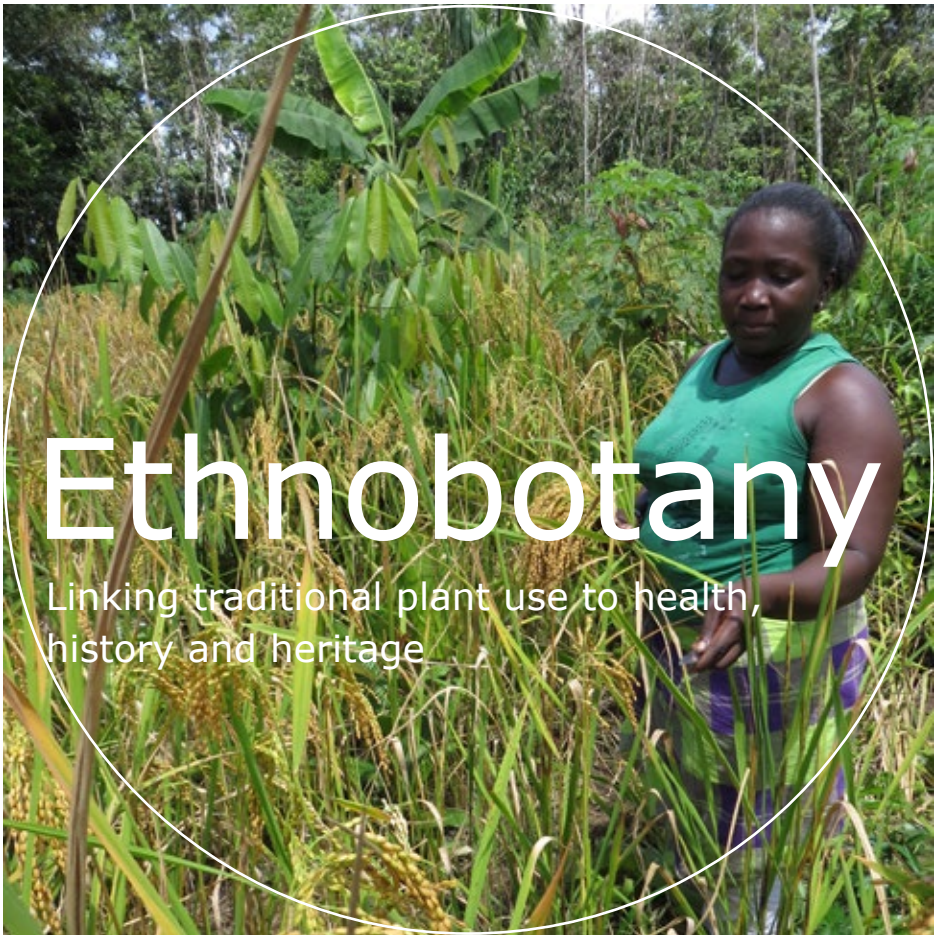

Ethnobotany

Linking traditional plant use to health, history and heritage

Prof.dr Tinde van Andel

Inaugural lecture upon taking up the position of Special professor of Ethnobotany at Wageningen University on 21 April 2016

WAGENINGEN UNIVERSITY
WAGENINGEN UR

Ethnobotany

Linking traditional plant use to health, history and heritage

Prof.dr. Tinde van Andel

Inaugural lecture upon taking up the position of Special professor of Ethnobotany at Wageningen University on 21 April 2016

WAGENINGEN UNIVERSITY
WAGENINGEN UR

ISBN 978-94-6257-374-1

Ethnobotany

Linking traditional plant use to health, history and heritage

1 Introduction

Esteemed Rector Magnificus, colleagues, family and friends, ladies and gentlemen

In the field of Ethnobotany, traditional plant use can be linked to human health, history, and heritage, both genetic heredity and cultural heritage. During this inaugural lecture, I will discuss several definitions of the science of Ethnobotany, list the current research themes in this field and provide details for those themes that were relevant for my research in the past decade. I will continue by highlighting the research questions I would like to answer in the coming five years in this Naturalis chair of Ethnobotany at the Biosystematics group at Wageningen University. Finally, I will explain what I would I like to teach to future ethnobotanists, because in June 2016 the first academic course in Ethnobotany is given at a Dutch University.

What is Ethnobotany?

The first definition of Ethnobotany was given in 1896 by the American botanist John William Harshberger (1896) as "the study of plant use by primitive and aboriginal people". This archaic definition has long ago been replaced by a better one, provided by Nancy Turner (1995): "Ethnobotany is the science of people's interactions with plants…. over time and space… including uses, knowledge, beliefs, management, classification systems of both modern and traditional societies".

The term "Ethnobotany" may be a relatively recent invention, but the study of useful plants is probably the oldest science in the world, as plants are not only essential elements of all ecosystems, but also fundamental to the functioning of all human societies. Soon after people learned to write, they started to document plant uses.

Kahun Gynaecological Papyrus, found in El-Lahun (Egypt) and dated to circa 1800 BCE, is the oldest known medical text in human history. This papyrus fragment

contains 35 separate paragraphs relating to women's health (Quirke, 2002). It describes gynaecological diseases, fertility, pregnancy, and contraception and lists several recipes with medicinal plants, such as carob fruits (*Ceratonia siliqua*).

The Egyptians have left us many more detailed descriptions of traditional plant use in their sculpture and murals on agriculture and gardening. An example is the comprehensive description of the preparation of wine, vividly painted on the walls of the 18th dynasty Theban tomb-chapel of Nakht. From grapevine and collecting the grapes, squeezing out the juice by trampling barefoot in basins of grapes, pressing the grape seed oil to drinking the end product, is depicted on these murals. Starting with the plant (grapevine) and the plant part (fruits), continuing with the preparation methods (pressing their juice), and ending with the application (drinking the wine), these murals follow the standard methods for documenting plant uses still used by ethnobotanists worldwide (Martin, 2010).

Current research themes in Ethnobotany

The major research themes in Ethnobotany at this moment can be summarized into six research questions:

1 What plants do people use?

This is the basic question for every ethnobotanical inventory, which can be answered by documenting the plant species that are used by local communities for food, medicine, shelter, equipment, ritual, and other purposes. It is essential to make herbarium specimens when collecting data on local plant names and uses, as this allows for the proper scientific identification of each plant. Ethnobotanists need to have good botanical skills, as traditional people often use a wide variety of plant species. Botanical identification starts with recognizing the family of the plant, after which genus and species can be determined by using the floristic literature of the particular geographical location. Ethnobotanists therefore are often botanical generalists, in contrast to taxonomists, who are specialists on a genus or a family. While taxonomists often limit their research to fertile herbarium collections with sufficient morphological features, ethnobotanists often need to identify sterile plants showed to them in the field, tightly squeezed or dried herb bundles, or plant fragments with few morphological characters (seeds, shredded leaves) sold on markets.

2 How do medicinal plants work?

This fundamental question underlies the scientific field of Ethnopharmacology, which investigates the pharmacological and toxicological activities of any herbal preparation used by humans that has – in the very broadest sense – some beneficial

or toxic or other direct pharmacological effects (Heinrich and Jäger, 2015). Thousands of scientists are active such in Natural Products research worldwide.

3 Is wild plant extraction sustainable?

Billions of people in this world use wild-harvested plants on a daily basis. To guarantee that this valuable resource remains available for future generations, it is of utmost importance that these plants are harvested in a sustainable way. This subfield of Ethnobotany focuses on the extraction of 'non-timber forest products' (all plants that can be harvested from natural ecosystems and man-made vegetation except commercial timber).

4 How did people domesticate plants?

In this scientific domain, Ethnobotany has much in common with the study of Agriculture. Throughout their history, humans have always collected plants from the wild, but to be considered domesticated, a population of plants must have their behaviour, life cycle, and/or appearance significantly altered as a result of being under human control for multiple generations. In modern agriculture, plant breeders have selected a limited number of plants for their fast growth, high yields and uniform appearance. As a result, the modern commercial crop cultivars have a narrow genetic diversity. The limited genetic diversity in crop species contributing to the world's food supplies has been considered a potential threat to food security (Khoury et al., 2014).

In contrast to modern agriculture, Ethnobotany mostly focuses on traditional communities that are still domesticating wild plants and practise traditional agriculture. Small farmers in developing countries often work with self-developed landraces, heirloom varieties that were selected for their taste, medicinal properties, pest resistance, or adaptation to poor soils and low-input agriculture. These landraces are often genetically unstable, have slow growth rates, low yields, and produce non-uniform products. Traditional agriculture is therefore unsuitable for cash crop farming, but by planting many different landraces in one field, small farmers maintain a high genetic diversity, which helps them to guarantee food security for themselves and their families.

5 How do people categorize plants?

All human societies have felt the need to create order in the chaos of biodiversity surrounding them. Folk taxonomy is the way people traditionally describe and organize their natural surroundings, using vernacular names and categories that are embedded in their own cultural and social systems (Raven et al., 1971). Ethnobotanists communicate about plants with their informants using vernacular

names. Folk taxonomy differs from scientific taxonomy in the fact that one vernacular name can include various taxa and one taxon can have several vernacular names. Understanding folk taxonomy is an essential part of the fieldwork of ethnobotanists (Berlin et al., 1966; Martin, 2010). There are striking similarities in the geographic arrangement of biological and linguistic diversity, the latter serving as a proxy for cultural diversity (Gorenflo et al., 2012). Biocultural diversity (the combination of botanical and linguistic diversity) is concentrated in the wet tropical areas of Africa, South East Asia, New Guinea and to a lesser extent the Amazon and Mexico (Stepp et al., 2004). Whether linguistic diversity is an evolutionary result of biological diversity, as humans need many words to keep all these species apart, remains a subject of further studies.

6 What happens when people migrate?

Generally, ethnobotanists argue that field studies on plant use should be carried out among traditional people who have inhabited a certain region for a prolonged period, as they are considered as the most knowledgeable on their surrounding environment. In reality, however, humans have migrated since the very beginning of their existence, and have adapted themselves fairly well to new environments. This process is still very relevant today.

In developed countries, migrants from tropical areas (often former colonies) are the main consumers of medicinal plants in crude form (Pieroni and Vandebroek, 2007). Muniz de Medeiros et al. (2012) distinguished two strategies of plant use by migrants: (1) adaptation of the new flora of the host country and (2) acquisition of the original plants from the home country. The choice for one of the two types of strategy for a given migrant population will highly depend on the level of floristic similarity between home and host country, the degree of contact with local populations in the host country, the contacts between migrants and their homeland, and the possibility to acquire plants from their homeland. Migrant Ethnobotany investigates what plant knowledge and uses are maintained, what is lost, what changes and what is new. Migrant ethnobotany becomes visible in the daily news, when we see pictures of Sudanese refugees collecting firewood near the Jungle of Calais (Bucciarelli, 2016). Although the trees in the French dunes are entirely different species than those that provided them with fuel in Sudan, these refugees will quickly learn which French trees are suitable for cooking and which ones are worthless firewood. The Sudanese are adapting themselves to the new flora of the host country, substituting Sudanese firewood species with French ones.

The other end of the spectrum- acquisition of original plants from the home country- we see in the so-called 'Gardens of Hope', small gardens that appear in Syrian

refugee camps in the near east (Elgot, 2014). When people migrate against their will, unable to bring their possessions, seeds from the homeland become cherished goods. As Naji (33), a Syrian refugee in the Za'atari camp in Jordan explains: "After six months of being here, I made the garden so that we can start building just a bit of hope and happiness. I'm not very happy. But when I see a garden with amazing greenery and flowers, one just automatically smiles and becomes happy".

2 More than just lists of useful plants

Ethnobotanists have been criticized for conducting descriptive science, producing long lists of plants without further quantitative analysis or scientific interpretation of their findings (de Albuquerque and Hanazaki, 2009). Documenting plant uses, however, can also serve as a basis for innovative research questions and testing hypotheses. In the past then years, my research team has performed quantitative surveys on medicinal plants sold on markets in Suriname (van Andel et al., 2007), Ghana (Andel van et al., 2012), Benin (Quiroz et al., 2014), Gabon (Towns et al., 2014a) and Tanzania (Posthouwer, 2015). Results of such market surveys do not only give an overview of a country's most important medicinal plants- those species sold most frequently or in greatest volume-, they also show the ailments that are locally prevalent, perceived as important or preferably treated with herbal medicine. As plants used for women's health, rituals, childcare and ingredients for aphrodisiac mixtures (van Andel et al., 2012a) were the major use categories on herbal markets in both Africa and the Caribbean, we focused our research on these specific health issues.

PhD student Alexandra Towns graduated in 2014 at Leiden University with her thesis 'Fertility and Fontanels: Women's knowledge of medicinal plants for reproductive health and childcare in western Africa' (Towns, 2014). One of her hypotheses was that medicinal plant use reflected the major reproductive health problems as listed by the World Health Organization: high blood pressure during pregnancy, post-partum hemorrhage and infections. Although the 87 women she interviewed in Benin and Gabon were knowledgeable on plants to treat the top causes of maternal morbidity, they knew and used more plants for conditions such as anemia, infertility, breast milk production, regulating menstruation and to ease birth. Informants' perceptions of the main causes of maternal suffering included malaria, infertility, menstruation and pregnancy concerns, which differed substantially from the viewpoint of the WHO (Towns et al., 2014b). Some ailments have cultural priorities, and some of these culture-bound illnesses are treated with plants because biomedical providers do not recognize them. Another remarkable finding of Towns' research was the consumption of many different 'pregnancy foods': local, wild or semi-cultivated African plants that were either eaten fresh in soup but also dried,

stored and consumed during pregnancy or general food shortage (Towns and van Andel, 2016; Towns, 2013). Long overlooked by scientists and development organizations, local African vegetables are now capturing attention for their nutritional and environmental benefits, low price, availability and better adaptation to low-input agriculture (Cernansky, 2015).

Ritual plants are a major commercial category on herbal markets, and form the main drivers behind the medicinal plant trade in Suriname and Benin (Quiroz et al., 2014; van Andel et al., 2007). PhD student Diana Quiroz graduated in 2015 at Wageningen University with her thesis 'Do not fear the supernatural! The relevance of ritual plant use for traditional culture, nature conservation, and human health in western Africa' (Quiroz, 2015). After conducting 102 interviews with ritual plant vendors, traditional healers and adepts of local African religions, Quiroz discovered that magic plants often serve as a tool to transfer oral history and local ecological knowledge (Quiroz and Van Andel, 2015). Magic plants often act as symbols of ancestral plant use, plants that were of importance to people's predecessors, or ancestors of important crop plants of the present, as in the case of crop wild relatives. Wild yams (*Dioscorea* spp.) and wild calabashes (*Lagenaria breviflora*) have spiritual value as the 'ancestors' of cultivated yams (e.g., *Dioscorea cayenensis*), a West African staple food and the bottle gourd (*Lagenaria siceraria*), domesticated into various shapes and sizes and used during cultural festivities throughout the continent. Local people recognize, albeit in a symbolical, religious way, the importance of crop wild relatives. Recently, plant breeders and agronomists have called for global conservation priorities for crop wild relatives, as these 'wild cousins' of domesticated crops possess the genetic diversity that is essential for developing more productive, nutritious and resilient crop varieties (Castañeda-Álvarez et al., 2016). Fetish markets and sacred gardens are the places where such crop wild relatives can be found, and where their uses and properties can be documented among those who carefully transplant them from their wild environment to their gardens.

3 How can wild plants be managed sustainable?

To find out whether the harvesting of wild plants by a certain group of people can be considered a destructive activity that leads to diminishing resources or does not harm natural plant populations, the first step is to find out what plant species people actually extract from the wild. Such an inventory should be done by collecting botanical vouchers and identifying these in a herbarium, in order to obtain an accurate list of species. During this inventory, researchers should accompany plant harvesters to the exact locations where they collect their wares, as the sustainability of the harvest strongly depends on the vegetation type where this takes place. The focus should be on slow-growing species that do not survive harvesting and occur in

small quantities only in forests or other vulnerable natural vegetation types (van Andel and Havinga, 2008). This is typically a small percentage of all plants that people use. We recently carried out such a rapid sustainability inventory on the Dutch Caribbean island of St. Eustatius (Posthouwer et al., submitted), where only 3% of the plants people harvested were potentially at risk of overharvesting. *Nectandra coriacea*, a Lauraceae tree that is endemic to a few Caribbean islands, grew only in the moist forest on the upper rim of the volcano crater in the Quill National Park. Saplings were completely pulled from the ground and their chipped roots ('kakanga root') was an essential ingredient of an aphrodisiac drink of the type of home-produced 'bitters' popular among young males in the Caribbean (van Andel et al., 2012a). Further studies should be done on this species to quantify its abundance and measure the effect of root collection on population size.

When collection areas are unknown, remote or inaccessible due to safety concerns, time or budgets constraints, species distribution modeling can be combined with market survey data to predict which species run the risk of being overharvested. We produced the first detailed distribution maps for 12 commercially extracted medicinal plants in West Africa by combing market surveys in Ghana and Benin with herbarium collection localities and data on climate, soil and forest cover (van Andel et al., 2015). Our models pointed out that the medicinal species *Sphenocentrum jollyanum, Okoubaka aubrevillei*, and *Piper guineense* were at greatest risk of being overharvested, as they had narrow distributions, a great commercial value, and occurred in threatened forests close to urban markets or near a highway connected to a large city. These rapid sustainability inventories offer useful tools to conservation organizations as they point out which species should be monitored, why and where.

4 Plant Use after Migration

The changes in people's plant knowledge and use after long distance migration was the subject of my ALW-Vidi research project Plant use from the Motherland: Linking Afro-Caribbean and West-African Ethnobotany (2010-2015). Almost 12 million enslaved Africans were transported against their will to the Americas from the 17th to the early 19th century. Dutch slave traders shipped some 300,000 Africans to Suriname, mainly from the regions of present-day Benin, Ghana, and southern Gabon to Angola (Eltis and Richardson, 2010). After the abolishment of slavery in 1863, new waves of immigrants entered Suriname: East Indian and Javanese wage labourers contracted to work on the country's extensive plantations.

With its high botanical diversity, its multi-cultural society and its turbulent colonial history, Suriname is an interesting country for ethnobotanical research. Medicinal and ritual plants are popular, and useful species possess a myriad of local names and

uses. Maroons, descendants of escaped slave that fled from the coastal plantations in the 17th and 18th century and established tribal settlements in Suriname's dense rainforests, have preserved much of their traditional African culture and plant knowledge. In order to survive in a rainforest full of plants they did not know, Maroons had to learn a new flora rapidly to adapt to this hostile environment. Today, they are recognized as specialists in herbal medicine and traditional religion, although they only have lived in the New World for less than 350 years. The key to their successful establishment in the Amazon forests lies in their extensive knowledge of African plants and their search for useful species in their new environment, and their communication of the results of their trial and error (van Andel, 2014). The fact that enslaved Africans immediately started categorizing the Suriname flora is reflected in the vernacular plant names in Afro-Surinamese languages, which in many cases can be linked to local names used for botanically related taxa in Africa today. Over 40% of all Maroon plant names contain African elements (van Andel et al., 2014). The overall conclusion of this research is that migrants with a good knowledge of plants and their uses, and those who stay close to them, have a better chance of survival in an unknown environment.

5 Tracing back a ritual crop to its African origin

In the previous paragraphs, I have showed that Ethnobotany is a multidisciplinary science, with a solid base in Botany. Ethnobotany uses theories and methods from Ecology, Social Sciences, and Humanities and tackles problems that can be applied in Agriculture, Nature Conservation, Nutrition and Health. To bridge the gaps between these scientific fields, ethnobotanists need to cooperate with researchers from these disciplines. In the following paragraph, I will show an example of how a multi-disciplinary team of historians, ethnobotanists, biosystematicists, agronomists and bioinformaticists is able to tackle a complex research question.

In 2006, during a market survey of medicinal and ritual plants in Suriname (van Andel et al., 2007), I bought a small bag of rice grains at the Vreedzaam market in Paramaribo. The unmilled seeds had dark brown husks and long awns. They were not meant for consumption, but rather used in ancestor offerings, funeral meals and ritual baths. The grains were only grown by Maroon farmers in the interior. When milling these seeds in a mortar, I discovered they had dark red bran and broke easily. It was Bela Teeken, PhD student at the Knowledge, Technology and Innovation group at the Social Sciences Dept. of Wageningen University, who discovered that these grains were Black rice (*Oryza glaberrima*), an African rice species domesticated in the inland Niger swamps in Mali some 3500 years ago. This is a distinct species than the well-known Asian rice (*O. sativa*), domesticated in China some 9,000 years ago and introduced in West Africa some 500 years ago by Portuguese sailors (Nuijten

et al., 2009). African rice generally gives lower yields than Asian rice, but it is better adapted to low-input agriculture, drought, poor and acid soils, pests and weeds. When the trans-Atlantic slave trade started, both rice species were grown by African farmers. Slave ship captains bought large quantities of West African food before making their trans-Atlantic journey. Leftover seeds from slave ships were secretly smuggled away by slaves and planted in their provision gardens (Carney, 2012). In these 'Botanical Gardens of the Dispossessed' (Carney and Rosomoff, 2009), equivalents of the 'Gardens of Hope' of the Syrian refugees today, African food crops were cherished as one of the few tangible items that were brought from the Motherland (Andel et al., 2015). When the first botanist collected herbarium vouchers in Suriname around 1687, African crops like okra (*Abelmoschus moschatus*) and sesame (*Sesamum indicum*) were commonly grown in slave gardens around Paramaribo (van Andel et al., 2012b).

According to historian Judith Carney (2009), all rice grown in the New World was African rice, before water-driven rice mills facilitated the replacement by Asian rice. *O. glaberrima* is difficult to mill, and must be dehusked by hand in a wooden mortar and pestle. The only physical evidence to prove Carney's theory, however, was a single sample of *O. glaberrima* collected in a Maroon farm in French Guiana in 1938 (Portères, 1955). To gather additional proof on the presence of African rice in Suriname, I collected herbarium samples of fertile *O. glaberrima* specimens in Mundjekreek, lower Suriname River (van Andel, 2010) and Jawjaw, Upper Suriname River (van Andel et al., 2015). One sample of black rice germinated at the Amsterdam Hortus Botanicus. With the establishment of the Naturalis chair in Ethnobotany at Biosystematics at Wageningen, I finally had the opportunity to find out whether the black rice from Suriname really was ancestor rice. By comparing the genome of the Surinamese *O. glaberrima* sample to 109 samples of the same species collected throughout West Africa for a study on drought and salinity tolerance carried out at New York University (Meyer et al., in press), we were able to pinpoint landraces in Ivory Coast, Sierra Leone, Liberia and Guinea that were strikingly similar to the Surinamese sample (Andel et al., under review). These rice types were cultivated by Mande-speaking peoples, who were captured as slaves and transported to Suriname, as is evidenced by Mande words appearing in Afro-Surinamese plant names (van Andel et al., 2014). Slave captain logbooks provide additional evidence of the purchase of both rice and slaves along the Upper Guinean Coast (Zeeland Archives, 2013). Landraces from West Africa's wettest regions were probably better adapted to Suriname's rainforest climate and did not change much after arrival in the New World. Our results show that studying ritual plant use from a multidisciplinary perspective can reveal people's unwritten history and allows us to trace the movement of plants and people in the past.

6 Plans for the future

In the coming years, I hope to trace back the migration history of the many other landraces of Maroon rice (mostly *O. sativa*) with a multidisciplinary team of rice historians, ethnobotanists, biosystematicists and bioinformaticists. We expect that Maroon rice fields reflect the turbulent, multicultural history of Suriname, with landraces of African origin as well as commercial cultivars and landraces exchanged with Asian wage laborers who migrated to Suriname after the abolishment of slavery, bringing along their own crops.

The Naturalis herbarium, with almost six million specimens, harbors many species of ancient crop cultivars and their wild relatives. These collections offer interesting opportunities for collaborative research with Wageningen scientists specialized in plant breeding and crop wild relatives. The recently submitted LAZARUS proposal aims to extract DNA from herbarium vouchers of rare hop (*Humulus lupulus*) cultivars and unravel their specific terpene pathways that are responsible for adding specific flavors during the process of beer brewing.

In June 2016, the course Ethnobotany is offered at Wageningen University (BIS-90306), developed during the first year of the Naturalis chair at Biosystematics. Students will be introduced to important concepts and theories in Ethnobotany, such as culture-bound illnesses, Doctrine of the Signatures and non-timber forest products. Other learning goals are recognizing specific plant use patters, applying both qualitative and quantitative research methods, designing interviews and documenting traditional plant uses. Towards the end of the course, students will carry out their own small research project at one of the largest migrant markets in the Netherlands (the Beverwijk Bazar).

The ultimate goal is to link the Leiden courses Plant Families of the Tropics (during which students learn to recognize the most important tropical plant families), Economic Botany (which focuses on useful tropical plants and their products) and the Wageningen course Ethnobotany into a new BSc minor *Plants and People*. This will make it easier for students from different backgrounds to specialize in Ethnobotany. This new chair in Ethnobotany at Biosystematics, which serves as a bridge between Naturalis and Wageningen University, will enable multidisciplinary research on crop landraces and their wild relatives and breed a new generation of young ethnobotanists in the Netherlands.

Acknowledgements

As a young MSc student, I was sent to the Colombian Amazon to make a vegetation description of swamp forests along the Río Caquetá. Without the local Muinane Indians, who helped me to collect specimens of every plant in my plots and taught me their local names and uses, I would never have been able to carry out this research. Although Ethnobotany was not part of this internship, I realized that the only way to understand these mega-diverse forests was by working with the people that lived there. I am grateful to Prof. Antoine Cleef for sending me out there. Although it wasn't the safest place for a 22-year old, blond Dutch girl, this journey has changed my life forever.

At the Utrecht University branch of the National Herbarium of the Netherlands, I was given the opportunity to do my PhD research on useful plants of Carib, Arawak and Warao Indians of northwest Guyana. It was my promotor Prof. Paul Maas who made me a botanist by convincing me that collecting and correctly identifying plant specimens is the basis of all plant sciences. His adequate management of the Neotropical herbarium and his inspiring way of teaching have served as a reference throughout my academic career. I am grateful to all people in Guyana, Suriname and West and Central Africa who shared their plant knowledge with me during my PhD research and subsequent postdoc projects at Utrecht and Leiden University. Thanks to NWO, I have been able to set up a research group in Ethnobotany in the Netherlands. My PhD students Maria Paula Balcazar, Diana Quiroz, Alexandra Towns, Sarina Veldman and Charlotte van 't Klooster have carried out much of the research presented here, as well as over 20 students from the Universities of Leiden, Utrecht, Amsterdam and Wageningen.

As an ethnobotanist in the field, you often need to consult old people, as they are the last ones who know certain plant names and uses. Back in the Netherlands, my research team also heavily relied on retired botanists, as they were often the last ones who could identify our difficult plant specimens. I am grateful for Prof. Pieter Baas for his endless efforts to keep and maintain the Dutch botanical knowledge together in the National Herbarium of the Netherlands. Thanks to Naturalis, the six million plants specimens of our National herbarium were safeguarded after the Dutch Universities, one after another, closed down their Tropical Botany departments. This chair was made possible by Naturalis director Edwin van Huis and Prof. Eric Schranz, head of Biosystematics at Wageningen UR. Finally I am grateful to my partner Chris, my sons Daan and Michiel, and my parents for their never ending support.

Ik heb gezegd.

References

Berlin, B., Breedlove, D.E., Raven, P.H., 1966. Folk Taxonomies and Biological Classification. *Science* 154, 273–275.

Carney, J.A., 2012. Seeds of Memory: Botanical Legacies of the African Diaspora, in: Voeks, R.A., Rashford, J. (Eds.), African Ethnobotany in the Americas. Springer, New York, pp. 13–33.

Carney, J.A., 2009. Black rice: the African origins of rice cultivation in the Americas. Harvard University Press, Boston.

Carney, J.A., Rosomoff, R.N., 2009. In the Shadow of Slavery: Africa's Botanical Legacy in the Atlantic World. University of California Press, Berkeley, CA.

Castañeda-Álvarez, N.P. et al., 2016. Global conservation priorities for crop wild relatives. *Nature Plants* 2, 16022.

Cernansky, R., 2015. The rise of Africa's super vegetables. Nature 522, 146–148.

De Albuquerque, U.P., Hanazaki, N., 2009. Five problems in current ethnobotanical research-and some suggestions for strengthening them. *Human Ecology* 37, 653–661.

Elgot, J., 2014. The Secret Gardens Of Syria's Refugee Camps. Huffington Post. http://www.huffingtonpost.co.uk/2014/10/29/secret-gardens-of-syrias-refugee-camps_n_6068550.html

Eltis, D., Richardson, D., 2010. Atlas of the Transatlantic Slave Trade. Yale University Press, New Haven, CT.

Gorenflo, L.J. et al. 2012. Co-occurrence of linguistic and biological diversity in biodiversity hotspots and high biodiversity wilderness areas. *Proc. Natl. Acad. Sci.* 109, 8032–8037.

Harshberger, J.W., 1896. The purposes of ethno-botany. *Botanical Gazette* 1, 146–154.

Heinrich, M., Jäger, A.K., 2015. Ethnopharmacology: a reader. John Wiley & Sons, Ltd, Chichester, UK.

Khoury, C.K. et al. 2014. Increasing homogeneity in global food supplies and the implications for food security. *Proc. Natl. Acad. Sci.* 111, 4001–4006.

Martin, G.J., 2010. Ethnobotany: a methods manual. Routledge, London.

Meyer, R.S. et al., in review. Domestication history and geographic adaptation inferred from a SNP map of African rice. *Nature Genetics*.

Muniz de Medeiros, P. et al., 2012. The Use of Medicinal Plants by Migrant People: Adaptation, Maintenance, and Replacement. *Evidence-Based Complement. Altern. Med.* Article ID, 1–11.

Pieroni, A., Vandebroek, I., 2007. Travelling cultures and Plants, The Ethnobiology and Ethnopharmacy of Human Migrations, Berghahn Books, New York.

Portères, R., 1955. Présence ancienne d'une variété cultivée *d'Oryza glaberrima* St. en Guyane Française. *J. Agric. Trop. Bot. Appl.* 2, 680.

Posthouwer, C. et al. (submitted) Sustainability of Wild Plant Extraction on the Dutch Caribbean Island St. Eustatius. Economic Botany.

Posthouwer, C., 2015. Medicinal Plants of Kariakoo Market, Dar es Salaam, Tanzania. MSc thesis, Leiden Unversity.

Quirke, S., 2002. The "Kahun Medical Papyrus" or "Gynaecological Papyrus" [WWW Document]. Univ. Coll. London. URL http://www.ucl.ac.uk/museums-static/digitalegypt/med/birthpapyrus.html

Quiroz, D. et al. 2014. Quantifying the domestic market in herbal medicine in Benin, West Africa. *J. Ethnopharmacol.* 151, 1100–1108.

Quiroz, D., Van Andel, T.R., 2015. Evidence of a link between taboos and sacrifices and resource scarcity of ritual plants. *J. Ethnobiol. Ethnomed.* 11, 5.

Quiroz, D.K., 2015. Do not fear the supernatural!: the relevance of ritual plant use for traditional culture, nature conservation, and human health in western Africa. PhD thesis, Wageningen University.

Stepp, J.R. et al. 2004. Development of a GIS for global biocultural diversity. *Policy Matters* 13, 267–270.

Towns, A.M., 2014. Fertility and Fontanels: Women's knowledge of medicinal plants for reproductive health and chilcare in western Africa. PhD thesis, Leiden University.

Towns, A.M., 2013. Cultivated, caught, and collected: Defining culturally appropriate foods in Tallé, Niger. *Development in Practice* 23, 169–183.

Towns, A.M. et al. 2014a. Volume, value and floristic diversity of Gabon◎s medicinal plant markets. *J. Ethnopharmacol.* 155, 1184–1193.

Towns, A.M., van Andel, T., 2016. Wild plants, pregnancy, and the food-medicine continuum in the southern regions of Ghana and Benin. *J. Ethnopharmacol.* 179, 375-382.

Towns, A.M. et al. 2014b. Comparing local perspectives on women's health with statistics on maternal mortality: an ethnobotanical study in Bénin and Gabon. BMC *Complement. Altern. Med.* 14, 113.

Turner, N., 1995. Ethnobotany today in northwestern North America, in: Schultes, R.E., Von Reis, S. (Eds.), Ethnobotany: Evolution of a Discipline. Dioscorides Press, Portland, pp. 264–283.

Van Andel, T.R., et al. in review. Ancestor Rice of Suriname Maroons traced back to its African origin. *Nature Plants*.

Van Andel, T.R. et al. 2012. Ghana's herbal market. *J. Ethnopharmacol.* 140, 368– 378.

Van Andel, T.R. et al. 2015. The `Botanical Gardens of the Dispossessed' revisited: richness and significance of Old World crops grown by Suriname Maroons. *Genet. Resour. Crop Evol.* 1–16.

Van Andel, T.R. 2014. The reinvention of household medicine by enslaved Africans in Suriname. Soc. Hist. Med. doi: 10.1093/shm/hkv014
Van Andel, T.R., 2010. African Rice (*Oryza glaberrima* Steud.): Lost Crop of the Enslaved Africans Discovered in Suriname. Econ. Bot. 64, 1–10.
Van Andel, T.R., et al. 2007. The medicinal plant trade in Suriname. *Ethnobot. Res. Appl.* 5, 351–372.
Van Andel, T.R., et al. 2015. Prioritizing West African medicinal plants for conservation and sustainable extraction studies based on market surveys and species distribution models. *Biol. Conserv.* 181, 173–181.
Van Andel, T.R. et al., 2012a. In search of the perfect aphrodisiac: Parallel use of bitter tonics in West Africa and the Caribbean. *J. Ethnopharmacol.* 143, 840–850.
Van Andel, T.R. et al. 2014. Local plant names reveal that enslaved Africans recognized substantial parts of the New World flora. *Proc. Natl. Acad. Sci* 111, E5346–E5353.
Van Andel, T.R. et al. 2012b. The forgotten Hermann Herbarium: A 17th century collection of useful plants from Suriname. Taxon 61, 1296–1304.
Zeeland Archives, 2013. MCC Slave Voyage the Unity 1761-1763 http://eenigheid.slavenhandelmcc.nl

Prof.dr Tinde van Andel

'The trans-Atlantic slave trade was a movement of people and plants. Hundreds of African crops and weeds were shipped to the Caribbean. Many of these species are still crucial to the survival of Afro-Caribbean people as food, medicine or ritual. Where exactly did these plants and the associated traditional knowledge come from? Innovative combinations of ethnobotany and genomics can help us to understand the largely unwritten migration history of plants, people, plant knowledge and plant use.'

ISBN 978-94-6257-374-1