical they were easy to perform. The anthropological part with the healers was much more difficult. We had to ask many questions about each of the plants that were used (for what it was used, how it was prepared, how it was applied, where and when the plants were collected, etc.) and all this considering the traditional, ceremonial and spiritual context of its use (Fig. 5,6).

Here one of my main limitations became evident: the language. As a botanist I had not identified it as limiting, however, as an ethnobotanist I now saw that not being fluent in the local language was a main limitation. It was not enough to know the plants, to be able to identify them taxonomically, and even to write and ask, I needed to understand the context of the use of plants and that meant being able to "connect" with people and for that the language was essential.

Fig. 4. Don Cruz Roa and his wife. San Pedro de Vilcabamba, Ecuador, September 1995.

All the information we gathered revealed the wide knowledge that our local counterparts, the healers, had about the plants. They identified and differentiated plants without the need for taxonomic keys, knew their ecology, phenology and their pharmacological properties. In reality, they did not need an "investigator" to know or recognize them. And in reality, those who were learning were we, a perception shared by my colleagues. However, when the healers began to ask about the information we collected, research became a means of transmitting knowledge in both directions, allowing a much more equitable exchange of knowledge. For weeks, we built a strong working relationship that ended up creating strong bonds of friendship.

The research progressed, however, none of us could clearly identify the way to obtain income from any of the plants studied, beyond the benefit obtained by healers by exercising their trade. When we arrived in Loja, we had contacted a local NGO to obtain the permits and explore possible scenarios in which we could invest the income derived from medicinal plants, mainly focused on improving the livelihoods of local populations and conserve forests. But at the time we could not identify any scenario.

The burning season came to the region, when large areas of forest are cleared by fire. The disappearance of the forests and the consequent disappearance of the plants used by the healers led the Vilcabamba Project, and mainly Iván G., to find funds to acquire a "piece" of forest to conserve it.

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Fig. 5. The curing altar ("*mesa*") of Don Cruz Roa. San Pedro de Vilcabamba, Ecuador, September 1995.

Fig. 6. Don Cruz Roa in a curing ceremony. San Pedro de Vilcabamba, Ecuador, September 1995.

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Then a second phase of the project began to develop. The land with forest was acquired, plans were drawn up to build a conservation research and education center, a rapid inventory of local flora and fauna was carried out, and options for the long-term economic sustainability of the project began to be evaluated. However, the use of traditional knowledge about medicinal plants for the discovery of potential medicines and the generation of economic income was immediately ruled out. There were many aspects related to this way of generating income that we had not considered and that our local advisors showed us. First we had to learn that a "new drug discovery" approach needs time and funds to be productive; second, if any results were to come out, this might lead to serious problems in relation to intellectual property; and third, the likelihood was high that in any case there would be no tangible benefit for the local population and conservation efforts anyway. But expectations among the local population had already been created, and we needed to find solutions. The NGOs with which we had initially contacted were still interested, however, they had mostly other interests and saw the project as just another source of income.

After some assessments, the decision was to form a new NGO, composed only of local counterparts, and in charge of developing the Conservation and Education Project in the area we had acquired. But we had not expected the negative reaction of the NGOs that we had discarded, and we were just beginning to work when the most important newspaper in Ecuador published the headline: "Loja, the new pharmacy for foreigners?" accusing the project of biopiracy. With the paperwork to obtain the new research permits on the way, this news was not favorable. However, we were able to demonstrate that from the beginning the project had all necessary permits that supported each of its activities, we had the informed consent of all the parties involved, and no material collected and / or analyzed had ever been exported from Ecuador. All this, backed by the formation of the local NGO managed by the project participants themselves, allowed this project to finally start working.

But all this did not cover all the expectations we had generated with our initial idea, no benefits for our local counterparts had been generated. In 2002, six years after starting the Vilcabamba Project, the book "Medicinal herbs of southern Ecuador" was published (Bejár et al., 2002). Again, expectations of being able to generate income with its sale surfaced. This book, however, did not have the expected success in terms of sales. Once again, we had failed to meet the economic expectations of our collaborators.

This experience, with all its stages, was an essential lesson for my professional development, not only as a botanist or ecologist, but as a conservationist. I learned that local populations are an integral part of conservation processes, which should force us to think about developing much more participatory and interdisciplinary projects. And that the conservation of either the natural resources and / or the traditional knowledge associated with them cannot be based on generating monetary expectations, that this is not the only way to give them the real value they have.

The "Vilcabamba project" turned out to be a true turning point in my professional career. Although I continued to investigate the ecology of vegetation, in a very short time the focus of my research changed completely towards ethnobotany and traditional knowledge.

Doing ethnobotany under the stipulations of the Nagoya Protocol

The "Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of the Benefits Arising from their Utilization" is a complementary agreement to the United Nations Convention on Biological Diversity (CBD). It was approved on October 29, 2010 in Nagoya, Japan and entered into force on October 12, 2014, 90 days after the deposit of the fiftieth instrument of ratification. The CBD was the result of the 1992 United Nations Conference on Environment and Development in Rio de Janeiro, Brazil. The signatory parties to the Convention agreed on three main objectives: 1) the conservation of biodiversity, 2) the sustainable use of natural resources and 3) the fair and equitable distribution of the benefits derived from the genetic resources of biodiversity (Secretariat of the Convention on Biological Diversity 2011). The third objective was addressed with the Nagoya Protocol, seeking to strengthen the legal framework related to the distribution of benefits derived from traditional knowledge and genetic resources (Harrop 2011).

The ratification of the Nagoya Protocol constitutes a great impetus for the fulfillment of the rights of indigenous and local communities and leads to several changes in both the approach and the development of ethnobiological research. Under this framework, prior consent and the availability of benefits for the owners of traditional knowledge are not only part of the work ethic, but they become law international that must be followed. With the practice of globalized science, it is necessary to ensure that

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the knowledge that local counterparts share with researchers is not misappropriated by third parties, nor used for purposes other than those that guided the original research. The benefits for local counterparts need to not only include the return of the information obtained, in a language and an accessible form chosen by the traditional owners, but also the repatriation of information (publications) from previous studies carried out in the same indigenous or local community, that were not returned by the original investigators. In all research publications, local counterparts should be recognized as authors, instead of simply being mentioned in the acknowledgments.

During the last 10 years, as an ethnobotanist, I have tried to incorporate all these changes in the research I have developed. Starting with the inclusion of local counterparts as researchers (Fig. 7,8) and authors of all the publications that were the product of the research, both in books (Paniagua et al. 2011; 2014 a; Paniagua Zambrana & Bussmann 2017; Randrianarivony et al. 2016) (Fig. 9,10,11) and in scientific articles. (Bussmann et al. 2015 a,b, 2016 a, b, c, 2018 a,b,c, Paniagua Zambrana et al. 2016, 2018 a,b).

From my initial experience investigating medicinal plants with healers in southern Ecuador, I moved to northern Peru. This region is considered the "Traditional Medicine Center" in the central Andes. The roots of this knowledge go back to the Cupisnique culture (1000 BC). For two decades I collaborated studying the use of medicinal plants in the region, we interviewed healers, collectors and sellers of medicinal plants and in a complementary study we conducted bioassays to evaluate the efficacy and toxicity of the plants. The growing demand for the use of the traditional medicinal plants, has generated problems related to the availability of these resources in the long term. Most of the plants sold for medicinal purposes are collected in the wild, without any type of management that guarantees the long-term sustainability of this extraction and the in-situ preservation of the species. Very few species cultivated. The commercial value of this type of use has meant that practically "any species" can be acquired from one of the thousands of companies that sell them over the Internet (Hidayati et al. 2015). And the term "any" does not only apply to the species a customer might be looking for, but to "any other" species that due to its resemblance is marketed under the same vernacular or commercial name.

Fig. 7. The Sekenani Maasai ethnobotany team. Sekenani, Maasai Mara, Kenya, May 2006.

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Fig. 8. The Chácobo Ethnobotany Project team, Alto Ivon, Beni, Bolivia, September 2013.

Fig. 9. Giving back! Return of research results to the Awajún community of Cusi Chico in form of their self-authored books. Amazonas, Peru, August 2012.

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Fig. 10. Giving back! Return of research results to the school of the Awajún community of Chiriaco in form of their self-authored books. Amazonas, Peru, August 2012.

Fig. 11. Giving back! Return of research results to the Llacuash community of Lamas Wayco in form of their self-authored books. Amazonas, Peru, August 2012.

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Our research has shown that the composition of the local pharmacopoeia in northern Peru and southern Ecuador has changed profoundly, not only since colonial times (as expected), but also in an accelerated way in the present (Bussmann & Sharon 2014). However, this change is much more evident in Ecuador, where the number of species used for this purpose has decreased drastically. Users constantly experiment with the "new" plants that appear in the market. An example of this is the appearance of fruits and products such as Noni (*Morinda citrifolia* L.), available in large quantities both in pharmacies and in the markets of the region since 2005, although it was already known in the rest of the world since long before. The sellers of medicinal plants clearly respond to market demand by seeking to provide new and "fashionable" species to their customers (Bussmann et al. 2015a).

The high demand for some species of medicinal plants has accelerated their disappearance in certain regions. The over-harvesting of some species, or the disappearance of their natural habitat, has caused these species to begin to be replaced by similar ones (sometimes only in appearance), with the consequent risk for the final consumer who frequently only knows the vernacular name of the plant and self-medicates. This is the case of medicinal plant replacements found in the markets of La Paz (Bolivia), where *Ephedra americana* is now sold under the name of "Cola de Caballo" to replace *Equisetum giganteum* and *Equisetum bogotense* (Bussmann et al. 2015b). This shows the little attention is paid to the correct identification of the plants that are marketed. The identification of the species should be made by specialists, or at least receive their confirmation. Taxonomy is a crucial tool for the validation and safety of plants used in traditional medicine.

Although the tradition of the use of medicinal plants extends to the entire Andean region, we were able to demonstrate that there are profound differences between the plants that are marketed for a certain purpose and even under the same vulgar name. To extrapolate information from one country to another, and even within the same country and / or city has high risks. We found deep differences between the plants sold in different markets within the same metropolitan areas (Bussmann et al. 2016a, 2018a), which can be explained by differences in the origin of the populations that migrate to the cities, their knowledge of the medicinal uses of plants, and the differences in floristic diversity in their regions of origin. Preferences for the use of plants are transferred to markets through the demand of customers and are reflected in the great diversity of plants (including names and uses) that can be found in the markets (Bussmann et al. 2016a, 2018a).

These results allow us to argue that the approach of development projects that involve plants, their use and / or application, must take the high diversity existing in the regions into account. Assumung that the use of a species or their form of use should be similar in different regions, because they simply occur in those regions, carries a very high risk, especially when the use of a species is rooted in a local culture. The differences in knowledge and use of plants can be very profound, even among neighboring communities of the same ethnic group, as our research on knowledge of the use of palms (Arecaceae) in the Northwest region of Latin America demonstrated (Paniagua Zambrana et al. to 2014, 2016, 2017). The social, cultural, historical and economic context clearly influence the local use of resources such as plants, and research has to take this into account to very carefully to avoid errors when interpreting the information obtained. To achieve this goal, studies based on solid, quantitative and standardized methods are required, which allow the replication of research and in this way elucidate the differences between communities in a detailed manner, as has been proposed in several publications (Paniagua Zambrana et al. 2010, Leonti et al., 2018).

The perception of the loss of traditional knowledge that has guided numerous investigations, must be carefully evaluated. Few researchers have the opportunity to replicate research to verify whether knowledge loss really occurs. Our experience in Africa allowed us to confirm the loss of knowledge in just a decade (Bussmann et al 2006, Bussmann et al 2018 d), however, in only a few cases the same research methods can be applied to the same people during different time intervals to reach such conclusions. This again highlights the lack of information about the protocols used to obtain the information, which can lead to incorrect conclusions when comparing different methods (Paniagua-Zambrana et al., 2018 b).

Our research with the Chácobo, an indigenous group from the Amazon in Bolivia has allowed us to demonstrate that the focus of the research, the methods applied, the number of participants, the time spent in the field, as well as the sociocultural characteristics of local counterparts trained as interviewers can be factors that can influence the results obtained. In this experience, we trained local counterparts to collect all the information, both by conducting interviews and collecting all backup material, including plant vouchers, and photographic

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records. The active participation of local interviewers allowed the process of obtaining information in the field to be much longer, and by using the local language and being part of the ethnic group, the work of the interviewers was much less invasive. With this approach it was possible to interview all adults of the participating ethnic group. In this way the information collected allowed to answer the original hypotheses in a much more solid way (Paniagua Zambrana et al., 2018 a,b,c). Methodologically, we were able to demonstrate that the training of local counterparts can be considered a much more effective method for long-term research.

Finally, the authorship of publications that are product of ethnobiological research must include knowledge owners as the main authors, based on the guidelines established in the Nagoya Protocol. Any commercial use of any of the published information requires additional prior informed consent of the participants and the communities, and an agreement on the distribution of benefits. This procedure needs to be recognized as essential both by academic institutions and by the institutions that support and finance research and grant permits. In this sense, the time and funds that these activities require, must be considered an essential part of each projecs. Editors and reviewers of scientific journals that receive manuscripts related to ethnobiological resreach must consider compliance with the guidelines mentioned in the Nagoya Protocol as an important requirement.

With all its stages, all the successes and mistakes, this has been the process with which ethnobotany has allowed me to make friends in the field. Friends with whom I have learned, understood and shared knowledge.

Conclusions

Ethnobotany in Latin America and around the world has entered a new era. Under international regulations and the growing global market, ethnobiology must adapt, adopting standard protocols that allow the collection of quantitative data, actively involving local researchers in all stages of research and their publication, and strengthening the commitment to repatriate all data collected. and previous studies and returning it to its original owners.

List of abbreviations: N/A

Ethics approval and consent to participate: All participants gave their prior informed consent before any study.

Consent for publication: All people depicted in images in this paper agreed that those images together with their identities could be published.

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