# "Ad aspera ad astra - 40 years of (Ethno)botany": an interview with Rainer W. Bussmann, Co-Editor in Chief of ERA

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**Ethnobotany Research and Applications 23:18 (2022)**

## Notes on Ethnobotany

## Abstract

An interview with Rainer W. Bussmann, Full Professor of Ethnobotany and Head of the Department of Ethnobotany at the Institute of Botany, Ilia State University, Georgia and co-director of Saving Knowledge. His work focuses on ethnobotanical research and the preservation of traditional knowledge, in the Andes, the Caucasus, and the Himalayas.

With "Mura," Bakuriani Alpine Botanical Garden. (Photo Narel Y. Paniagua-Zambrana)

Manuscript received: 04/03/2022 – Revised manuscript received: 06/03/2022 - Published: 07/03/2022
http://dx.doi.org/10.32859/era.23.18.1-52

## Do you consider yourself primarily a botanist or an ethnobotanist?

I am an Ethnobotanist, although this is slightly narrow, but I am obsessed with plants and what people can do with them. By training I am however originally a Vegetation Ecologist and Taxonomist.

## Where did you grow up, and how did this influence your scientific career?

I grew up in a tiny village in the Allgäu region of Southern Germany, close to the alps, with the closest "city" having some 12000 inhabitants, and with more cows than people in the district. However, I always had little sense of belonging there, because my whole family ended up in the place as refugees. My mothers' family came from the Federal State capital Stuttgart, fleeing Allied bombing raids, and was solidly bourgeoise. My father's family were Danube Swabians from Syrmia (in what now is Serbia), who had migrated there in the 1780s, and in 1944 had escaped Tito's partisans. At home we spoke the Lower Swabian dialect of Stuttgart, at school the Upper Swabian dialect of the Western Allgäu (and learned High German of course). But culturally none of us had a real sense of belonging, which no doubt has influenced my later career.

All my ancestors were farmers and winemakers (although my mothers' parents had become barbers), and I am the first academic in the family. As child I spent lots of time exploring the local forests, pastures, *Sphagnum* bogs, and stables, but I never felt encouraged to work with plants. Sure, some clients of the barber shop were rumored to "know the healing power of herbs," and in some cases, e.g., when a child could not sleep, you went to the local "health prayer man," but overall herbs had hardly any place in our household. But there must have been some fascination for ethnobotany in me - in my grandmothers' barber shop I always used to make "herb cocktails" for customers that I did not like.

Rainer W. Bussmann's mother and grandparents Photo Rainer W Bussmann).

Rainer W Bussmann's father and grandparents (Photo Rainer W Bussmann).

Rainer W. Bussmann "Dabbling in agriculture" around 1970. (Photo Rainer W. Bussmann)

Fortunately for me, in Germany we had (and still have) a three-tiered school system after primary school, with Hauptschule (basic secondary, more for manual jobs), Realschule (intermediate secondary, originally for clerical jobs), and Gymnasium (leading to the Abitur, i.e., giving you a degree that allows you to enter university). One Biology segment in sixth grade was about insects, which fascinated me, and a little later I actually started collecting insects (I in fact started an "Insect club" with some friends), and breeding butterflies. These of course needed fodder plants, which got me into botany. At that point I still regarded traditional plant use as something quaint and antiquated. I started participating in the Federal State mapping program of our local flora, which would cause constant anxiety for my parents, who were afraid I might end up as a peat body in our local *Sphagnum* bogs. By age 13, I knew that I wanted to become a botanist, and work at a large herbarium, exploring the world collecting plants. I started publishing simple botanical papers and giving classes and leading excursions in botany at the local adult college when I was 14 (Bussmann 1982, 1983a,b,c, 1984a,b,c,c, 1987, 1988, 1992, Bussmann & Rieks 1985a,b). From that point I never considered studying anything but Botany.

**Where did you study? What would you say are important qualifications for an ethnobotanist?**
I studied biology at Universität Tübingen in Germany - the only university I actually applied to, because it is one of the oldest in Europe, going back to 1477, and I had heard it had a long tradition in botany, going all the way back to Leonhard Fuchs, who is regarded as one of the three "founding fathers of modern Botany." Fortunately, I did not get discouraged when some undergraduate tutor told me that botany only led to unemployment, and that I should study microbiology or genetics, which was the fashion of the time. What I loved about Tübingen was the breath of what you could chose to study. While staying true to botany (my official departmental home was Botany and Mycology), I also did minors in plant physiology, zoology, parasitology, and paleontology. At that time the first degree one got was still the "diploma," equivalent to a Master's. I believe that it is a disaster that the Anglo university degree structure, with a Bachelor as "degree" is being implemented in so many countries. A Bachelors' degree would be what we had as "pre-diploma," essentially an intermediate exam that allowed you to work on your Masters' degree, but it serves little to show a qualification other than that the holder has received a basic university education.

During my university time I had the great privilege to participate in a wide range of courses, and advanced excursions e.g., to France, Turkey, former Yugoslavia, and Kenya, which would become the starting point of my professional botany career. One result of these excursions were a few interesting publications, funny enough,. mostly on zoological topics (Rödel & Bussmann 1990a,b, 1992a,b, Rödel *et al.* 1989), and I still remember collecting the the first plat names after me (*Poa bussmannii* H. Scholz) during one of these excursions.

On expedition in the Swedish Arctic. September 1991 (Photo Mark-Oliver Rödel).

The broad university education I enjoyed in Tübingen was really a blessing for my future work. The taxonomic identification of plants is absolutely essential for conducting meaningful ethnobotanical studies, but sadly many researchers have difficulty identifying species., and have not even the basic training to collect good botanical vouchers, so classic taxonomical training for me is an important tool for any serious ethnobotanist. Being an ecologist has also been very useful, e.g., to understand the ecological conditions under which useful species grow, how they can be propagated and introduced into cultivation and so on. Physiology has served me to better understand the production of plant metabolites. I wish I had also had some training in e.g., anthropology, because it would have made initial interviews much easier, but overall, what is easiest to learn "on the go" is the social science part of ethnobotanical science.

For my diploma (MSc) thesis I decided to go to Kenya and study the floristic composition of African mountain forests, which then led into a doctoral thesis on the same topic, later expanding into vegetation studies in all mountain forest regions in Kenya and Ethiopia (Bussmann 1993, 1994, 1996, 1997, 1999a,b,c,d, 2001a,b, 2002a,b, 2006a, Bussmann & Beck 1995a, 1998, 1999a,b, Bussmann *et al.* 2001). However, this was obsolete at the same time it was published, because very soon after, a large part of these forests was illegally cut down to establish marijuana crops.

Still, at that time traditional plant use had no importance for me. Like many young and eager conservationists, I actually saw people as "destroyers" of "my" forests (Bussmann 1996), not realizing that they of course had used the resource for a long time. But at least I did some work on regeneration / germination of local timber species, which the Anglo-colonial foresters had always ignored, focusing on plantations of pines, eucalyptus, and cypress (Bussmann 1999e, 2004a, Bussmann & Beck 1995b,c, Bussmann & Lange 1999a, 2000, Bytebier & Bussmann 2000, Lange *et al.* 1997, Onyango *et al.* 2004). And I greatly admired the plant knowledge of my local guides, who in fact had many more tools than myself for identification of plants (including smells of the plants, color of latex, color of the bark after cutting is, etc. etc.), and of course they knew all the uses of the respective species.

From 1994 to 2002 I worked as Post Doc at the University of Bayreuth developing ecological research in the mountain forests of Kenya and Ethiopia, and as scientific coordinator of the DFG (German Science Foundation) program, "Functionality in a Tropical Mountain Rainforest: Diversity, Dynamic Processes and Utility Potentials under Ecosystem Perspectives," featured in the German television documentary series "Humboldts Erben". During that same time, I also led a project on vegetation in the forests of East Africa, including the establishment of the Maseno University Botanical Garden (Onyango *et al.* 2002), and was one of the founding participants of the Global Mountain Biodiversity Assessment (GMBA).

Starting 2001, I finally "became an ethnobotanist" and started focusing my research on the ecology of cloud forests and medicinal plants in northern Peru, under the Program of International Health Research Training and Health of Minorities (MHIRT) of the National Institute of Health.

In 2002 I moved to the USA, joining the University of Hawaii (Manoa) as Scientific Director of the Harold L. Lyon Arboretum, and as Associate Professor of Botany from 2003 to 2006. For me, the research there, focusing on the Polynesian-Pacific region, was much too narrow for me, so I left HI, and from 2006-2007 joined the Department of Geography at the University of Texas (Austin) as a visiting professor. In 2007 I then was appointed Director of the William L. Brown Center, and William L. Brown Curator of Economic Botany at the Missouri Botanical Garden.

After a decade I left the USA and Missouri Botanical Garden in 2017 to start a new Department of Ethnobotany at the Institute of Botany and Bakuriani Alpine Botanical Garden (BABG) at Ilia State University, Georgia (Caucasus).

On expedition in Swedish Arctic Lapponia, August 1991 (Photo Rainer W. Bussmann)

Fieldwork in Kenya 1994. (Photo Rainer W. Bussmann)

The peak region of Mt. Kenya, 5199m. *Dendrosenecio keniodendron* (Giant Groundsel) in the foreground.

**Why did you get interested in ethnobotany?**

During my work in Africa, I would slowly understand that my conservationist point of view, excluding the local population from forest use and management, was profoundly wrong and colonial, 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). "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 investigations local and foreign researchers carried out between the 1970s and 2015. Unfortunately, none of the publications in which he

collaborated recognize his participation as a co-author, including mine, as it was tradition that even when the publication included local knowledge, only the researchers appeared as authors.

The tea (*Camelia sinensis*) and heavily used agricultural zone surrounding Mt. Kenya. (Photo Rainer W. Bussmann)

In Spring of 1994, I spent a lot of time in high class safari camps, analyzing data and writing my thesis. I liked the tents, everything worked, the food was great, and it was overall cheaper (and of course much nicer) than renting a room in Nairobi. While writing my doctoral thesis and recovering from a severe attack of Rickettsiosis in a remote camp in northern Kenya, one evening at dinner, some guy walked up to my table and asked if he could join my meal. The person turned out to be the then President of the Board of the San Diego Museum of Man, who was planning to finance an ethnobotanical expedition to Southern Ecuador. In the course of the conversation, it became clear that the expedition needed a plant taxonomist, an opportunity that I decided to take. This in essence is when my ethnobotanical career started. The team already had an anthropologist, and 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. I casually mentioned that I knew Ecuador (I had been traveling there in 1990 as student), that I was a botanist (although I did not mention my very limited knowledge of the Neotropical flora) and my interest in collaborating. This led to an invitation to visit him in San Diego (USA) and discuss the possibilities of participating.

When in December of 1994 I had finished my PhD, I went for a visit to San Diego. Getting to San Diego was easy but getting hold of the donor 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 Dr. 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, and Dr. Ezra Béjar, the pharmacologist, who was a laboratory researcher who had never really been in the field and was a specialist in active compounds used to treat diabetes and heart problems. In September of 1995 the three of us started what would become known as the "Vilcabamba Project".

In Loja, a small town in the south of Ecuador, our main collaborator, Don Cruz Roa, 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 plants, awaited us. To me the laboratory tests to identify compounds in plants were tedious but they were easy to perform. The anthropological part was much more difficult. Here one of my main limitations became evident: the language. As a botanist I had never identified this as problem, however, as an ethnobotanist I now saw that not being fluent in the local language was a main limitation. It was by no means enough to know the plants, to be able to identify them taxonomically, and even to write and ask questions - one really 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.

Don Cruz Roa and his wife. San Pedro de Vilcabamba, Ecuador, September 1995. (Photo Rainer W. Bussmann)

All the information we gathered revealed the wide knowledge that our local counterparts, had about plants. They identified and differentiated species without the need for taxonomic keys, knew their ecology, phenology, and their pharmacological properties. In reality, they did not need us "investigators" to know or recognize them. The only people who needed to "learn" were actually us. 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 profound bonds of friendship.

With the work progressing, all of us tried to clearly identify a way how 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 research permits and explore possible scenarios in which to invest a possible income derived from medicinal plants, mainly focused on improving the livelihoods of local populations and conserve local ecosystems. But at the time we could not identify any feasible scenario. The burning season when large areas of forest were always affected by fire had started in the region by the time our first research trip concluded. The prospect of the disappearance of the forests and the consequent disappearance of the plants used by the healers led our donor to find funds to acquire a "piece" of forest to conserve it. As a "sideline" this also started my NGO career, convincing the respective donor that in order to preserve the highly biodiverse and scientifically unexplored mountain forest ecosystems of the region, we needed on the one hand to involve the local population in management decisions, and that multi-disciplinary in-depth study would also be urgently needed. 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. This led to the purchase of about 1500 ha of cloud forest, the construction of "Estación Científica San Francisco" one of the largest research stations in Latin America.

This in turn led allowed the foundation of "Nature and Culture International," an NGO that is by now protecting over 20 million acres in the Americas, and as which's vice-president and scientific director I served for over a decade. This effort, in turn, allowed me to help create and coordinate the largest and longest running tropical ecology program ever financed by the German Science Foundation (DFG), which have been continuously running since 1997. Although we participated in some conferences (Béjar *et al.* 1997a,b) it did take, six years after starting the Vilcabamba Project, to get a first book "Medicinal herbs of southern Ecuador" (Bejár et al., 2001) published, followed

by a few articles on both vegetation and medicinal plant use (Bussmann 1999f, 2001c,d, 2002e,f,g, 2003a,b, 2005, 2006b,c, Bussmann & Lange 1998, 2001, 2002, Bussmann & Sharon 2006a, 2007a, Bussmann *et al.* 2008, Gálvez *et al.* 2002, 2003, Leischner & Bussmann 2002, 2003, Lozano *et al.* 2005a,b, 2006, 2007a,b,c,d,e, 2008, 2009, 2010, 2020, Lozano & Bussmann 2003, 2005, Ohl & Bussmann 2004, Peyre *et al.* 2015, Richter *et al.* 2008, Romero-Fernandez *et al.* 2003, Uday *et al.* 2004).

The curing altar ("*mesa*") of Don Cruz Roa. San Pedro de Vilcabamba, Ecuador, September 1995. (Photo Rainer W. Bussmann)

Don Cruz Roa in a curing ceremony. San Pedro de Vilcabamba, Ecuador, September 1995. (Photo Rainer W. Bussmann)

The experience in Loja, with all its stages, was an essential lesson for my professional development, not only as a botanist and ecologist, but as a conservationist. I learned that local populations were an integral part of conservation processes, which needed developing much more participatory and interdisciplinary approaches. In that way the "Vilcabamba project" turned out to be a true turning point in my professional career. Although I continued to work a few more years on the vegetation ecology of mountain forests, very soon the focus of my research changed completely towards ethnobotany and traditional knowledge.

A few years after my initial experience investigating medicinal plants with healers in southern Ecuador, in 2001 I moved to northern Peru, a region that is considered the "Traditional Medicine Center" of the central Andes, with the roots of this knowledge go back to the Cupisnique culture (1000 BC). This heritage is still very visible in the syncretic local healing altars (*mesas*) that *curanderos* use to treat their patients.

For two decades Douglas Sharon and I collaborated studying the use of medicinal plants in the region, interviewing healers, collectors, and sellers of medicinal plants, and complementing the study with bioassays to evaluate the efficacy and toxicity of the plants, probably presenting the most detailed study of any region in Latin America, as well as adjacent countries (Ascate Pasos *et al.* 2020, Azahuanche *et al.* 2012, Bussmann 2006c, 2018b, Bussmann, Barocio *et al.* 2008, Bussmann & Glenn 2010a,b,c,d,e, 2011a,b,c,d,e, Bussmann, Glenn *et al.* 2010a,b, 2011, Bussmann, Malca *et al.* 2010, 2011, Bussmann & Sharon 2006b, 2007b, 2009a, 2010a,b, 2014, 2015a,b,c, 2018a,b, Bussmann, Sharon *et al.* 2007a,b, 2008a,b, 2009a,b, 2010, Bussmann, Tellez *et al.* 2018, Castañeda *et al.* 2021, Hennig *et al.* 2010, Laure-Mora *et al.* 2021, Malca García *et al.* 2015a,b, 2016, 2017, Monigatti *et al.* 2013, Revene *et al.* 2008, Rodriguez *et al.* 2007, Romero *et al.* 2020, Sharon & Bussmann 2006a,b,c, 2014, Sharon, Glass-Coffin *et al.* 2010, Spirova *et al.* 2019, Torres-Guevara *et al.* 2020, 2021, Wilsky *et al.* 2020).

The healing altar (mesa) of Julia Calderon, las Delicias, Trujillo, 2003 (Photo Rainer W. Bussmann)

The growing demand for the use of the traditional medicinal plants, had already generated problems related to the availability of these resources in the long term. Most of the plants sold for medicinal purposes were collected in the wild, without any type of management that would have guaranteed the long-term sustainability and in-situ preservation of the species. Very few species were cultivated. The commercial value of this type of use meant that practically "any species" could be acquired from one of the thousands of companies that sell them over the Internet.

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 was marketed under the same vernacular or commercial name.

Our research showed that the composition of the local pharmacopoeia in northern Peru and southern Ecuador had changed profoundly, not only since colonial times (as expected), but also in an accelerated way in the present (Bussmann & Sharon 2014). However, this change was much more evident in Ecuador, where the number of species used as medicine had decreased drastically. Users constantly experimented with "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, and widely sold and adulterated around the globe (Bussmann 2006d, 2007a,b, Bussmann, Hennig *et al.* 2013). The sellers of medicinal plants clearly responded 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 accelerated their disappearance in certain regions. Over-harvesting, or the disappearance of their natural habitat, caused these species to begin to be replaced by similar ones (sometimes only in appearance), with the subsequent risk for the final consumer who frequently only knew the vernacular name of the plant and self-medicated. This was e.g., the case of medicinal plant replacements found in the markets of La Paz (Bolivia), where *Ephedra americana* was sold under the name of "Cola de Caballo - Horestail" to replace *Equisetum giganteum* and *Equisetum bogotense* (Bussmann, Paniagua-Zambrana *et al.* 2015c), highlighting how little attention was paid to the correct identification of the plants that were marketed (Bussmann, Paniagua-Zambrana *et al.* 2015c). Clearly taxonomy is a crucial tool for the validation and safety of plants used in traditional medicine (Bussmann 2015, 2022, Raman *et al.* 2017).

Although the tradition of the use of medicinal plants extends along the entire Andean region, we were able to demonstrate that there were profound differences between the plants that were marketed for a certain purpose and even under the same vernacular name. To extrapolate information from one country to another, and even within the same country and / or city had high risks. We even found deep differences between the plants sold in different markets within the same metropolitan areas (Bussmann, Paniagua-Zambrana *et al.* 2016, 2018b,d), which could be explained by differences in the origin of the human populations that migrated 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 were transferred to markets through the demand of customers and are reflected in the great diversity of plants (including names and uses) that could be found in the markets (Bussmann, Paniagua-Zambrana *et al.* 2016, 2018b,d). This is also a clear expression of the globalization we see in plant use, especially the use of medicinal species, which are often marketed as "traditional," although very frequently they have been introduced to a certain region in colonial times, or much more recently (Bussmann 2013c, Bussmann & Sharon 2009c, Bussmann &, Paniagua-Zambrana 2012a,b, 2014, Bussmann, Paniagua-Zambrana *et al.* 2014c, 2015b.)

Although much of my ethnobotanical work, especially in the first decade of the 2000s, concentrated on the Andean region, especially Northern Peru, I did still keep "a leg" in Africa, which has been my passion since I did my Masters' and Doctoral work there, and naturally much of the work on this continent also focused on ethnobotany. While initial work was centered in my old "area of influence" around Mt. Kenya (Njoroge *et al.* 2003, 2004a,b, 2010, Njoroge & Bussmann 2006a,b,c, 2007, 2009), I also had the privilege to work with the Maasai, showing real knowledge loss over a decade (Bussmann, Gilbreath *et al.* 2006, Bussmann, Paniagua-Zambrana *et al.* 2018e), the Samburu (Bussmann 2006e), Oromo (Bussmann, Swartzinsky *et al.* 2011, Luizza *et al.* 2013), Luo (Kiefer & Bussmann 2004, 2008) and do some comparative assessments of plant use in the region (Bussmann 2013b). Recently much of this was incorporated in "Ethnobotany of the Mountains of Africa" (Bussmann 2021).

One of the fascinating aspects of the African region, when I worked at Missouri Botanical Garden, was the possibility to conduct ethnobotanical studies in Madagascar, and documenting the profound differences this huge island has in comparison to the African continent, especially due to its almost entirely endemic flora, and to see how understudied the region was (Bussmann, Paniagua-Zambrana *et al.* 2015a, 2018e, Rabearivony *et al.* 2015, Rakotarivelo *et al.* 2014, 2015, Randriamiharisoa *et al.* 2015, Randrianarivony *et al.* 2016b,c, 2017, Razafindraibe *et al.* 2013).

The Sekenani Maasai ethnobotany team. Sekenani, Maasai Mara, Kenya, May 2006 (Photo Rainer W Bussmann).

Dragging the expedition boat upriver, expedition in Eastern Madagascar, February 2011. (Photo Fortunat Rakotoarivony)

Of course, over the last years, and especially with the formation of the Department of Ethnobotany here at the Institute of Botany in Tbilisi, our heart lies with ethnobotanical studies in the wiser Caucasus region. This is not just the case because we call Georgia our home, but also because there existed a long Caucasus German tradition before Germans were deported under Stalin, and not surprisingly, quite a few of the Germans who emigrated to the Caucasus in the early 19th century were Swabians, so I might even have had distant cousins here, which makes me feel like I have cultural roots here in Georgia. Since we started work here in 2013, through the work with a team of excellent colleagues, the Georgian Caucasus has become a thoroughly studied region with regard to ethnobotany again (Batsatsashvili, Kikvidze *et al.* 2020a,b, Bussmann 2017, Bussmann, Batsatsashvili *et al.* 2016a,b,c,d, 2017a,b,c,

2018a,b,c, 2020, 2021, Bussmann, Paniagua-Zambrana *et al.* 2014d, 2021, Bussmann, Batsatsashvili *et al.* 202, Fayvush *et al.* 2017, Kupradze *et al.* 2015, Mehdiyeva *et al.* 2017, Nakhutsrishvili *et al.* 2022, Pieroni *et al.* 2021).

Interview in Tusheti, Georgia, September 2015 (Photo Narel Y. Paniagua-Zambrana).

One of the interesting and maybe surprising aspects of my ethnobotanical work over the last decade has been my collaboration with a plethora of fabulous colleagues in India, Nepal, and Pakistan which has made the Himalayan, and especially Pakistan, one of the most ethnobotanically studied regions on the globe. This collaboration already started in the earlier 2000s, after meeting Dr. Ripu Kunwar at a conference in Vienna. Together we developed in depth ethnobotanical studies especially in the Far-Western part of Nepal (Kunwar, Fadiman *et al.* 2018, 2020, Kunwar, Baral *et al.* 2016, Kunwar, Burlakoto *et al.* 2010, Kunwar & Bussmann 2006, 2008, 2009a,b, Kunwar Chowdhary *et al.* 2008, Kunwar, Katuwal *et al.* 2010, Kunwar, Makhat *et al.* 2012, 2013, Kunwar, Nepal *et al.* 2006, Kunwar, Shresta *et al.* 2010, 2019, Kunear, Uprety *et al.* 2009, Kunwar, Sher *et al.* 2021, Kunwar, Rimal *et al.* 2021, Kunwar, Subedi *et al.* 2021, Kutal, Kunwar *et al.* 2021). This research later expanded to Northern India (Banday *et al.* 2021, Bhat *et al.* 2013, 2015, Debbarma et al, 2017, Hassan *et al.* 2021a,b, Kumar *et al.* 2011a,b, 2021, Mir *et al.* 2021, Reang *et al.* 2016, Semwal *et al.* 2020, Singh *et al.* 2017a,b, 2019a,b, Tamang *et al.* 2021, Tewari *et al.* 2020, Tkakur *et al.* 2014, Verma *et al.* 2007).

However, the most prolific cooperation in our science I have certainly seen in Pakistan, which in less than a decade has become one of the most researched country on the planet with regard to ethnobotanical studies, which shows the great dedication of Pakistani colleagues to make a real impact in our field of research (Abbas *et al.* 2019, 2020, 2021a, Abbasi & Bussmann 2021, Ahmad *et al.* 2020, 2021a,b, Ali *et al.* 2019, 2020, Ali Shah *et al.* 2021, Amjad *et al.* 2021, Asmat *et al.* 2021, Bibi *et al.* 2021, Dutta *et al.* 2021, Haq *et al.* 2020, 2021, Hart & Bussmann 2019, Harun *et al.* 2022, Husain *et al.* 2022, Jan *et al.* 2019, 2020, 2021a,b,c, Majeed *et al.* 2020, 2021, Malik *et al.* 2018, 2021a, Muhammad *et al.* 2019, 2021, Shah *et al.* 2020, Sher *et al.* 2015, 2016, 2017, 2020, Singh *et al.* 2019a, Sulaiman *et al.* 2020, Ullah *et al.* 2019, 2021a,b, Umair *et al.* 2019, Ur-Rahman *et al.* 2018a,b, 2019a,b,c, 2020, 2021a,b,c, 2022, Wali *et al.* 2019a,b, 2021), and of course China, where I have also made some contributions to ethnobotanical research (Liu *et al.* 2016, 2018, 2019, Long *et al.* 2016, Ma *et al.* 2019a,b).

## Have you mostly concentrated on ethnobotanical work over the last decades?

While I essentially have become an ethnobotanist, I have always continued "regular" botanical work, and to some extent my background as vegetation ecologist, especially trying to assess the ecology and regeneration of mountain forests around the globe (Bussmann 2002d, 2004b, Restrepo *et al.* 2009). Naturally, the impact of climate change

on such ecosystems has also always been on my mind (Laurance *et al.* 2011, Liu *et al.* 2018, Qin *et al.* 2017, Yang *et al.* 2021, Zhang *et al.* 2022).

"Classic" botanical collection in Costa Rica 2009 (Photo Rainer W. Bussmann)

On expedition in Huallaga, Northern Peru 2011 (Photo Carlos Vega Ocaña).

Interestingly, cooperating with many colleagues especially from India, Nepal, and Pakistan, my vegetation ecology work in the last decades has very much concentrated on the Himalayan region (Abbas *et al.* 2021b, Ali *et al.* 2022a, Khalid *et al.* 2022, Kumar *et al.* 2012, 2013, Kunwar *et al.* 2018, 2019, malik *et al.* 2021c, Ur Rahman *et al.* 2019).

And I still enjoy classic expeditions, focusing mostly on under-collected areas in Northern Peru and Madagascar. To a very large extent the style of real expeditions has little changes since the times of Ruiz & Pavón or Humboldt. Granted, vaccines and modern drugs have greatly reduced the health risks of expeditions, and the field equipment is clearly better, but the physical strain is little different, given that today the researchers normally participate in the manual work required, be it managing pack mules, or dragging boats upriver.

On expedition in Huallaga, Northern Peru 2011 (Photo Carlos Vega Ocaña).

For non-botanists the simple joy of collecting and identifying plant species might be hard to understand, but for me there is nothing more relaxing (maybe apart from waling my dogs), than being out in the mountains and collecting specimens. Such collections are of course the basis for the scientific identification of the material, and often description of species new to western science.

Collection joy in the Huallaga, Northern Peru 2011 (Photo Carlos Vega Ocaña).


Plant pressing in Ambalabe, Eastern Madagascar, 2012 (Photo Narel Y. Paniagua-Zambrana).

## How did your ethnobotanical career develop, and how has the discipline changed over time?

As I mentioned, I started out as taxonomist, and vegetation ecologist, fist doing floristic work in Germany and other parts of Central Europe, and then switching to Africa, and from there to vegetation research in Latin America before I really got into ethnobotanical studies.

My ethnobotanical work started out as simple taxonomic assistance to anthropological colleagues. I identified the plants, and they did the questions (and it was impressive to see how much one could ask about). Based on this I soon focused on the one hand on how to design better ethnobotanical studies, and how these could contribute on improving the livelihoods of the people I work with, while at the same time fostering conservation. Within our discipline I see food and gastronomy as particularly important sub-disciplines. Food in general, because it represents the basis of any livelihood, and traditional food plants are the most important "ingredient" to confront global change, and of course to feed a growing population. At the same time traditional food plants can provide interesting ingredients for supplement and food ingredient development, and thus contribute to sustainable community income. Gastronomy, because I love to cook and to eat, and believe that gastronomy is an excellent tool to bring ethnobotany to a wider population.

Maybe in contrast to many colleagues I do not see medicinal plants as particularly interesting. Much of the global traditional pharmacopoeia has already been documented, and in fact most papers reporting on medicinal plants are highly repetitive (including mine). I do not believe that traditional knowledge of plants will provide us with lots of compounds to treat lots of important diseases. This was an interesting idea in the 1980s, but since then synthetic drug discovery has won the game. Sure, one can argue that natural compounds have contributed many base structures for allopathic medicine, and that there are "lots of compounds in the pipeline," as has been reiterated over and over, especially by colleagues who happen to be heavily invested in the companies trying to develop and market such new drugs. However, fact is that over the last decades very little has come out of the botanical drug discovery pipeline, and even less has contributed to improve the livelihoods of the traditional knowledge holders, while at the same time causing increasingly polemic and hostile discussions in our discipline. Plants are much more important as sources for the supplement and food ingredient industry.

Ethnobotany has become a more quantitative science in the last decades, and the use of dozens of different indices, most derived from ecological studies, has become fashionable. On the pone hand this has helped to portrait ethnobotany as a "hard" science, on the other it has allowed to visualize ethnobotanical results better. The huge problem of all indices is however that they do not account for the number of participants actually contributing plant information, and often mix the knowledge of laypeople and expert informants. We have widely shown that especially the use of a single index is completely superfluous, because it only gives a very small part of the true plant use picture and says nothing whatsoever about the real importance of species, and how even the training of the interviewing scientists can lead to a perception off knowledge loss (Bussmann, Paniagua-Zambrana *et al.* 2018a). The use of multiple indices in this context is necessary to get at least better information about the possible over-exploitation of species, but even in such cases this makes only sense if we also have information about ecology, distribution, population dynamics, regeneration, and threat status of the species in question, and consider which plant part is actually used, and how this might affect the survival of harvested species. But again, none of our indices really takes the number of interviewed participants into account, for which reason all of them are actually not statistically sound. This holds especially true for the use of indices to elucidate species that "might be interesting for drug discovery." No index whatsoever does really provide such data, and no index actually differentiates between "knowledge of use," and the "actual use" of a species, which is a huge shortfall. And finally, most ethnobotanical studies, especially in biodiverse areas, have way too few interview participants (Zenderland *et al.* 2019).

Also, I believe that we as ethnobotanists should engage in activism and application of what we do. I have co-founded various NGOs in this field, because I think it is our responsibility as scientists to apply our knowledge. To me there should be no boundary between academic ethnobotany and its application (Bussmann 2002c).

## What does it mean to do 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. 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.

The ratification of the Nagoya Protocol constitutes a great impetus for the fulfilment 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 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 (Bussmann & Paniagua-Zambrana 2021).

Especially under the Nagoya Protocol we should let the research topics "chose us," in the sense that it should ideally be the local and indigenous communities we work with that should give the incentives to study aspects of their traditional knowledge that they deem important. Although we always have been on the forefront of equal participation, especially during the last 10 years, I have tried to incorporate all these changes even more in the research I have developed. Starting with the inclusion of local counterparts as researchers 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) 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). 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).

The Chácobo Ethnobotany Project team, Alto Ivon, Beni, Bolivia, September 2013 (Photo Rainer W Bussmann & Narel Y. Paniagua-Zambrana).

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 the "Chácobo Ethnobotany Project" we trained local counterparts to collect all the information, both by conducting interviews and collecting all backup material, including plant vouchers, and photographic 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, Bussmann et al., 2014g, 2016, 2017a,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, and of course the results must be repatriated - given back - to the original knowledge holders in a way they regard as appropriate. Throughout my career I have always tried to achieve this (Bussmann & Paniagua-Zambrana 2011, 2014a, Paniagua-Zambrana, Bussmann *et al.* 2011, 2012a,b,c, 2014a,b,c,d,e,f, 2017, 2018, Rakotoarivelo *et al.* 2013, Randrianarivony *et al.* 2016b, Ur Rahman *et al.* 2019b, Vega *et al.* 2014, ბუსმან *et al.* 2020a,b,c,d,e,f,g,h,i,j,k, 2021, 2022). 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 projects. Editors and reviewers of scientific journals that receive manuscripts related to ethnobiological research must consider compliance with the guidelines mentioned in the Nagoya Protocol as an important requirement.

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 (Photo Rainer W Bussmann & Narel Y. Paniagua-Zambrana).

Giving back! Return of research results to the Llacuash community of Lamas Wayco in form of their self-authored books. Amazonas, Peru, August 2012 (Photo Rainer W Bussmann & Narel Y. Paniagua-Zambrana).

Interview, Rio Tahuayo, Peru, 2012 (Photo Narel Y. Paniagua-Zambrana)

## Who were the most influential people for your career?

At school, one of my teachers who encouraged me to engage in botanical collection to document the local flora, and all the other "pastime" botanists I worked with, and who also encouraged me to publish very early on, and to start teaching at the local adult college. This was particularly important, because it was the first time that as a boy

suffering from Asperger's Syndrome I met people who really seemed to understand me and understood why I was so much interested in plants.

At university of course, Dr. Klaus Drumm, who was a specialist on algae, but at the same time an incredible ethnobotanist who actually "practiced" ethnobotany at home. Also, my professors who encouraged me to "study broad", and especially Prof. Dr. Erwin Beck, my thesis advisor, who always was there to support "his African students," while giving us as much liberty as we wanted.

From an ethnobotanical perspective, colleagues who inspire me most are people who show that you can do fantastic research and excellent publications without falling into the "auto-promotion" trap, like Ina Vandebroek, Andrea Pieroni, Renata Söukand, or Lukasz Luczaj, all of whom I also regard as friends. And especially all the people I have worked with in the field, and who have taught me all I know about plant use, and with whom I have shared countless meals and beverages. And in this sense, one of my grandfathers, who taught me that we are all created equal, no matter where we come from, what we believe and practice, what ethnicity we have, and how wealthy we are.

And, of course, my wife and soulmate Narel Paniagua, who is an excellent botanist and ethnobotanist in her own right. We are simply a fabulous research team!

Rainer W Bussmann and Narel. Y. Paniagua-Zambrana in Kuelap, Amazonas, Peru, 2013 (Photo Carlos Vega).

Rainer W Bussmann and Narel. Y. Paniagua-Zambrana in Kuelap, Amazonas, Peru, 2013 (Photo Carlos Vega).

## What were the highlights of your career?

There are a few. The publication of my first "critical" paper on forest destruction and management in Kenya, which in turn led to an interesting "interview" with the Kenyan secret service because it showed that much deforestation was done for the *Cannabis* plantations of one of the president's sons and led long delays in my mail for months.

Another highlight was the establishment of "Estación Cientifica San Francisco" in Ecuador and Nature and Culture International as NGO, and the German Tropical Ecology Program mentioned above.


Estacion Científica San Francisco, Loja-Zamora, Ecuador (Photo Rainer W. Bussmann)

Of course, turning William L. Brown Center at Missouri Botanical Garden from what was largely a bioprospecting program into a research powerhouse focusing on ethnobotany, climate change, ethnopharmacology, botanical discovery, and protection of traditional knowledge, with projects on five continents was another highlight.

Scientifically, one result I most greatly enjoyed was the identification of *Ulluchu*, the last unidentified hallucinogen in Latin America, dating back to the Moche period some 500-800AC (Bussmann & Sharon 2009b).

And finally, of course, the formation of the Department of Ethnobotany here at the Botanical Institute of ilia State University in Tbilisi, which is quickly becoming one the most cited ethnobotany programs in the world, essentially without funding, is especially dear for me, because it shows what you can do with lots of dedication, where other institutions with lots of donor support fail.

## What were the most disappointing times in your career?

When setting up Estación Científica San Francisco we were accused of biopiracy, because we did not want to bribe some corrupt local NGO counterparts and officials. 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.

During the time I was on the Society of Economic Botany council and SEB president, I was also council member of all our other societies (Society of Ethnobiology, International Society of Ethnopharmacology, International Society of Ethnobiology, Economic Botany Section of Botanical Society of America) and tried hard to get the societies to unite, given that man y of us are members in more than one society. That essentially was an utter failure, as everybody was keen to keep doing their own thing. To a large extent this still reflects the split of our main societies that goes back to the 1970s and 1980s. It is my understanding of history that in the mid 1970s some colleagues were discouraged by SEB and joined others starting what became the Society of Ethnobiology. In the 1980s some other colleagues from SEB were discouraged about the lack of international activities, and participation so they joined others including Darrell Posey and started the International Society of Ethnobiology. Sadly, we were never again able to unite the different societies. What riles me is that we seem to have been progressed very little towards the implementation of the Nagoya Protocol especially when it comes to SEB. Granted, SEB was originally largely a society of mostly English-speaking older white men. In the 1990s fortunately this structure started to change, with many (albeit again white and English speaking) women getting involved in SEB. The current governance seems still be dominated by largely white, albeit younger, native English speakers. I am of course part of the white men group, and so part of the problem, although I am definitely not a native English speaker. This does not mean that SEB needs to stay that way. It would actually be rather interesting to analyze who gets cited most within the journal Economic Botany. Likely the journal authors as well as the general membership are much more diverse than say the officers and the council, and it would be nice to see a governance actually reflecting the diversity of the members.

When leading William L. Brown Center, to realize that there was no support whatsoever in the administration to confront issues of racial injustice, both in St. Louis and at a global level (it was the time the Trump travel ban came into force), which was the main reason to leave St. Louis. The political situation in the USA meant that as an immigrant and the son of a family with three generations of refugees, I no longer felt safe and welcome in Missouri and at my institution. Many colleagues, and various local universities, spoke out explicitly against the US government's immigration ban, opposed the denial of climate change, and criticized racism and social inequality in St. Louis. Unfortunately, my own institution remained silent on all of these issues, mainly because funders on the board followed a Republican policy line. This also meant that it was becoming increasingly difficult to invite foreign colleagues to the USA and to work in countries that the US government did not approve of.

What I also see very problematic in our science is the disgusting racism that we still see in publishing. As Narel Paniagua-Zambrana put it in a recent interview
"*...as a scientist, is very difficult to understand the resistance of scientific journals to accept our collaborators in the communities as co-authors in the publications generated as products of our participatory research. Many journals that publish articles related to ethnobotany and traditional knowledge, and many reviewers and editors, are of the*

*opinion that all authors in a publication must have some academic training. In some instances, editors and reviewers asked us if our local collaborators knew how to read and write and what their academic degree was, totally unaware that they in fact were the original owners of the knowledge that was included in these publications! As scientists we must learn to value all kinds of knowledge...."*

This is right on! Further, while papers in English-language journals naturally should follow a specific style, it is another example of racism to see how editors and reviewers (who frequently and clearly themselves are not native English speakers) ask that the authors "have their manuscript revised by a native English speaker". This first of all shows profound ignorance, given that colleagues from any country where English is actually one of the de facto and / or de jure national languages might be regarded as native English speakers. This is not to say that they necessarily speak or write English following one of the regularly used international styles, so the manuscripts do have to be adjusted accordingly, but calling them "non-native speakers" is a simple expression of racism. To illustrate this:I am not a native English speaker. When I worked at German institutions I often received the verdict from reviewers that "a native speaker" should revise the manuscript. This entirely ceased when I worked at USA institutions, the reviewers assuming that somebody working in the USA of course was automatically a native English speaker, while e.g., not giving somebody from Pakistan that benefit of doubt. As soon as left the USA and started publishing under a Bolivian or Georgian address, I again received automatically requests that the manuscript needed to be revised by a "native" speaker. This kind of racism in scientific publishing must end (Albuquerque *et al.* 2021).

## What would you say is most important for one's career?

My most important experience during my career was definitely never being put off by locked doors and restrictions, e.g., for participation in courses and internships. If there is an interesting event, it is always worth trying to get in! I did my whole-semester practicum required for my major while I was still an undergraduate, started working as a course assistant in the 4th semester and had the necessary courses for my major and my three minor subjects behind me after the 6th semester. One shouldn't let oneself be put off by locked professorial doors. If one does not try, it is already a "no" - so why not taking a chance? It might actually work!

To me the most important personal "trait" is respect for others, to always remember that we are all equal. As scientists, and of course individuals, we are not any better / more important / more intelligent or whatever than our local counterparts, just because you are we have a university education. Without the participation and knowledge of our local participants and colleagues, none of our research would ever get done, and none of our papers written. It is important involving local participants in all aspects of research, from design, to fieldwork, to publication, and to not forget to give the knowledge you documented back to the communities in a format they want and can use (Bussmann 2019a,b).

It is also important realizing being a researcher is by no means more "interesting" than other occupations, e.g., being a farmer! Essentially it involves lots of days doing exactly the same - writing another paper, revising a paper rejected by a journal, reviewing papers.....To me being a scientist is not a job, it is a lifestyle, and in this sense, much like for a farmer, there are no weekends, holidays, vacation or whatsoever. It is important to follow one's passion! I will never just do a project because there is money out there - or stick with a job because it is well paid or because it has prestige if it violates my ethics!

I always find it very annoying when colleagues decline to review papers because they are on vacation, busy, need to write a thesis, another paper, or whatever, completely ignorant of the fact that some other colleague (who is also busy) will have to act a reviewer for their papers. Similarly, I do find the "Impact Factor" craze one of the most detrimental factors in ethnobotanical publishing. There are several reasons. First of all, a high IF does not necessarily indicate the quality of a journal and all papers in it. The IF is calculated based on the number of citations of ALL papers in a journal divided by the number of papers. This means that e.g., in a journal with 100 papers one paper could be cited 1000 times, and the others never - and the journal would still have an IF of 10. This is an extreme example, but it serves to illustrate that it is nonsense to try publishing in a journal that has little relation to our discipline and might not even be accessible to most colleagues in poorer countries, and even less to the research participants who own the knowledge included in the paper. Second, in my opinion it is utterly irresponsible to push especially students to submitting papers to very high IF journals, well knowing that the papers are likely rejected. This unnecessarily delays publication and the completion of degrees. Third, publishing in high IF journals do not guarantee any benefit for the original knowledge holders, on the contrary, it might actually reduce the real impact of a publication A very widely circulated electronic book might in fact have much more impact than a high IF paper

behind a paywall. Fourth, while publishing in international journals, and in English, which still remains the most widely read scientific language, is important, there is absolutely nothing bad in publishing in a local journal, and it is also good to publish in local language. What is important is that a journal is peer-reviewed and adheres to strict scientific standards, and that publications are as widely available as possible.

Finally, never let people tell you that you are not qualified to do something because of who you are or what condition you have. I for example have Asperger's Syndrome. I do not like to be surrounded by many people, and I hate small-talk, parties, and similar social activities, even more so when they involve academics that have little education in say geography, history (if I were not an ethnobotanist, I would have become a historian), world religions etc. etc. I have no understanding whatsoever for the idea that being a student should circulate around parties, dating, and university athletics. For me being a student was a privilege and meant to study and work. One might think having Asperger's would be detrimental for a career that involves lots of people interaction and endless hours of interviews. Turns out the contrary is true - I can completely concentrate on interview participants and tune out any distractions. It also helps to write and publish, and to be a reasonably good editor - although we with Asperger's are known to be somewhat legasthenic. Like many people with Asperger's, I certainly do not show a lot of empathy, and am very outspoken, which does not always go well especially in settings where one is expected to be "politically correct" to the extreme.

## What do you see as the most important mission of ethnobotany for the future?

In my opinion the future of ethnobotany, lies in applied research, especially in the food sector. This research needs of course to be fully participatory at all levels. Ethnobotanical studies need better designs involving the local participants in the process. And we need better taxonomic training for ethnobotanists. Too many students - as well as more advanced researchers - have almost no clue how to collect a good voucher, and how to identify it. This needs to change. This is why I think the most important "ethnobotanical" book to read is a good treatment of general botany - like Strasburger's Textbook in Botany. There is no ethnobotany without a serious understanding of botany and plant ecology as a science.

Ethnobotany is a science of people and plants, and it involves face to face contact. The current pandemic has made this even clearer. Training local interviewers is the best way to collect lots of good data, while at the same time protecting vulnerable communities. The current Covid-19 pandemic also has shown the future importance of much closer cooperation with local counterparts on the one hand (Franco & Bussmann 2020, Pieroni *et al.* 2020), and ethnobotany as an important science to assess and verify health claims based on "traditional" medicine (Fan *et al.* 2020, Hussain *et al.* 2020, Maldonado *et al.* 2020, Unnikrishnan *et al.* 2015). As such ethnobotanic al science needs solid, standardized methods, again closely involving local counterparts, which is something we have tried to show with colleagues in a variety of studies (Leonti *et al.* 2018, Paniagua-Zambrana, Bussmann *et al.* 2018a,b, Reyes-García *et al.* 2021a,b, Vandebroek *et al.* 2011).

Data studies, i.e., lists of useful species, especially medicinal plants, are still one of the most common outputs of Ethnobotanical research. While not particularly interesting, they provide data for meta-analysis, and thus have their place. However, good ethnobotanical studies need to take history, culture, ecology etc. of the study area into account to, together with the local participants, be able to analyze the data from a broader perspective.

## Any downtime?

What is downtime? I always loved collecting plants (also lichens, bryophytes, fungi...) and I love cooking. So, my "downtime" is simply doing what I always do - working with plants, but somewhat outside an academic context.

I also like gardening / farming. At our Bolivian country house, we had a garden with over 300 species, and supplied local restaurants with fruits, vegetables, and flowers. Managing a garden makes one very humble I think, because it helps understanding how difficult the life of many of our research participants actually is - there is a huge difference to grow plants because you like to do it, versus to farm as a means for your livelihood!

Like many ethnobotanists, I love to cook and to eat, and I do like making wine. This of course makes perfect sense to me - if you are working with people and plants, it all comes together at the kitchen table.

I do not care about sports. While I recognize the benefits, practicing some kind of sport or going to the gym always felt very boring to me. I prefer long walks with my dogs, which also allows me to think. However, what most people do not know is that I have been doing quite a bit of mountain climbing, and at some point, lots of Yoga and Krav Maga.

Climbing Cotopaxi (5895m), Ecuador, 1997 (Photo Rainer W Bussmann)

And of course, I love dogs - you will almost never find me anywhere without at least an "adopted" dog.

Rainer W Bussmann and Narel Y. Paniagua-Zambrana with Ravi and Leo, St. Louis, 2013 (Photo Rainer W. Bussmann)

## Any favorite plants?

My favorite plant is *Nigritella nigra*, a tiny blackish alpine orchid, with a wonderful chocolate-vanilla smell (and no apparent use).

*Nigritella nigra,* Boveç, Slovenia, 1988 (Photo Rainer W Bussmann).

And a second plant has been a botanical "gift" that I had the privilege to make to my wife, Narel Paniagua-Zambrana. *Blakea nareliana* (Melastomataceae) is a small tree, endemic to the cloud forest area in the Huallaga area in the Andes of northern Peru, collected in the place where we carried out our first field expedition together in 2010.

*Blakea* nareliana (Melastomataceae) collected in the cloud forest zone in the Huallaga River region in the Andes of northern Peru, 2010. (Photo RW Bussmann).

As "useful" plant maybe mountain-ash (*Sorbus caucasigena*) with its beautiful reddish-orange fruits, which make for great jam and tasty spirits. But bring me any interesting species and I will be happy, and describing new species is always a great pleasure (Bussmann 2013a, Bussmann *et al.* 2010, Bussmann & Paniagua-Zambrana 2012b, Bussmann, Paniagua-Zambrana *et al.* 2013a,b, Busmann, Tellez *et al.* 2013, Cotton *et al.* 2019, Romero *et al.* 2017).

## Declarations

**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.
**Availability of data and materials:** N/A
**Competing interests:** N/A
**Funding:** N/A

*Sorbus caucasigena,* Tusheti, Georgia, 2016 (Photo Rainer W Bussmann)

## Acknowledgements

We thank all our indigenous and local colleagues for their support and collaboration for more than two decades, in thousands of interviews, and collecting tens of thousands of herbarium samples. Without them and them, this work would never have been possible.

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Never lose your smile :-) (Photo Narel Y. Paniagua-Zambrana)