Music Department

Royal Holloway University of London

Musical Bamboos: Flute Making, Natural Resources, and Sustainability in the Bolivian Andes

Sebastian Hachmeyer

Thesis submitted for the Degree of Doctor of Philosophy

2020

Declaration of Authorship

I, Sebastian Hachmeyer, thereby declare that this thesis and the work presented in it is entirely my own. Where I have consulted the work of others, this is always clearly stated.

Sebastian Hachmeyer

23rd November 2020

MUSICAL BAMBOOS

Flute Making, Natural Resources, and Sustainability in the Bolivian Andes

Front Picture:

Mounded *kjirki tuquru* Bamboos in Baja Minas

(Photography: S. Hachmeyer)

To my father

Norbert Hachmeyer († 2020)

… and the *maestros*

Luriri Andrés Mamani Quispe († 2020)

Amawt'a Carlos Yujra Mamani († 2019)

What a wonderful plant the bamboo.

Floyd Alonzo McClure

Abstract

In the Bolivian Andes, urban-dwelling highland flute makers from the specialised Aymara flute-making community of Walata Grande craft a variety of flutes from native woody bamboos collected in their natural habitats in tropical forests of the eastern Andean slopes. Over recent decades, sustainability issues surrounding their use and sourcing have come to the fore. The two main concerns mentioned by Walateño makers are: that bamboo habitats are being destroyed as the deforestation of the tropical forests accelerates, and that recognised bamboo collection sites are being overexploited. Understanding these issues calls for an interdisciplinary mixed methods research approach that involves studying both the flute making culture/economy and the ecology of musical bamboos. While the deforestation of tropical forests is a consequence of non-musical economic activities such as agriculture and cattle rearing, the overexploitation of collection sites is the result of shifting modes of highland flute making and bamboo sourcing. Highland flute making has always been dependent on bamboo species diversity and maturation/life cycles. However, as makers have become reliant on intermediaries, valuable sourcing knowledge is being lost, further challenging the viability of musical bamboos. Beyond the environmental degradation and destruction of bamboo habitats, a closer analysis reveals that shifting social and economic relations and knowledge transmission are also central to the sustainability of flute making and bamboo sourcing in the Bolivian Andes.

Keywords: Flute Making, Natural Resources, Sustainability, Bolivian Andes, Walata Grande

List of Contents

List of Figures and Tables

<u>FIGURES</u>:

TABLES:

List of Acronyms and Abbreviations

ABT – Autoridad de Fiscalización y Control Social de Bosques y Tierras (Authority of Inspection and Social Control of Forests and Lands)

ACTO – Amazon Cooperation Treaty Organisation

ADEPCOCA – Asociación de Productores de Coca de los Yungas de La Paz (Association of Coca Producers of the Yungas of La Paz)

ARBOLESEM – Asociación Artesanal Boliviana Señor de Mayo (Bolivian Craft Association Señor de Mayo)

CAIT – Climate Analysis Indicator Tool

CI – Conservation International

CSUTCB – Confederación Sindical Única de Trabajadores Campesinos de Bolivia (Single Confederate Union of Rural Workers of Bolivia)

DGGDF – Dirección General de Gestión y Desarrollo Forestal (General Direction of Forest Management and Development)

FAO – Food and Agriculture Organisation of the United Nations

GHG – Greenhouse Gas

GPS – Geographic Positioning System

LPB – National Herbarium of La Paz

LUCF – Land-Use Change and Forestry

MAS – Movimiento al Socialismo (Movement towards Socialism)

MMAyA – Ministerio de Medio Ambiente y Agua (Ministry of Environment and Water)

MNR – Movimiento Nacionalista Revolucionario (Nationalist Revolucionary Movement)

MUSEF – Museo de Etnografía y Folklore La Paz (Museum of Ethnography and Folklore La Paz)

NGO – Non-Governmental Organisation

POFOMA – Policía Forestal y de Preservación de Medio Ambiente (Forests and Environmental Preservation Police)

PVC – Polyvinyl Chloride

SERNAP – Servicio Nacional de Áreas Protegidas (National Service of Protected Areas)

SIMB – Sistema de Información y Monitoreo de Bosques (System of Forest Information and Monitoring)

TCO – Tierra Comunitaria de Origen (Communitarian Land of Origin)

UNESCO – United Nations Educational, Scientific, and Cultural Organisation

UNDP – United Nations Development Programme

UNODC – United Nations Office on Drugs and Crime

Acknowledgements

Undertaking PhD research is not a solitary journey. This thesis is based on the knowledge of highland flute makers and musical bamboo traders and collectors, who I wish to acknowledge here. I express my gratitude to all highland flute makers from Walata Grande, who freely and voluntarily formed part of this research and shared the sincerest belief that a viable and sustainable future for highland flute making and musical bamboo sourcing is possible. I wish to thank all musical bamboo traders and collectors, who answered my questions, hosted me and my wife in their homes, and dedicated their valuable time to showing me musical bamboos in the tropical forests. Not only my PhD research, but also our lives, depended on their guidance and local environmental knowledge.

I wish to express my deepest gratitude to my beloved wife Jesika Meliza Paredes Ayala, without whose guidance, support, and unconditional love this PhD project would have never been possible. Furthermore, I wish to thank my families in Germany and Bolivia for sharing happy but also sometimes difficult moments in life. I am also grateful for having shared musical and spiritual encounters with friends at *Casa Ajayu* in La Paz, and all the other musical groups in the Bolivian Andes, of which I could be part during the last six years of my life in Bolivia.

I give special thanks to my supervisors at Royal Holloway University of London, Dr. Henry Stobart (Music Department) and Prof. Jayalaxshmi Mistry (Geography Department), whose excellent interdisciplinary supervision and inspiring comments on previous versions of the chapters helped refine arguments. I would like to particularly express my gratitude to Dr. Henry

Stobart, who supported the development of this PhD project at the initial proposal stage, helped me consolidate it at Royal Holloway University of London, and arranged the excellent co-supervision with Prof. Jayalaxshmi Mistry in the Geography Department. I also wish to thank Royal Holloway University of London for the financial support of this PhD project (Collage Studentship, Irene Marshall Scholarship, Paul Broome Development Research Prize, and Royal Holloway Travel Award). I wish to further thank Prof. Dr. Julio Mendívil, who supported this PhD project at Goethe University Frankfurt in the academic year (2016/17) prior to the official launch of my doctorate studies at Royal Holloway University of London. In this context, I take the opportunity to thank the Hans Böckler Foundation in Germany, which granted a doctorate scholarship for my time at Goethe University Frankfurt. Furthermore, I wish to thank Prof. Dr. Raimund Vogels at the Hanover Academy of Music, Drama, and Media for helping me to set foot in the German academic ecosystem of ethnomusicology.

Special thanks also go to the director of the National Herbarium in La Paz, Dr. Carla Maldonado, for allowing me to use the digital specimen data base, and to the General Direction of Forest Management and Development in the Bolivian Department of Environment and Water, for granting me access to official deforestation data of the Information and Forest Monitoring System. I also wish to thank Ximena Londoño (El Paraíso del Bambú) and Dr. Christopher Tyrrell (Milwaukee Public Museum) for revising my musical bamboo samples, and Dr. Jonathan Alderman (University of St. Andrews) for proofreading this thesis.

For comments, suggestions, reflections, and further support, I wish to thank: Stephan Beck (Herbario Nacional de La Paz), Alfredo Fuentes

(Herbario Nacional de La Paz), Edgar Mayta (Herbario Nacional de La Paz), Moises Mendoza (Herbario del Oriente/Museo Noel Kempff Mercado), Magaly Mercado (Herbario Forestal Martín Cárdenas), Julia Gutiérrez (Herbario del Sur de Bolivia), Efrain Tinta (Fundación Tierra), Daniel Larrea (Asociación de Conservación de Ecosistemas Amazónicos Andinos ACEAA), Carlos de Ugarte (Asociación de Conservación de Ecosistemas Amazónicos Andinos), Gabriela Villanueva (Asociación de Conservación de Ecosistemas Amazónicos Andinos), Kazuya Naoki (Centro de Análisis Espacial UMSA), Juan Carlos Ledezma (Conservación Internacional), Richard Mújica (Pachakamani), Leonel Cerruto (Kawsay), Arnaud Gérard (SoundLab Universidad Autónoma Tomás Frías), Alejandro Barrientos (Universidad Mayor de San Andrés), Bernardo Rozo-López (Universidad Mayor de San Andrés), Michelle Bigenho (Colgate University), Nico Tassi (University College London), Nepomuk Riva (Hanover Academy of Music, Drama, and Media), Michael Fuhr (Center for World Music Hildesheim), Andrea Nicklisch (Römer-Pelizaeus Museum Hildesheim), Birgit Abels (University of Göttingen), Raymond Aung (Royal Holloway University of London), Mark Crompton (Royal Holloway University of London), España Villegas (Instituto Exclusivo La Paz) and my *yatichiri* Mabel, Harol, and Brígida, and finally all the public servants in Bolivian ministries (anonymised in this thesis), who collaborated on this research.

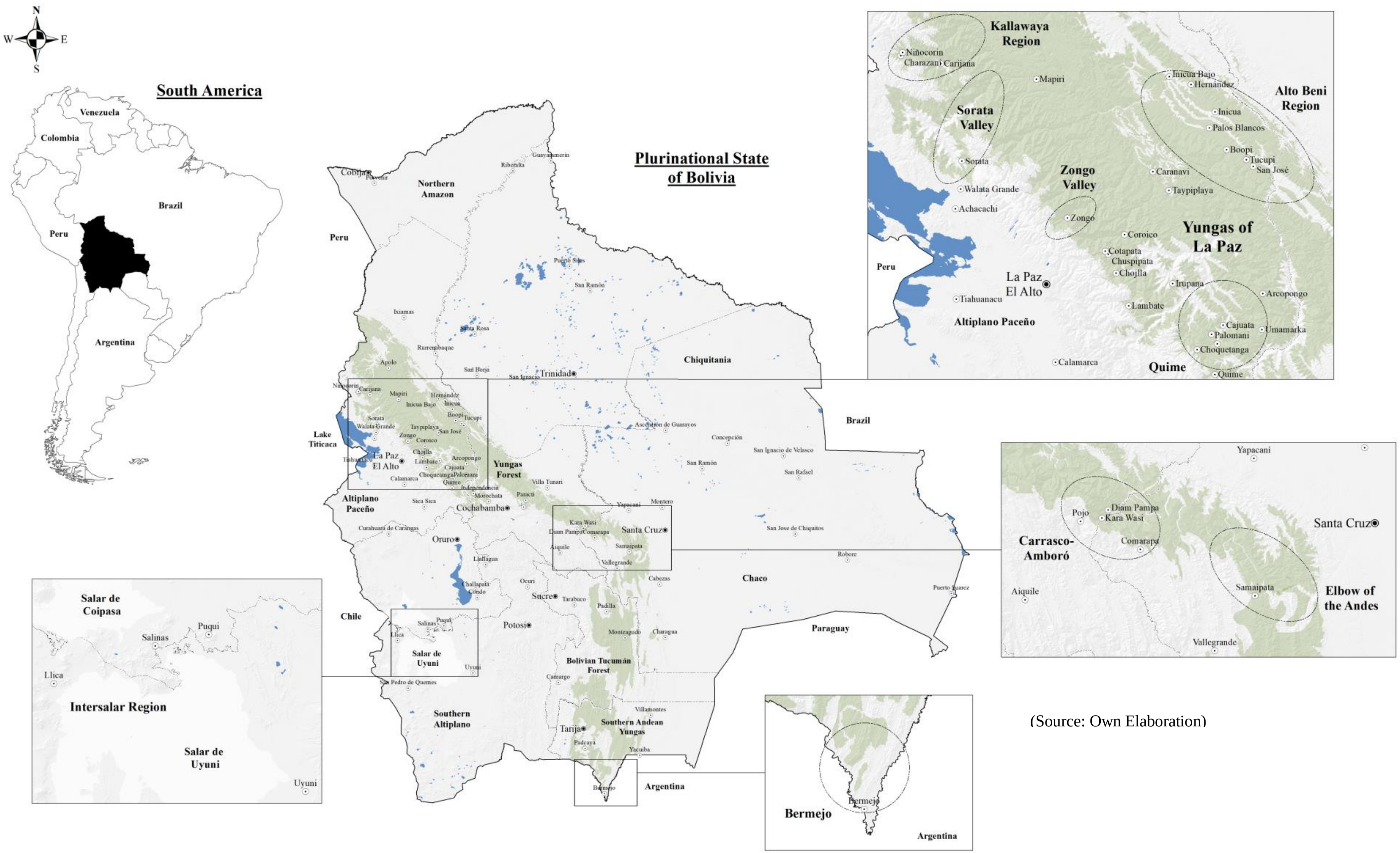
Last but not least, I wish to thank all the tutelar spirits in the Bolivian Andes who guided my life and hopefully will do so in the future.

Prologue

One day in *lupilapak pacha* ('season of the burning sun') 2017, my wife Jesika and I decided to leave La Paz city to do a hike on the pre-Columbian Inka trail to the community of Takesi in the *yungas* of La Paz department. This was the first time I literally got in touch with the natural habitat of musical bamboos, the mountain cloud forests of the *yungas*. I was overwhelmed by its beauty. Standing on the edge of a mountain abyss, surrounded by dense clouds hanging over the treetops of the cloud forest, I felt like a wanderer above the tropical Andean sea of fog. From above, I gazed on the crowns of the densely vegetated *yungas* forest, one of the most biodiverse places on Earth. I did not feel like the master over a landscape, but only as a tiny part of the cosmos. I felt immensely small, a profoundly spiritual moment. And despite the naturalness of this part of the *yungas*, there is environmental change elsewhere, which sounds far too euphemistic for what is really going on, that is deforestation, human-made destruction, and accelerating biodiversity loss in a globally recognised biodiversity hotspot. It is home of the musical bamboos, a natural haven of wildlife and earthly shelter, *laq'a tiji*.

Sebastian Hachmeyer
Juyphi Pacha 2020

Map of Research Context



(Source: Own Elaboration)

MUSICAL BAMBOOS

Chapter 1

Introduction

Musical Bamboos

In a nutshell, this thesis is about musical bamboos. Inspired by Allen's (2012) ecomusicological article about the musical trees (placing emphasis on woods used in musical instrument making), the term vividly articulates and encapsulates the idea of tropical native woody bamboos being used in highland flute making in the Bolivian Andes. In the light of growing ecomusicological scholarship about the use of natural resources in musical instrument making, in this thesis I explore how tropical native woody bamboos are used among specialised, urban-dwelling flute makers from the Aymara[1] village of Walata Grande on the highlands around the city of La Paz (officially *Nuestra Señora de La Paz*). I analyse the factors contributing to material scarcities in urban flute-making workshops and the current state of unsustainability in flute making and bamboo sourcing.

Drawing on an analytical framework of sustainability, this thesis explores through an interdisciplinary mixed methods approach three interrelated aspects: how social, economic, and cultural dynamics in highland flute making and bamboo sourcing impact negatively on the viability of musical bamboo populations in recognised sourcing regions; how deforestation of

[1] Ethnic group in the Andes and Altiplano regions of Bolivia, Peru, and Chile. Also, the name of the same-named Indigenous language spoken on the highlands.

tropical forests in the *yungas*[2] and the Andean-Amazonian foothills destroys native bamboo habitats and determines musical bamboo sourcing in a broader environmental sense; and how bamboo growth cycles and flowering periods ecologically frame material availability cycles in urban flute-making workshops in a more general way. I argue that finding a simple solution to the multi-layered and complex sustainability problem outlined in this thesis is hardly possible due to, among others, the diversity of employed musical bamboo species with different ecological niches and ranges, the myriad of involved actors with often divergent interests and perceptions of the problem, the economic benefits of material scarcities and the general precariousness of flute making, the overall economic orientation of the majority of flute makers towards growth-oriented tourist commerce, and the limits imposed by the ecology of musical bamboos itself.

As a starting point, the next section introduces an ethnographic encounter, out of which the topic of this thesis has emerged in the field. I move on to describe the research rationale and some scientific lacunas to which the thesis responds and introduce ecomusicology as a growing field of interdisciplinary inquiry. In the subsequent sections, I introduce the musical bamboos of the Andes, Walata Grande and flute making on the La Paz highlands, and some central theoretical concepts at the conceptual core of this thesis. I conclude this chapter by describing in detail the organisation and chapters of this thesis and how each chapter links to the analytical framework of sustainability drawing together the different aspects of my interdisciplinary mixed methods research.

---

[2] Andean Ecoregion. Denominates the subtropical valleys of the eastern Andean slopes. Derives from the Aymara word *yunka* meaning 'warm or temperate earth/land'.

Emergence of the Topic

I remember well my first encounter with an urban-dwelling, specialised Aymara highland Indigenous flute maker from Walata Grande in La Paz city. This was back in February 2015, and I was working for a Cochabamba-based NGO on alternative Indigenous education programmes, conducting the last bits of fieldwork among the Northern Bolivian Quechua-speaking Kallawaya for my master's dissertation in Human Ecology (Hachmeyer, 2015; see also published articles 2017a, 2017b, 2018a, 2019a). Parts of this research dealt with the local *qantu* panpipe-making tradition in the Kallawaya region.[3]

Every community with a *qantu* panpipe ensemble used to have one or more local panpipe makers, known as *phukuna khuchuq* ('wind instrument cutter'). These local panpipe makers were an integral part of each ensemble and often guided musical performance. They only made new consorts of panpipes if really necessary, while often only replacing broken tubes. However, consorts of panpipes had to be renewed frequently because the particularly fragile thin-walled *chhalla* panpipe bamboo used to make such instruments often broke and usually did not last more than a single festive season (Langevin, 1992). Flutes were only crafted for social and musical use in the community and did not have any commercial purpose, unlike the economic aspect of contemporary Walateño flute making in metropolitan La Paz, which will be the subject of this thesis.

[3] The typical *qantu* panpipe style is played in large consorts (so-called *tropas*) of panpipe players using interlocking technique (hocketing) between complementary pairs of panpipes, organised in six registers of parallel fifths and octaves played in monophony (Baumann, 1985).

All materials used by community-based *qantu phukuna khuchuq* in the Kallawaya region had local origins. Native *chhalla* bamboos were collected in their natural habitats in the mountain cloud forests of the Kallawaya *yungas* and the yarn for tying the *qantu* raft panpipes was locally produced wool from domestic livestock, such as sheep or alpaca. These local panpipe-making practices generated low *chhalla* bamboo demands while naturally having little impact on the viability of local bamboo populations. Local *qantu* panpipe making was completely governed by the life cycle of one exclusively used and locally sourced *chhalla* panpipe bamboo species growing in its natural habitat in the Kallawaya *yungas* (North of La Paz department).[4] There were many reasons for the exclusive use of this particular *chhalla* bamboo species, including its extremely long internodes and characteristically thin walls. These were said to create a distinctive sound quality which, among *qantu* panpipe makers and blowers, was aesthetically and socially desired and sought.

Apparently, bamboo growth habits changed over time resulting in the production of shorter internodes, which *qantu* panpipe makers adapted to by raising the pitch of their panpipe ensemble tunings, thus requiring shorter internodes, especially regarding lower bass registers (Langevin, 1992). After the growth and lignification (hardening) phase, local panpipe makers in the Kallawaya region collected exclusively mature culms before the *chhalla* bamboos began to decay and rot. They then stored the pre-cut internodes to bridge the next growth and maturation cycle. Thus, musical bamboo

[4] Interestingly, *qantu* panpipe makers and musicians I have talked to often associated the rapid and collective *chhalla* bamboo death in the Kallawaya *yungas* with a recurring disease haunting these bamboos (for similar testimonies, see Langevin, 1992, p. 409).

collection was a meticulous process based on traditional knowledge about the tropical bamboo ecology, the cloud forest environment, and the behaviours of the *chhalla* bamboo tubes during drying and storing.

These local *qantu* panpipe-making practices in the Kallawaya region are almost lost today. Scarcities of locally sourced *chhalla* bamboo for making *qantu* panpipes were triggered by an abandoning of local bamboo-sourcing practices in Kallawaya *yungas* communities (Hachmeyer, 2015). Moreover, panpipe ensembles in the Kallawaya region started to buy their consorts from urban-dwelling Walateño flute makers in the city (Hachmeyer, 2018a). Among other factors, this was the result of the ongoing integration of the distant rural Kallawaya region into the urban economic centres of the *altiplano paceño*.

One of my main fieldwork sites in the Kallawaya region was the rural valley community of Niñocorin, which belongs to *ayllu*[5] Kaata in the municipality of Charazani in the province of Bautista Saavedra. Niñocorin has one of today's most renowned *qantu* ensembles in the Kallawaya region and beyond. I was hosted by a collaborator of the NGO I worked for, a Kallawaya *yachaj* or 'wiseman' called Feliciano Patty, a former *qantu* player in Niñocorin's collective panpipe ensemble, a genius in autochthonous flute music, and an Indigenous intellectual and thinker, who introduced me to one of the last local *qantu* panpipe makers in the region. While chewing coca leaves together, the community-based *qantu* panpipe maker told me that he

[5] Ancient Andean unit of social, political, economic, and spiritual organisation of several Aymara Indigenous communities, typically linked through kinship, ethnicity, territory, and leadership.

had to sporadically buy *chhalla* panpipe bamboo from urban-dwelling Walateño flute makers in order to bridge the local scarcities.

At that moment, I was not aware of what I was going to hear later, when I showed my *qantu* panpipes which I purchased in rural Niñocorin to one of these urban-dwelling Aymara Walateño flute makers in the city of La Paz, 250 km further south on the La Paz highlands. Famous Walateño flute maker Nicasio Quispe has a musical instrument shop in the touristic Linares street in the city centre of La Paz (Figure 1).[6] One day in February 2015, I went into his shop with my *qantu* panpipes from Niñocorin and explained my inquiry to one of his sons. Although his son, who later became a friend of mine, also crafts a variety of flutes nowadays, he could not help me with my specific questions about the *qantu* panpipes from Niñocorin and the origin of the *chhalla* panpipe bamboo. He recommended that I talk to his more experienced father and arranged a meeting.

A week later, I met Nicasio. He glanced at my *qantu* panpipes only for a short while and immediately said: "This *chhalla* comes from Quime."[7] Without the slightest doubt, Nicasio categorised the bamboos in the locally widespread *chhalla* panpipe bamboo typology, in which 'Quime' is one of the main sourcing regions of a specific type of *chhalla* panpipe bamboo (see Chapters Four and Five). Instead of talking about the *qantu* panpipes from Niñocorin, Nicasio preferred to tell me about temporary bamboo shortages and sourcing problems that urban-dwelling flute makers from Walata Grande face. I became more interested in what he told me and asked with an

[6] Names of collaborators and interlocutors are anonymised in this thesis unless they agreed to be acknowledged with their real names (more details in Chapter Three).

[7] "Esa chhalla viene de Quime."

undertone of worry and concern: “What is happening with these bamboos?”[8] He succinctly responded: “They cut them down and burn them as if they were weeds”.[9]

Figure 1: Walata Musical Instrument Shop (Source: Own Photo)

“Walata: The Sound of the Andes” (Linares Street, La Paz City)

I will never forget my overwhelming surprise at that moment. I visited an urban-dwelling Aymara flute maker from Walata Grande in his musical instrument shop in the historical centre of La Paz in order to converse with him about the shortages of local *chhalla* panpipe bamboos for *qantu* panpipe making in the northern Bolivian Kallawaya region, just to hear about even more far-reaching challenges that urban-dwelling Walateño flute makers in La Paz city face concerning their own musical bamboo supply.

I further asked: “Have I got this right? On the one hand, the demand for materials [i.e. musical bamboos for making flutes] has increased?”[10] “Yes.

[8] “¿Qué está pasando con estos bambúes?”

[9] “¡Los cortan y queman como si fueran hierbas malas!”

[10] “¿Lo entendí bien? Por un lado, ¿la demanda para los materiales ha subido?”

Our parents had children, and we needed to earn money, too, and started to make flutes ourselves. We also had new opportunities to sell. For example, we had the craft cooperative and gained new markets. We simply needed more bamboo."[11]

"Which is the other aspect?"[12]

"The other aspect is that people in the *yungas* have multiplied, too. They also had children and grandchildren, who are also in need of a *chaqra* ['farming plot'] in order to plant [crops]. And the bamboos do not mean any money for them. They have no use for them. It's like I said, they consider them as weeds and cut them down and burn them, and instead plant rice, cacao, sugar cane, papaya, banana, and other crops."[13]

This conversation laid the foundation stone for my research. From that moment, I set out to better understand what Nicasio had told me. He basically raised two interrelated issues threatening the viability of musical bamboos: Firstly, deforestation and land-use change, that is the expansion of the agricultural frontier, implying the conversion of natural vegetation and the destruction of tropical forests, where musical bamboos naturally grow in their native habitats; secondly, increasing and shifting bamboo demand among economically expanding and diversifying highland flute makers, which has

[11] "Si. Nuestros padres han tenido hijos, y nosotros teníamos que ganar dinero también, y empezamos a hacer flautas por nuestra cuenta. Hemos también tenido nuevas oportunidades de venta. Por ejemplo, teníamos la cooperativa y ganamos nuevos mercados. Simplemente, necesitábamos más materiales."

[12] "¿Cuál es el otro aspecto?"

[13] "El otro aspecto es que la gente en los yungas también se ha multiplicado. Han tenido hijos y nietos también, quienes necesitan pues también chaqra para sembrar. Y los bambúes no significan dinero para ellos. No los usan. Es como te dije, los miran como hierba mala y los cortan y queman, y en su vez ponen arróz, cacao, caña de azúcar, papaya, plátano y otros productos."

presumably exerted increasing environmental pressure on musical bamboo populations in recognised sourcing regions.

In addition to these environmental and natural resource use-related issues raised by Nicasio, which I heard repeatedly during my fieldwork, some of Nicasio's fellow flute makers, to my surprise, also emphasised the notion that musical bamboo scarcities in urban flute-making workshops are, to a certain degree, quite natural; a claim which goes back to the way bamboo growth and maturation cycles ecologically frame flute making in a more general way.

Research Rationale

Dealing with these important ecological, environmental, and sustainability issues related to woody bamboo use in flute making requires a profound understanding of the flute making culture/economy on the highlands *and* the tropical ecology of native woody bamboos growing further down the Eastern Andean slopes. In order to shed more light onto these issues, my research needed to deal with analytically distinct but empirically interrelated aspects: deforestation-induced bamboo habitat destruction, the overexploitation of bamboo populations, and tropical bamboo ecology.

If one talks to concerned Walateño flute makers like Nicasio, they often remark about accelerating deforestation of tropical forests and the related destruction of native musical bamboo habitats. This is not directly related to the environmental impact of the highland flute making culture/economy itself, but rather the result of land-use changes in the *yungas* and Andean-Amazonian foothills linked to broader environmental concerns about deforestation in the country. The overexploitation of bamboo resources in recognised sourcing regions, however, must be linked to the shifting modes of flute making and bamboo sourcing which have exerted increasing environmental pressures on bamboo populations through engendering unsustainable collection practices. Growth and maturation cycles of musical bamboos, in turn, must be considered as a basic element ecologically framing material availability cycles in flute making within recurring time intervals.

To address these issues, in this thesis I explore ethnographically how the shifting contexts of highland flute making and bamboo sourcing have impacted the viability of native woody bamboo populations in recognised sourcing regions. I analyse the nexus between highland flute making and the environment, which provides materials for it, by looking at how the ecology of native woody bamboos in tropical forests shapes Andean flute making on the highlands of La Paz department. At a general level this involves the detailed study of bamboo growth, maturation, and flowering cycles, and at a more specific one, delving into questions about bamboo demand, bamboo supply, and bamboo sourcing. Furthermore, I employ species distribution modelling and spatial analysis, using a geographic information system (GIS), to explore the broader dynamics of how deforestation and the implied destruction of native woody bamboo habitats in tropical forests has impacted on highland flute making and bamboo sourcing. I analyse the spatial distribution of tropical native woody bamboos vis-à-vis recognised sourcing regions. In light of the deforestation of tropical forests, I set out to model the potential geographic distribution of musical bamboos and to quantify potential habitat destruction due to deforestation.

In the light of the accelerating deforestation of tropical forests and changing economic structures of highland flute making, which have exerted increasing environmental pressures on musical bamboo populations in recognised sourcing regions, questions surrounding the sustainability in flute making and musical bamboo use have come to the fore. This thesis is the result of these trends and aims to fill this gap. However, it is noteworthy that, with my field research among flute makers and bamboo collectors/traders, I did not aim to implement greater sustainability in a kind of transdisciplinary approach, which is common among sustainability scientists (e.g., Brandt et al., 2013; Groß & Stauffacher, 2014; Hirsch Hadron, 2006; Lang et al., 2012; Scholz & Steiner, 2015; Scholz et al., 2006). Rather, I wanted to analyse the driving forces contributing to the current state of unsustainability. I wanted to understand the realities and processes at work, which is arguably a necessary precondition to most kinds of practical interventions (Hale, 2008). However, some of my conclusions in this thesis may potentially help, for others, to develop strategies for implementing means to enhance sustainability in flute making and musical bamboo sourcing in the future, if this is so desired.

Remarks on Interdisciplinarity

For an ethno/ecomusicologist, human ecologist, and environmental geographer interested in musical instrument making, natural resource use, sustainability, and the dependency of a music-culture[14] on the natural environment, the Bolivian Andes is definitely the right place to be. Ethnomusicological studies have shown the intimate relationship between rural highland Indigenous music making, place-identity, and agricultural ecology/production (e.g., Solomon, 1997; Stobart, 2006a). Yet, within these very important ethnomusicological studies, material questions and issues

[14] I use the word music-culture in the sense of Titon (2017). According to Titon (2017, p. 19-31), a music-culture comprises four main components: Ideas about music, activities involving music, repertories of music, and material culture (materiality of music).

surrounding the sourcing and sustainability of natural materials used for making musical instruments, flutes in particular, were conspicuously absent (Mújica, 2014a; Mújica & Villarroel, 2017). This might be related to questions of interdisciplinarity.

More than ten years ago, Bolivian brothers and ethnomusicologists Ramiro and Iván Gutiérrez stated in a short paragraph that “neither can we count upon specific studies about the bamboo life cycle in their distinct varieties, nor about the degree of ecological damage occurring in the areas of production” (Gutiérrez & Gutiérrez, 2009, p. 81 [my translation]). Although various botanical studies about the ecology of native woody bamboos in the Americas exist (e.g., Judziewicz et al., 1999), botanical scientific knowledge about bamboo phenology has been little developed to date (see Chapter Six). However, as I will show in this thesis, flute makers possess a particular ecological knowledge about the life cycles of some tropical woody bamboos, particularly those species framing Andean flute making on the Bolivian highlands. The fact that this ecological knowledge of the gathering of tropical woody bamboos is on the verge of being lost will be thematised in this thesis.

The second part of the statement about the degree of ecological damage occurring in musical bamboo sourcing regions is also very valid for today. This is mainly due to a lack of interdisciplinary research focusing on the interrelation between flute making and the natural environment on which it depends for materials. Existing ethnomusicological or organological studies of Andean flutes are often imprecise and lacking detail in relation to botanical and ecological aspects of the plants used in musical instrument making and performance, just as botanical studies tend to be in relation to particular musical or ethnomusicological knowledge about Andean musical instruments, particularly flutes. Among other consequences, this has contributed to controversial theories about, and scientific explanations of, the seasonal appearance of musical instruments and genres in highland Indigenous flute construction and music making based on a symbolic interpretation of natural resources and their local origins and habitats (see Chapter Three).

Furthermore, earlier ethnomusicological studies have rarely focussed on flute making from an environmental perspective, while botanists/ecologists have tended to approach native woody bamboos from an apolitical and acultural perspective sidestepping any environmental concerns and cultural uses. I wish to bring political and cultural consciousness back centre stage in ecological studies about tropical native woody bamboos, while making musical ethnography more sensitive to musical bamboo-related ecological and environmental issues. This calls for an interdisciplinary mixed-methods approach to studying both the bamboo-based flute-making culture/economy of the highlands and the ecology of native woody bamboos in the tropical forests; and the intersection and multiple connections, and particularly dialectical relationships, between tropical forests and highland flute making workshops. It becomes evident that highland flute making is ecologically embedded in the tropical ecology of musical bamboos, just as some musical bamboo populations in tropical forests are shaped by the material demands of the highland flute-making culture, besides being threatened more broadly by deforestation in the country.

Ecomusicology

Interdisciplinary research is also highly desirable in ecomusicology, where ecologists or biologists make joint efforts with music scholars or ethnomusicologists in order to produce genuine interdisciplinary knowledge in the nexus of music, sound, acoustics, landscape, ecology, and environment (e.g., Boyle & Waterman, 2016; Guyette & Post, 2016; Post & Pijanowski, 2019). In their *Current Directions in Ecomusicology*, Allen and Dawe (2016) offer an excellent overview of the diversity of topics that fall with the remit of ecomusicology. They define ecomusicology as an interdisciplinary "dynamic field" (Allen & Dawe, 2016, p. 1) and an umbrella term for many other (sub)disciplines. Ecomusicology, as such a dynamic field of interdisciplinary inquiry, "considers musical and sonic issues, both textual and performative, related to ecology and the natural environment" (Allen, 2013, para. 1). It is the "study of music, culture, sound, and nature in a period of environmental crisis" (Titon, 2013, p. 9). In a recent interview (Allen & Hachmeyer, Forthcoming), Allen argued for the short-hand definition of ecomusicology as music and environmental studies, the systematic study of human interaction with the environment. Ecomusicology links to ecocriticism or the literary study of texts illustrating environmental concerns and the various ways literature deals with nature (Allen, 2013; Allen & Dawe, 2016). Therefore, it can also be described as the study into the way music illustrates environmental concerns and intersects with nature, landscape, and environment.

However, studies in ecomusicology also localise and trace connections having to do with the materiality of music, for instance energy-thirsty and environmentally damaging musical and sound infrastructures, the ecological and carbon footprint of live music and world tours, environmental implications of music recordings, or finally the animal and plant materials from which musical instruments are made (Allen & Dawe, 2016; Devine, 2015, 2019; Pedelty, 2011). As Perlman (2012) has foreseen, the materiality of musical instruments has indeed added a new crucial item to the ecomusicological agenda. In this regard, this thesis links to burgeoning ecomusicological research (conducted from diverse disciplinary backgrounds) about the materials used in musical instrument making (Allen, 2012, 2019; Bennett, 2016; Curtis 1993; Dawe, 2013, 2016; Dirksen, 2019; Gibson, 2019; Gibson & Warren, 2016, Forthcoming; Greenberg, 2016; Libin, 1994; Martinez-Reyes, 2015; Post, 2011, 2019; Ryan, 2015, 2016; Simonett, 2016; Yano et al., 1997), especially those studies arguing that a viable plant or animal population providing materials with which to make musical instruments is fundamental for the continuation of music-cultures (Ryan, 2016; Simonett, 2016).

For instance, Ryan (2015, 2016) analyses the impacts of climate change, human land use, and natural environmental processes on the eucalyptus-based music-culture in Australia (didgeridoo, gum leaves). Similarly, in her "eco-organological perspective", Simonett (2016) shows how agricultural encroachment and expansion endangers the giant moth, whose cocoons filled with pebbles are used as leg rattles in ceremonies among the Yoreme people in Northern Mexico. The underlying assumption in both studies is that a viable plant or animal population providing materials for musical instrument making is fundamental for the continuation of these music-cultures, as "materials are a fundamental primary resource necessary for cultural production" (Simonett, 2016, p. 3).

Instead of taking this very complex, and, as I argue, dialectical relationship between a music-culture and the natural environment for granted as a normative statement framing empirical research, I aim to profoundly analyse it empirically in the context of urban-dwelling highland flute makers, considering broader economic, social, and cultural factors intervening and mediating in this relationship. Before further developing my analytical framework of sustainability, which draws together the different aspects of my interdisciplinary mixed methods research, I firstly introduce the research context in more detail.

Introducing the Musical Bamboos of the Andes

The main components of a woody bamboo are rhizomes and roots, culms and internodes, branches, leaves, and flowers (McClure, 1966; Judziewicz et al., 1999; Stapleton, 1997). Rhizomes are complete underground stems, which serve to support aerial culms (joint stems), store food reserves, and function in vegetative reproduction. The culm has nodes and internodes, which are species-specific and vary in size and form. From the nodes of the culm, branches extend, which themselves have smaller nodes and branches with leaves and flowers. The parts of the woody bamboo used in highland flute making are the hollow internodes. Walateño flute makers on the La Paz highlands use the nodes as natural closures of the resonator tubes, in most cases becoming the flute's foot joint. The principal musical bamboos widely used in the Bolivian Andes are called *tuquru*[15] (*Aulonemia*) and *(siku)chhalla*[16] (*Rhipidocladum*) in Aymara (Figure 2). These local linguistic

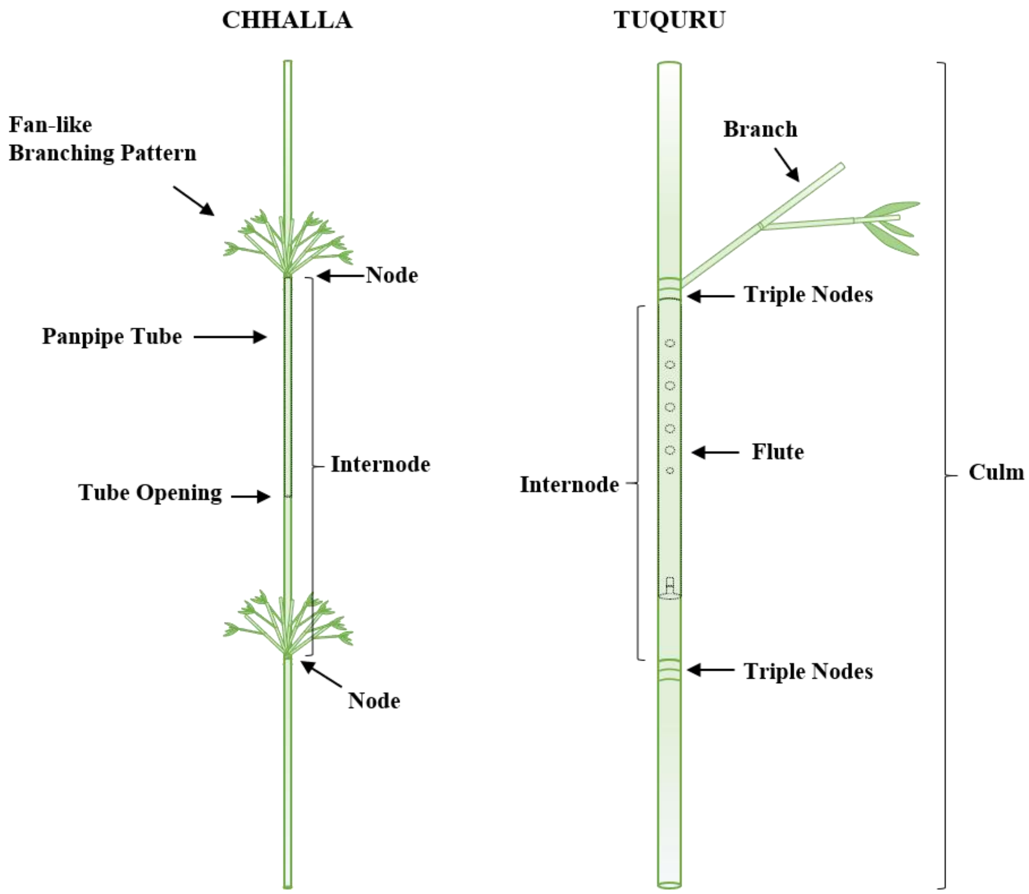
---

[15] The word *tuquru* is also used to designate a mature onion plant, which is an essential part of an All Saints altar (ay. *apxata*). *Tuquru* bamboo internodes are further used by traditional weavers (ay. *sawuri*) as a tool of a traditional vertical loom and its internode water (ay. *tuquru uma*) is used by Aymara herbalists (ay. *qulliri*) to heal lung diseases.

[16] The word *chhalla* is further used to designate the dried canes of maize. In fact, panicoids and bamboos belong to the same family of grasses (see Chapter Five). In order to specify that one is talking about woody bamboos for making panpipes, the Aymara word for panpipe *siku*

categories denote the dried internodes and the plants from which they derive. The former is used to make a variety of vertical and transverse flutes, while the latter is only used for making raft panpipes (see Chapter Three).

Figure 2: Diagram of *Chhalla* and *Tuquru* Bamboo (Source: Own Elaboration)



In addition to *tuquru* and *chhalla*, highland flute makers in the Bolivian Andes also make use of the giant reed (*Arundo donax*) known as *suqusa*/*suq'usa* in Aymara, or *cañahueca* in Spanish, which is, however, taxonomically speaking not a woody bamboo but a cane-like reed. Today, the giant reed is more frequently employed in panpipe making (*jula-jula*, *waucu*, *ayarachi*, *ayarichi*) in the southern highlands around northern Potosí (Quechua) and the Chuquisaca valleys (Yampara), which might be linked to

is often added in front of *chhalla*. Their combination s*iku chhalla* would then mean something like dried cane of panpipes.

abundant reeds in their natural habitats (wetlands) in dry Inter-Andean valleys. Walateño flute makers in the northern highlands only use *suqusa* nowadays for making seasonally played (around *Todos Santos* or 'All Saints') fipple flutes known as *muq'uni* in Aymara, or *alma pinkillu* in Spanish.[17] Because of this low demand, there is an absence of a particular *suqusa* trade for flute making and Walateño makers take advantage of its trade for non-musical purposes.[18] Furthermore, many Walateño flute makers argued that "*suqusa* grows everywhere"[19]. This suggests a general material availability and a potential invasiveness of large-statured grasses like the giant reed, which ecologists have studied in many warm regions in the world including the Americas, Caribbean, Africa, Mediterranean, and Oceania (e.g., Dudley, 2000; Hardion et al., 2014; Lambert et al., 2010). Due to its wide availability and infrequent use by Walateño flute makers, the giant reed or *suqusa* will not be discussed further in this thesis (except briefly in Chapter Three); instead, I will focus on the two principal musical bamboos mentioned above (*chhalla* and *tuquru*).

Walata Grande: Flute Making on the La Paz Highlands

The long history of organological studies in the Andes allows French (ethno)musicologist Gérard Borras (2002) to argue that, throughout its

[17] Before they turned to mahogany, Aymara highland flute makers from Walata Grande also used the giant reed for making *suqus tarqa* duct flutes (Borras, 2010).

[18] Walateño flute makers sourced *suqusa* in former times in the few dry valleys of La Paz department, for example in the provinces of Bautista Saavedra (Charazani), Larecaja (Sorata) and Loayza (Luribay). A particularly high amount arrives in La Paz and El Alto before the feast of the dead in November, since *suqusa* is used for making bread baskets. Moreover, *suqusa* is used by many people in wakes and funerals for making stands for floral bouquets.

[19] "Suqusa crece por todo lado."

history, musical research in the Andes has generally paid more attention to musical instruments than to the music they produce. In the context that concerns us in this thesis, the *altiplano paceño* or the highlands of La Paz department, wind instruments or flutes are of particular importance. The vast majority of contemporary flute types played on the La Paz highlands are made from native woody bamboos (*chhalla* and *tuquru*) growing in their natural habitats in tropical forests further down the eastern slopes of the Andes.

Any research about highland flute making on the *altiplano paceño* must necessarily reference a rural Aymara highland community, which, by the end of the twentieth century, had become one of the most important flute-making centres of the entire Altiplano: *Jach'a Wallata* or Walata Grande. The rural Aymara village lies at the foothills of Mount Illampu (6368m), situated at an altitude of approximately 4100 metres above sea level. Administratively, it forms part of Achacachi municipality in the province of Omasuyos in La Paz department (Bolivia is divided into nine departments). With its proximity to the urban centres of La Paz and El Alto (approximately 100 km away), Walata Grande is strategically situated in the heart of the *altiplano paceño*, close to the eastern shores of Lake Titicaca to the west and the mountain cloud forests of the subtropical *yungas* in Larecaja province to the east. The cultural and economic history of Walata Grande is an exceptional example of how a rural highland Indigenous Aymara peasant community has developed extraordinary skills in crafting a variety of rural Indigenous, or as they are nowadays called in urban spaces, 'autochthonous aerophones' (sp. *aerófonos autóctonos*) made from a variety of native woody bamboos and canes.

As a result of the general urbanisation process on the Bolivian Altiplano, following the land reform of 1953 (see Chapter Three), the majority of these

Walateño flute makers, known as *luriri* (‘the one who make’) in Aymara, are nowadays urban-based and mainly live in metropolitan La Paz (Figure 3). This has led to significant structural adaptations in their flute-making culture and economy (Borras, 1995; Mamani Aruquipa, 2005, 2006). They were able to adapt to ever-changing socioeconomic, political, and musical environments and became specialised manufacturers of Andean flutes having monopolised almost all flute-making activities on the Altiplano during the second half of the twentieth century. They transcended and displaced the local crafting focus of rural Indigenous Aymara communities, whose agricultural ecologically embedded musical performance practices governed highland flute making in former times (see Chapter Three).

Figure 3: The Valley of La Paz (Source: Own Photo)

From the Lookout in Final Kollasuyo Street (Mount Illimani in the Background)

Most Walateño flute makers are nowadays mass producers of Andean flutes as “tourism art and souvenirs” (Hume, 2014). Some have become very important professional flute makers with international clientele and markets. They have successfully accessed new market niches related to different professional and semi-professional popular music-making practices in the

Andes and beyond, which has required the acquisition of knowledge about Western music theory and acoustics. Despite these recent trends, to date several important *luriri* from Walata Grande continue to make rural-style, so called autochthonous flutes, sustaining autochthonous music making in both rural and urban settings on the *altiplano paceño*.

Spheres of Flute Making

Table 1: Spheres of Flute Making (Source: Own Elaboration)

Autochthonous	***Professional***	***Touristic***
		
Autochthonous Flutes	**Professional Flutes**	**Souvenir Flutes**

Walateño flute makers nowadays craft flutes within these different spheres of flute making. Applying a local classification scheme used by Walateño flute makers themselves, one can analytically distinguish between three contemporary spheres of flute making, namely the ‘autochthonous’, the ‘professional’, and the ‘touristic’ (Table 1). This analytical concept, which I develop in relation to economic anthropological ideas of spheres of production-exchange (Barth, 1967; Bohannan & Bohannan, 1968; Lehmann, 1982; Sillitoe, 2006), is a heuristic tool for analysing contemporary Walateño flute-making practices. These spheres are not discrete but rather complexly overlap, and a single Walateño flute maker usually moves within more than one such sphere. Interesting renegotiations regarding musical values and meanings attributed to varying bamboo types occur especially in those liminal spaces where flute-making spheres overlap (see Chapter Four).

However, an analytical separation makes sense when looking at their reproductive capacity and their sociocultural, economic, and technological implications for flute making. I wish to bring together the manufacture and circulation of flutes in one analytical concept, as different spheres imply different flute-making practices (modes) and specific musical and sociocultural backgrounds for their commercialisation. Within these flute-making spheres, which I will described in more detail in Chapter Three, flute makers also have distinct bamboo demands and ways in which bamboos are employed (see Chapter Four).

From Material Culture to Environmental and Sustainability Issues

In the 1990s, Borras (1995) showed how Aymara flute makers from Walata Grande had, over time, copied local manifestations of highland Indigenous flute types onto bamboo-made measuring sticks called *tupu* in Aymara (Figure 4), enabling them to monopolise Indigenous flute production. These *tupu* measuring sticks contained the exact culturally coded information for how to make particular rural-style autochthonous flutes and their local variants, including underlying assumptions about Aymara highland Indigenous sound aesthetics. With this archival system, Aymara flute makers were able to organise and manage the vast musical, sonorous, and organological diversity of rural highland Indigenous flutes on the Aymara Altiplano. These *tupu* were inherited from one generation to another, alongside the secret of how to read them. Thus, practical flute-making knowledge has been combined with the ability to make and read *tupu*. Thanks to this materialisation, Borras (1995) could study, through the decoding of these *tupu*, a great variety of musical expressions from the *altiplano paceño* in a small nucleus of urban-dwelling Walateño flute makers in La Paz city.

Figure 4: *Tupu* Measuring Sticks (Source: Photo by Julio Mamani)

Tupu Measuring Sticks of Julio Mamani (Inherited from his Father Sebastián)

Today, these *tupu* form a huge archive of past musical life on the La Paz highlands. This evidences a process by which the *tupu* was transformed from a material culture as lived and enacted experience into a cultural artefact of museological interest.[20] In line with the "material-cultural turn" in anthropology (Hicks, 2010), and several ethnomusicological and organological works about musical instruments and their intersection with material, social, historical, and cultural worlds (Dawe, 2001, 2005, 2007, 2013; DeVale, 1990; Kartomi, 1990, 2005; Qureshi, 1997, 2000), Borras (2002) has convincingly argued that behind the musical instrument lies a multitude of information that goes beyond strictly sound production. He

[20] Nowadays, many *tupu* can be found in Ernesto Cavour's *Museo de Instrumentos Nativos de Bolivia* in the touristic Jaén street. In the 1990s, the *Museo de Etnografía y Folklore* (MUSEF), in collaboration with Borras, further organised an exhibition about the *tupu* of Walata Grande.

suggests that the theoretical and methodological contributions of those who analyse the material culture of music could be helpful for better understanding the musical instrument itself, the sound aesthetics it produces, and the cultures and societies that use it. Against this background, I adhere to this focus on the material aspects of music as this may add something new to our understanding of the classical musical anthropological question of why different people make music with varying musical or other sound-producing instruments (see Seeger, 1987).

However, the material culture approach presented by Borras (1995, 2002) does not deal with ecological and environmental issues, or the fact that many of the natural materials used to make these musical instruments have been becoming scarce because of environmental change, mismanagement, exploitation, and overuse. These issues were not raised by Borras in the 1990s, and this is where I take up his important organological study on Walata Grande and Andean highland Indigenous flute making, turning the focus on the materiality of culture towards a new environmental culture of materiality and questions surrounding the sustainability in natural resource use.

One very famous example of such a critical situation concerning the use of natural materials used in highland flute making in the Bolivian Andes, beyond musical bamboos, is the case of big-leaf mahogany (*Swietenia macrophylla*), whose precious wood locally known as *mara* is used by highland Aymara Walateño flute makers to make the sonorously rich and heavy wooden recorder-like duct flutes called *tarqa* in Aymara. Although the thesis is about bamboos, I will include a few sentences about mahogany wood here, which will help me to better contextualise the complexities at work within the musical bamboo case. Many *tarq luriri* (‘the ones who make *tarqa*’) told me about contemporary mahogany scarcities and difficulties in finding suitable pieces in the *barracas* or local wood stores in the city. There is no specific mahogany wood trade for *tarqa* making. *Tarq luriri* must therefore compete with the many artisans who require mahogany woods, such as furniture makers. However, they are also often only recyclers, who are able to make their musical instruments with the off-cuts that other wood workers would normally throw away. In fact, the local musicultural demand for mahogany is comparably low. The problem lies elsewhere.

According to Grogan et al. (2010), over-harvesting driven by international consumer demands has led to a significant decline in the big-leaf mahogany population in South America. The authors argue that of the historic range of big-leaf mahogany, which was calculated based on Lamb’s (1966) range map, 33.9% remains in South America. In Bolivia, only 23.4% of mahogany’s historic range remains, equating to a reduction of more than three quarters. As a result of the mahogany scarcity in the urban wood stores in La Paz, prices for *tarqa* fipple flutes have risen significantly over the last two decades. Walateño *tarq luriri* searched for viable wood alternatives to maintain accessible prices for clients with low purchasing power. They turned to cheaper and more accessible woods like cedar (*Cedrela angustifolia*), which has, however, a very piquant taste compared to mahogany’s sweetness. As *tarq phusiri* (‘the ones who blow *tarqa*’) take the whole wooden block into their mouths, they complain about the piquant taste of cheaper woods like cedar but are unable or unwilling to pay for more expensive mahogany flutes.

This is a good example of how broader environmental realities surrounding the availability of natural materials have impacted on local flute construction and music making on the level of human sensory perception and cognition, but also in more material and economic terms. However, mahogany scarcities are not triggered by wood harnessing activities of the local flute making or music culture, its material demands so to speak. Rather, they are caused by international consumer demand for precious woods, which are often illegally logged and exported on commercial fluvial routes on the uncontrolled Bolivian Amazon rivers leading into the neighbouring Brazilian departments of Rondônia and Mato Grosso; and from there into Northern hemispherical halls and living rooms as floor coverings or furniture.

The case of musical bamboos, as I will show throughout this thesis, is much more complex, as flute makers are themselves implicated in unsustainable practices. This requires a thorough analysis of the underlying economic dynamics shaping the sourcing and use of native woody bamboos in highland flute making. Understanding the shifting economic structures of flute making in the context of the tropical ecology of native woody bamboos and the local livelihoods in the many musical bamboo collection regions in tropical forests is key in this regard. Although the accelerating deforestation of tropical forests, implying native bamboo habitat destruction, play a role in threatening the viability of some musical bamboo species, thereby determining sourcing practices to a significant degree, closer analysis reveals that further aspects such as musical bamboo life cycles, shifting musical bamboo demands, and lack of knowledge transmission are pivotal points for understanding the current state of unsustainability.

Limitations of Cultural Safeguarding

Regarding knowledge transmission and the continuation of highland flute-making practices, it is noteworthy that Walateño flute makers have envisioned a cultural safeguarding project whose limitations I wish to discuss in relation to the topic of this thesis. In 2008, the La Paz departmental government declared the community of Walata Grande intangible cultural heritage of La Paz department. Walata Grande's quest for official state recognition for their highland flute-making practices led the community to apply via the Chamber of Deputies for national-level recognition in 2015, at the time when I began my fieldwork on musical bamboos. This application is a valuable source regarding how the otherwise very conflicted and divided community of Walata Grande nevertheless found consensus concerning a joint vision for the future of their flute-making activities. With the decision to apply for national recognition as intangible cultural heritage, Walateño flute makers entered the stage of cultural laws and politics, the Bolivian "heritage fever" (Bigenho & Stobart, Forthcoming). They became subject to central state mechanisms evaluating questions surrounding the cultural safeguarding of highland flute making in Plurinational Bolivia. These viability evaluations undertaken by the Ministry of Culture and Tourism's Department of Cultural Patrimony were based on a national legal framework for protecting and promoting intangible cultural heritage, in which international agreements have been implemented, mainly from UNESCO as the predominant international player of cultural safeguarding on the global stage.

The application, in accordance with relevant Bolivian laws, placed emphasis on concepts related to the vision of intangible cultural heritage, namely intergenerational knowledge transmission and the safeguarding of cultural practices, knowledge, and skills related to the crafting of musical instruments. Nevertheless, its overall emphasis and central arguments instead revolved around flute making as an economic activity. Within this economic spirit, the application often evoked the term *artesanía* ('craft') and basically searched for support related to the marketing and commercialisation of flutes.

In fact, the concept of cultural safeguarding was only partially able to cover flute makers' demands, while aspects of economic promotion and access to new markets rather lie within the responsibility of the Bolivian Ministry of Productive Development and Plural Economy. This conflation of flute making as a cultural and economic activity was not the only critical point within their application. The reproduction of highland flute-making practices, including knowledge and skills, further depends on the continuity of the natural materials, from which these flutes are made, that is musical bamboos. As will become evident throughout the thesis, in Chapter Three and Four in particular, it was the often emphasised "constant recreation" (UNESCO, 2003) of Walateño flute-making practices in the urban environment and in tourism contexts in the first place, which has contributed to the current state of unsustainability within natural resource use. Not a single word can be found in the application about current material shortages and sourcing problems, let alone the social organisation of contemporary bamboo sourcing. Nothing had been written regarding safeguarding flute makers' ecological and environmental knowledge about native woody bamboos and the cloud forest environment. Such an ecological and environmental knowledge in the Andes is often linked to a particular system of resource access and redistribution known as ecological verticality.

Natural Resources and Ecological/Environmental Knowledge

In this thesis, I will draw in some parts on what is known in Andean cultural ecology and economic anthropology as 'ecological verticality' or the 'vertical archipelago', an Andean economic model of direct access to natural resources situated on multiple ecological tiers, and centralised redistribution, which goes back to the pioneering scholarship of John Murra (1975) (see also various chapters in Lehman, 1982) (further discussed in detail in Chapter Three). Since its formulation in the 1970s, this model has been developed towards the idea of ecological complementarity implying a series of exchanges of natural resources rather than direct access (Masuda et al., 1985; Murra, 1985; Salomon, 1985). These concepts contribute to understanding economic strategies of natural resource use in the Andes, coupled with specialised knowledge about biophysical conditions of multiple environments and the ecology of a diversity of plant resources. As Harris (1982, p. 71) has argued: "Human adaptation in the Andes has thus incorporated a fine degree of ecological and geographical specialisation." Furthermore, I am interested in how the complementarity of different ecological tiers and the exchange of environmental resources imply different social relations (see Bradley, 1982).

Musical instrument makers too not only possess knowledge about musical values and meanings in a community but also about land and resources (Post, 2019). In the case of musical bamboos, this traditional environmental and ecological knowledge[21] includes geographical distributions, environmental niches, growth habits, and morphologies, among others. As will become evident in this thesis, it is a valuable source for particularly low-invasive musical bamboo collection practices, while its erosion and loss have become

[21] Traditional environmental or ecological knowledge can be defined as "a cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes, 2012, p. 7).

very problematic as regards questions surrounding musical bamboo sustainability. In this regard, and complementary to the overall analytical framework of sustainability developed further below, another valuable concept of natural resource management finding application in this thesis is the “tragedy of the commons” (Hardin, 1968). The tragedy of the commons, in its modern sense, is a social dilemma and a problem of unorganised collective action leading to the overuse, depletion, and spoiling of a shared, unregulated, and often scarce resource. Its central premise is that individual users, independently from each other, behave according to their own short-term self-interest, which is often at odds with long-term interests of the group of users and the common good itself (Ostrom, 1990). The lack of collective organisation in musical bamboo sourcing among Walateño flute makers has produced specific resource dilemmas which will be addressed in this thesis (particularly in Chapter Six). The consequences of these resource dilemmas, that is overexploitation and depletion of bamboo resources in recognised sourcing regions, is one important factor contributing to the experiences of material scarcities in urban flute-making workshops.

Against this background, and in order to analyse different perceptions of musical bamboo scarcities in contemporary flute-making spheres (see Chapter Four), I will draw on Homer-Dixon’s (1999) definition of “environmental scarcities”, which are scarcities of a renewable resource such as native woody bamboos. Homer-Dixon (1999, p. 48) analytically distinguishes between three main types of scarcities, which are supply-induced (through a drop in supply of a key resource), demand-induced (through an increase in demand), and structural scarcities (through a change in the relative access to the resource). In the context of musical bamboos and highland flute making on the *altiplano paceño* supply-induced and demand-induced types of bamboo scarcities are especially important. I analyse these distinct sources of bamboo scarcities and ways in which they interact with each other (see Chapter Four). Furthermore, I will distinguish these forms of bamboo scarcities in the modern economic sense from natural bamboo ecology-induced, seasonal, and cyclic periods of bamboo shortages.

Towards an Analytical Framework of Sustainability

Sustainability is the central framing concept that draws together the different aspects of my interdisciplinary mixed methods research under a common umbrella. In applied ethnomusicology, the term sustainability has been popularised by the work of Jeff Todd Titon, especially in his research blog[22], the 2009 issue of *World of Music* on "Music and Sustainability", and subsequent treatments (2013, 2015, 2016). In his articles, Titon (2009a, 2009b) provides a theoretical framework for conceptualising sustainability as a new approach for cultural policy-making relating to the continuation of diverse music-cultures based on an analogy with ecology and its central concept of the ecosystem. Convincingly arguing against attempts to preserve music as cultural heritage (tradition as resource, safeguarding property assets, ownership problem, tourist commerce, staged authenticities, commodification of music, etc.) (see also Grant, 2012), he proposes that we regard music-cultures as ecosystems and preserve the entire "musicultural habitat" (Titon, 2009b, p. 129) through stewardship. His theoretical approach has found operationalisation and practical application, most famously, in Schippers and Grant's (2016) international research project and book

[22] See https://sustainablemusic.blogspot.com/

Sustainable Futures for Music Cultures: An Ecological Perspective, where the authors compile a series of case studies applying and discussing a general framework for sustainability in a musical ecosystem.[23]

I draw on some of Titon's (2009a, 2009b) main arguments in this thesis when it comes to cultural policies and the safeguarding of highland flute making in Bolivia. However, this differs from the principal idea of sustainability at the conceptual core of this research. In line with Allen's (2017, 2018, 2019) ecomusicological writings[24], I argue that the theorising of sustainability as a concept in applied ethnomusicology was initially too human-centred and did not consider any direct reference to the natural environment or the material basis for musical instruments being a "physical connection to the natural resources that humans use for cultural activities" (Allen, 2017, p. 403).[25]

Against this background, I claim that reference to a more sustainable bamboo resource use in the sense of environmental sustainability lies at the heart of my understanding of sustainability in this thesis. In a narrow sense, I consider sustainability in the first place as a guiding principle of economic action within natural resource use, stating that musical bamboo resources should only be used sustainably in relation to the bamboo plant's mortality and capacity of natural reproduction (otherwise overexploitations occur).

---

[23] The research project and the book built on the authors' former works about the topic (Bendrups & Schippers, 2015; Schippers, 2014, 2015; Schippers & Bendrups, 2015; Schipper & Letts, 2013; Grant, 2010, 2011, 2014). For another example see Chambers (2018).

[24] Brennan & Devine (2020) make a similar argument in their discussion about the dimensions of sustainability in relation to music studies.

[25] See also Grant's (2013) Oxford Bibliography of "Music Sustainability", where no reference is made to ecomusicological studies and to the natural environment or material basis of cultural (re)production.

Thus, the use of bamboo resources is sustained over the long term and maintained for present and future generations (intergenerational justice). If bamboo resources are used unsustainably, this must necessarily involve change in the way resources are used to enhance greater sustainability, implying a change-oriented perspective (as, for example, proposed by Allen, 2019). In a broader sense, and in my understanding, environmental sustainability also implies integrated environmental protection, not only for conserving natural resources, but also for the sake of conserving biodiversity and the health of natural environments itself.

In the sense of dynamic dialectical relationships between woody bamboos (nature) and flute makers (humans), from a materialist perspective (Foster, 1999), it is flute makers' economic actions and productive forces, that is craft, and their bamboo demand which determine resource use and sourcing practices. Economic actions are always socially organised and often further culturally shaped (as explained more in detail in Chapter Three). However, native woody bamboo habitats are, to a certain degree, also threatened by non-musical activities such as agriculture and cattle rearing. These are environmental issues in a broader sense linked to deforestation, which need to be integrated into the analysis of musical bamboo sustainability.

Environment/Ecology-based Sustainability and Human Factors

I will further develop my analytical framework in relation to the common discourse of sustainable development of the United Nations. Here, the term sustainability is often invoked as a framework for problem solving consisting of different interrelated pillars, domains, or circles, which are the environmental, the economic, and the social. Recently, the cultural has been proposed as a fourth domain of this sustainable development framework.

However, as Allen (2019) and others have argued, giving equal importance to each of these domains does not reflect the fact that human societies and cultures depend for survival on the environment and life-sustaining ecological processes/systems. Therefore, the natural environment forms the basis for life and existence as an independent realm. In terms of the other domains, I find these too complexly intertwined in the real world to justify a separation empirically. I therefore incorporate all these domains into an all-encompassing human realm, which is cradled by the natural realm. Yet, for analytical purposes, it is useful to point out different economic, social, and cultural factors intervening in the appropriation of bamboo resources.

As will become evident throughout the thesis, flute makers must make their living and produce constant income from an economic perspective in order to continue making flutes (economic aspect of sustainable development). However, shifting economic structures (e.g., accessing new markets, tourist commerce, and mechanisation processes) shifted and increased bamboo demands and had negative environmental impacts on bamboo populations. Similarly, the shifts in musical appreciation of certain bamboo types over time and in the urban environment produced new vulnerabilities to bamboo scarcities and shifted sourcing practices. Finally, the lack of a collective social organisation in bamboo sourcing caused resource dilemmas, while craft specialisation and the social division of labour between flute making and bamboo sourcing engendered new musical bamboo trades, in which bamboos came to be traded as commodities, with all the negative implications of a more extractivist collection practice.

It is noteworthy that I am also very much concerned with the cultural reproduction and continuity of highland flute making. Yet, if shifting contexts of highland flute making, for example in tourist commerce, which often shapes cultural safeguarding projects and ideas about cultural sustainability (McKercher & duCros, 2002; see also Soini & Birkeland, 2014, and Titon, 2009b), become key drivers of unsustainability in bamboo resource use, this becomes problematic from an ethical standpoint (see Allen, 2019). The thesis therefore takes the position of "strong sustainability", where natural capital cannot be substituted by human capital, as opposed to "weak sustainability" in which natural capital exploitation is justified with the growth of human capital (see also Allen, 2017). The problem of cultural reproduction in different contexts having unintended environmental consequences also relates to questions of resilience in ecological thinking.

Ecology, Resilience, and Musicultural Metabolism

In a recent article, Allen (2018, p. 1) draws attention to the "problem of ecology" in music and sound studies, namely the "invocation of ecology to mean something other than what ecological scientists mean by it". Instead of understanding it as a scientific endeavour into the relationships between organisms and their biophysical environment, recent work in music and sound studies, for example presented at the annual conference "Sound Ecologies" of the Society for Ethnomusicology in 2010, has invoked ecology as a metaphor for the interconnectedness of human musical actors and institutions (Allen, 2018; Pedelty, 2011). Abiotic, non-human, environmental, or natural contexts were largely absent from these music or sound ecologies. Furthermore, Keogh (2013) and later Keogh and Collinson (2016), have called into question the "ecology of music" in applied ethnomusicology in reference to what they call the "residual understanding of ecology", the anachronistic idea in ecosystem ecology that ecosystems gravitate towards a balanced, stable, and harmonious equilibrium.

The applied ethnomusicological response to this controversy has led to the adoption of resilience theory and adaptive management as a new approach to thinking about musical sustainability (e.g., Titon, 2015, 2016, 2018). As Titon (2015, 2016) understands it, drawing on Gunderson et al. (2009), resilience is the capacity of a system to adapt to changes and recover after disturbances. The main arguments in favour of the resilience concept are that it shifts the focus from equilibrium to disruption, perturbation, and dynamic system changes and that theorising the sustainability of music-cultures in terms of resilience helps to incorporate formerly side-stepped environmental issues and further aspects related to the natural environment (Allen, 2017, 2018, 2019; Titon, 2015, 2016, 2018). Interestingly, recent studies in ecomusicology have also drawn on resilience theory to understand natural resource use in musical instrument making, as exemplified by Ryan's (2016) study in Australia of Eucalypt-derived musical traditions. As resilience theory has occupied interesting spaces within both applied ethnomusicology and ecomusicology, it deserves a little bit more discussion.

Despite the fact that resilience theory has recently been critiqued by scientists linked to systems thinking as being too narrow-minded regarding the "different multilayered threats to system survival which go beyond the response to 'sudden shocks'" (Berardi et al., 2013, p. 2), I personally consider resilience theory an inadequate analytical tool with which to analyse human-environment relationships, natural resource use, and the current situation of highland flute makers and musical bamboos in the Bolivian Andes. As the focus of resilience theory lies on dynamic system changes, its main metaphor, besides system thresholds, is the adaptive cycle, describing a sequence of such system dynamics (growth/accumulation, conservation, collapse/release, and reorganisation) (Gunderson & Holling, 2002; Walker & Salt, 2006, p. 11, pp. 74-95). Resilience theory has been independently applied to both environmental (natural) and human systems, and thus could be applied to musical bamboo populations *and* a bamboo flute-making culture or economy. An application of resilience theory and the adaptive cycle could possibly function for each of these independent systems.[26]

However, as argued above, constant recreations of cultural practices, here in terms of cultural resilience, might contribute to unsustainable musical bamboo use/sourcing and environmental degradation (weak sustainability). Thus, human and natural systems must be coupled in order to avoid environmental sustainability problems. But my basic concern and the "logical contradiction" (Hornborg, 2013, p. 119) of resilience theory and the adaptive cycle lies exactly within its application to such a single so-called coupled

---

[26] The adaptive cycle of a musical bamboo population as a natural system could be described as follows: In the growth phase, bamboos grow and form clumps in the tropical forest, until they stabilise in the conservation phase and accumulate biomass. After the rapid collapse (release), be this induced by natural fire or anthropogenic disturbances such as extractivist bamboo collecting activities, the bamboo populations reorganise leading to a renewal of musical bamboo populations in other parts of the tropical forest (changing realised niche), most probably not in the exact same state, but in a similar one nevertheless enabling its continuation. On the contrary, the adaptive cycle of a highland bamboo flute-making culture or economy as a human system could be described as follows: The flute-making culture or economy grows and expands by using natural resources, until it stabilises and accumulates cultural and economic capital in the conservation phase. After the collapse or release phase, be this induced by bamboo material depletions or decreasing sales opportunities in traditional market niches, the flute making culture or economy reorganises by accessing new bamboo populations in other forests and opening new market niches leading to its renewal, yet not in the same state as before, but on a qualitatively different one, in terms of flute making but also in terms of metabolic regimes, that is bamboo material demands, enabling its continuation.

human-environment or social-ecological system (e.g., Berkes et al., 2003; Berkes & Folke, 1998; for an ecomusicological example, see Ryan, 2016). In line with the dialectical nature of Hornborg's (2013) argument, I would concur that the coupling of the natural system (bamboo population) with the human system (bamboo-based flute-making economy) would mean that the growth of the latter must be inversely related to the growth of the former. Consequentially, conceiving of the bamboo population and the bamboo flute-making economy as one single human-environment system following one common adaptive cycle makes little sense from the perspective of the dialectical argument presented by Hornborg (2013).

In sum, considering broader questions of sustainability as they link to natural resource use in flute making, I will further draw in this thesis on critical social-ecological theory, which emphasises the "materialist conception of nature" (Foster, 2000), where society, or a societal or cultural system, including a music or flute-making culture, is part of nature, or embedded in a natural system, and dialectically relates to it in terms of social or cultural, or in this case musicultural metabolism. In the sense of such a cultural-ecological framework, which links to my understanding of sustainability presented above, music and flute-making cultures are ecologically embedded and must satisfy certain material needs. With my adaptation of Foster's (1999, 2000) materialist environmental sociology concept of social metabolism, I want to draw attention to the fact that the highland flute-making culture/economy requires natural resources, for example musical bamboos, for their constant reproduction. In other words, there is a dialectical relationship between flute-making workshops on the highlands and musical bamboo populations in tropical forests on the eastern

Andean slopes, with the growth of the former being inversely related to the growth of the latter.

As a matter of fact, Andeans including Walateño flute makers would probably subscribe to the claim that humans are part of what we call nature. However, what is meant when they evoke the term nature might significantly differ from what Westerners would understand by it, which is especially true for spiritual guides, Andean shamans, among them Aymara *amawt'a* or *yatiri*, extending the human culture into the "culture of nature" (Yujra Mamani, 2021; see also Hachmeyer, 2021a). Therefore, human relationships in the Andes to nature, or to the natural environment and landscape features, often have further social, semiotic, and ritual components. This is exemplified by the many stories about former musical bamboo sourcing travels of currently non-sourcing urban-dwelling Walateño flute makers involving spiritual relationships to 'mountain guardians' (ay. *achachila, awicha*) and 'protector spirits' (ay. *ajayu uywiri*) (see Chapter Three).

Organisation and Chapters of the Thesis

All chapters of this thesis are ethnographically and empirically driven, while referring back to the theoretical grounding of the thesis where appropriate. Every chapter also contains an introduction and conclusion section that links the different aspects raised in each chapter back to the framework of sustainability in order to analytically make sense of the complexities of the topics discussed. I will take the reader on a journey that reflects the developments in the field and the chronology of my fieldwork. Therefore, I recommend reading through the chapters chronologically as each chapter builds on the content of the previous ones. This allows me to accumulate information, thereby deepening different and specific aspects making up the complexity of the problem, until the concluding chapter finally draws together all issues raised in the thesis with the help of the sustainability framework.

The first three chapters frame the thesis. After this introduction, in which I introduced the research rationale, central guiding questions, the research background, and some central analytical and theoretical considerations, Chapter Two unfolds the methodological framework of the thesis. Besides describing in detail the interdisciplinary mixed methods approach, with which this research was conducted, I discuss my positionality, ethnographic self-image, fieldwork ethics, and ethnographic tensions. These tensions were an obstacle for my fieldwork in many ways but also pointed towards certain social dilemmas in flute makers' interpersonal relationships. These will play a key role in understanding the social factors contributing to the current unsustainable state in musical bamboo sourcing.

Chapter Three then contextualises the research in a historical account of Walata Grande and highland flute making. This chapter is key to comprehend the shifting economic modes of flute making from the sustainability perspective developed in this thesis. It lays the foundation for understanding shifting environmental relationships of the flute making culture/economy, which can be traced back to certain historical transformations. Concretely, this chapter discusses the theme of craft specialisation against the background of a broad archaeological and historical overview of the use of musical bamboos in highland flute making on the Altiplano. I argue that the ethnohistorical concept of craft specialisation is only partially suitable for understanding the rise of Walata Grande as a specialised flute making centre on the Altiplano. Rather than turning my focus towards ethnohistorical concepts, I describe how Walata Grande's economic flute-making practices became decontextualised over the second half of the twentieth century and explore experiences of urban migration and accessing new markets. I claim that Walata Grande specialised in flute making rather recently, producing the nowadays widespread social division of labour between flute making and bamboo sourcing which paved the road for the trade of musical bamboos as commodities. Because of these shifting contexts, different spheres of flute making emerged in the urban environment, which are described in detail.

The next three chapters are the empirical chapters of the thesis. Chapter Four deals with musical bamboos in contemporary flute-making workshops. It explores material demands, urban bamboo supply, bamboo shortages, and musical meanings/values attributed to different bamboo types and variants. The chapter relates to environmental sustainability in the narrow sense as a guiding principle in resource use by analysing current bamboo demands and exploring resource distribution dynamics within the urban flute making economy. I argue that musical bamboo demands and therefore perceptions of scarcity differ between the contemporary flute-making spheres, with the quantity-oriented petty commodity production of flute souvenirs structurally producing higher bamboo demands. I assess flute makers' responses to material scarcities and the precariousness of flute making to which musical bamboo sourcing difficulties contribute. The chapter finally discusses the importance of musical bamboos in mediating cultural meanings in musical performances and analyses material preferences and bamboo selection habits.

Chapter Five deals with the geography of musical bamboos. It explores local bamboo typologies, bamboo species distributions, the context of deforestation in Bolivia, and musical bamboo habitat destruction. This relates to environmental sustainability in the broader sense of environmental protection. Arguing that the existence of musical bamboos in viable and healthy habitats is a necessary environmental precondition for any kind of sourcing practices, I set out in this chapter to explore the ranges and spatial distributions of different musical bamboos species vis-à-vis the many collection sites in recognised sourcing regions. I assess deforestation in Bolivia with a particular focus on *yungas* cloud forests and quantify musical bamboo habitat destruction. After discussing the implications of the results for musical bamboo sourcing, I conclude the chapter by arguing for a more nuanced understanding of the impacts of deforestation and bamboo habitat destruction on flute making and bamboo sourcing practices.

Chapter Six is about the ecology and economics of musical bamboo gathering. Based on ethnographic experiences in recognised sourcing regions, this chapter explores the local environmental and ecological knowledge of flute makers and bamboo collectors and assesses the drivers of unsustainability in musical bamboo sourcing and collection. I take a closer look at how the ecology of musical bamboo frames flute making and bamboo sourcing and assess best bamboo gathering practices. Moreover, the chapter discusses resource dilemmas and how the current form of musical bamboo trade contributes to ecological concerns about the reproduction of bamboos and ethical concerns about questions concerning social responsibilities within new forms of bamboo middleman trading. Drawing on the analytical framework of sustainability, I show the importance of bamboo ecology and the natural environment as a fundamental and independent realm, while distinguishing different social, economic, and cultural factors framing, shaping, or determining musical bamboo sourcing.

Chapter Seven is the final chapter of this thesis which draws together the different aspects of my research in order to make sense of the complexities at work. Referring once more back again to the analytical framework of sustainability, the chapter develops a summary about the broader context of sustainability in flute making and bamboo use/sourcing. I explore the wider contributions of this thesis and the addressed interdisciplinary audiences, before discussing in a final outlook some implications of my research for practical interventions in the future.

Chapter 2

Methodology

Interdisciplinary Mixed Methods Research

This chapter unfolds the methodological framework of the thesis. The specific characteristics of the research context determined the selection of appropriate mixed methods. For a genuinely problem-based piece of research, I combined qualitative elements from ethnomusicology such as ethnography, participant observations, and informal interviews with more quantitative elements from phytogeography and conservation biology such as species distribution modelling and spatial analysis with a geographic information system (GIS). In this chapter, I will describe these methods in detail and how they relate to each other. Moreover, I will discuss my positionality, ethnographic self-image, fieldwork ethics, and ethnographic tensions. Some of the aspects discussed in this chapter play a key role for understanding the social functioning of the flute making community of Walata Grande and reveal some of the social factors that contribute to the current unsustainable state in flute making and musical bamboo sourcing. The chapter therefore also creates context for the rest of the chapters.

Overview: Interdisciplinary Mixed Methods

This thesis is based on interdisciplinary mixed methods research and long-term fieldwork in Bolivia, which I developed between January 2016 and December 2018. My fieldwork was comprised of three parts and developed in the following chronological manner (Table 2).

Table 2: Chronology of Fieldwork (Source: Own Elaboration)

	Activity	Time	Duration	Place
Part One	Ethnography Flute Making	January 2016 until August 2017	18 Months	La Paz El Alto
Part Two	Phytogeographic Study Herbarium Visits	January 2017 until August 2017	8 Months	La Paz
Part Three	Ethnography Bamboo Sourcing	November 2017 until December 2018	14 Months	Yungas Ecoregion

In the first 18 months, I carried out conversational interviews with urban-dwelling flute makers from the rural Aymara community of Walata Grande and developed closer ethnographic relationships with some of them using participant observations. I accompanied Walateño flute makers in their flute-making activities in distinct urban flute-making contexts in the highland cities of La Paz and El Alto. Being with them, I learned how to craft a variety of contemporary highland Andean Indigenous flutes with distinct types of tropical native woody bamboos. To complement my overall ethnographic approach, I prepared and carried out – mostly between January and August 2017, and with updates in 2019 – a phytogeographic and conservation biology study, comprising a species distribution modelling of Bolivian native tropical woody bamboos (*Bambuseae*) and a spatial analysis with a geographic information system. Finally, between November 2017 and December 2018, I undertook ethnographic, phytogeographic, and botanical fieldwork in central recognised bamboo-sourcing regions in *yungas* cloud forests and tropical rainforests of the Andean-Amazonian foothills. This methodological framework of qualitative and quantitative elements aimed to produce a more holistic picture about highland flute making, natural resources, and sustainability in the Bolivian Andes. In what follows, I will explain each of these research areas in detail.

Ethnography among Flute Makers

Studying the traditional *tupu* measuring sticks with which Walateño flute makers archived and crafted a variety of autochthonous flutes, Borras's (1995) material cultural focus of his organological study shifted from the final product, the flute, towards the *tupu* measuring stick as a meaningful material object containing the exact culturally coded information of how particular autochthonous flutes must be made (including underlying assumptions about harmony and Andean Indigenous sound aesthetics) (see also Borras, 2002).

The material-oriented focus of my ethnographic approach shifted from the flutes and the *tupu* measuring sticks to the natural materials, from which contemporary Andean flutes are made, musical bamboos, which are locally known by their Aymara names of *chhalla* (for making panpipes) and *tuquru* (for crafting vertical and side-blown flutes) (see Chapter One and Three). With my ethnographic study among urban-dwelling Walateño flute makers, I wanted to understand the reality of contemporary highland flute making on the *altiplano paceño* by literally "thinking through bamboo", as Henare et al. (2007) in their material-oriented ethnography would say.

In this context, important ethnomusicological sources of inspiration are Roda (2014) and Bates (2012). In his article *The Social Life of Musical Instruments*, Bates (2012, p. 366) interprets DeVale's (1990) understanding of organology and its purpose to help explain society and culture as musical instruments embody their essences as an organological "mandate for thinking through instruments". Studying the fine-tuning of a *tabla* drum in a workshop of a professional *tabla* maker in Banaras, India, Roda (2014, p. 361) thinks in his materialist musical ethnography "through the role of various actors present on the 'workshop stage'".

I will draw on these materialist ethnographic accounts, though without following an explicit Actor-Network-Theory agenda. Although I am inspired by material-semiotic understandings when it comes to bamboo resource use and the application of modern technology in the city (see Chapter Three), I rather want to develop my ethnographic argument against the background of critical social-ecological theory as my central ethnographic focus lies on the implications of contemporary flute making activities on musical bamboo sourcing and environmental sustainability (see Chapter One).

I wanted to understand highland flute making, musical bamboo use, and sustainability in the Bolivian Andes through the "bamboo's-eye view" on the world, taking inspiration from Pollan's (2002) ethnobotanical book *The Botany of Desire*; though the difference being that musical bamboos are wild and native plants growing in their natural habitats in tropical forests, rather than the domesticated and cultivated crops Pollen (2002) focussed on. One could possibly say that the human desire for these musical bamboos, in an aesthetical sense, relates to the sensorial impulses and affects involved in highland flute and music making.

Ethnographic Unfolding

Following up on my early conversations with urban-dwelling flute makers from Walata Grande and considering their unique historical and cultural development as specialised flute makers in the Bolivian highlands (see Chapter One and Three), it made sense from a methodological point of view to increase my conversations with these urban-dwelling Walateño flute makers. In terms of methodology, I ethnographically investigated the three contemporary flute making contexts presented in the previous chapter, namely the 'autochthonous', the 'professional', and the 'touristic'. I developed most ethnographic activities including participant observations and in-depth conversational interviews with urban-dwelling flute makers from Walata Grande in La Paz and El Alto between 2016 and 2017.

During my fieldwork, I conversed with 20 flute makers and their families about diverse topics related to my research.[27] These included their musical bamboo use/demand, ways of securing bamboo supply in urban circuits, the importance of musical bamboos in flute and music making, to mention just a few. My aim was to ethnographically study the highland flute making culture, its social and economic structures, and the shifting (bamboo) material demand, in short, how flute makers use a variety of musical bamboos for making Andean flutes in contemporary urban flute making contexts.

Furthermore, I developed closer ethnographic relationships with a handful Walateño flute makers (e.g., Ignacio Quispe, the Mamani brothers Andrés, Antonio, Julio, and Favío, Gilberto Huallpa, Basilio Uri), some of them having turned into close friendships going beyond the mere day-to-day ethnographic collaboration. Through participant observations, I accompanied my flute maker friends in their flute making activities over the three years of my field research in Bolivia. This included many hours of personal conversations and lively discussions in their homes, flute making workshops, musical instrument shops, and street stands (Figure 5).

[27] Flute makers consulted (among others): Policarpio Mamani, Basilio Uri, Ismael Uri, Francisco Torres, Vicente Torres, Felipe Torres, Esteban Quispe, Laureano Mamani, Eugenio Mamani, Andrés Mamani, Antonio Mamani, Marcos Mamani Julio Mamani, Favío Mamani, Ignacio Quispe, Francisco Quispe, Valentin Chipana, Nicasio Quispe, Aymar Quispe, Martin Limachi, Angelino Quispe, Gilberto Huallpa, Virgilio Mamani, Rodolfo Quispe, Aurelio Quispe.

Figure 5: Flute Making Workshops (Source: Own Photos)

Workshop of Andrés Mamani (El Alto)

Workshop of Basilio Uri (El Alto)

While flute making is principally an activity of men, Gutiérrez (1991a) reports that back in the 1990s women and children traditionally helped during the various steps in the crafting process. This panorama has shifted in the city and I encountered very few women and children actively engaged in flute making or marketing. Consequentially, I talked more to male flute makers, among them middle-aged and elderly men. Whenever I had the opportunity, I also tried to converse with involved women and children, although they were much more reluctant to talk to me than the already very suspicious and cautious male flute makers.

Flute makers, who agreed to being openly acknowledged, appear with their real names in the thesis. Otherwise, I have anonymised flute makers and other collaborators due to ethical concerns regarding a number of sensitive topics. These include ethnographic tensions with some Walateño flute makers and internal, often very conflictive, competitive, and envious relationships among Walateño flute makers themselves. Furthermore, I wish to acknowledge the openness with which some Walateño flute makers conversed with me about issues related to the informality of their economic activities, but also about their personal life histories as Aymara flute makers and their attitudes towards their community and the future of highland flute making. In some cases, these were very self-reflective and self-critical, so that revealing names could potentially cause social disturbances in the community.

For my ethnography among Aymara-speaking Walateño flute makers, I took Aymara language classes during the initial months of my fieldwork and learnt to speak it to an intermediate level. Despite my Aymara language skills, I more frequently used my very fluent Spanish in my research-related activities, as this was more natural in most conversations with interlocutors.

Additionally, as I had to deal with different actors during my research, my interlocutors were not limited to Aymara speaking flute makers from Walata Grande, or highland bamboo traders from the neighbouring community of Walata Chico. However, even among these bilingual Aymara speakers I more frequently conversed in Spanish. Every time I started to talk in Aymara, they often acknowledged my efforts, and quickly changed into Spanish as we moved on into more complex discussions. It should be noted that I have not met any monolingual Aymara speaking highland flute makers or bamboo traders during my research.

During my ethnographic fieldwork, I rarely recorded flute makers or took photos, as I sensed they felt very uncomfortable with the presence of recording devices and cameras. At home, I wrote in my fieldwork diary whenever I felt the necessity to write down important information. I was very careful not to give the overtly colonial impression of only wanting to record them for research purposes. To the contrary, I always tried to give flute makers the feeling that I am interested into their biographies and life stories, and that I share many concerns about the future of highland flute making and musical bamboo sourcing in contemporary Bolivia.

Fieldwork Contexts and Making Flutes

At the beginning of my fieldwork, I started to talk to those Walateño flute makers who had publicly accessible workshops or street stands (ay. *qhatu*) in different places in La Paz, as compared to others working at home, with whom I initially lacked contact. As Borras's (1995) study serves as an important historical comparative source, I started to establish contact with the remaining, nowadays foremost elderly flute makers from Juan Granier street, close to Garita de Lima, while further following up on my conversations with

Walateño flute makers in Linares street, the touristic centre of La Paz city. Initially, I received reserved comments about my research and was confronted by mistrust. Step by step, through very careful encounters, I had to gain trust among suspicious Aymara flute makers. To this end, I increased the frequency of my visits in the first months of my fieldwork developing a routine of visiting flute makers in their workshops or at their *qhatu* on an almost daily basis.

During that time, I often bought (for myself, our musical collective, or friends) consorts of flutes and asked flute makers to craft them with my assistance in order to gain first practical experiences in making a variety of flutes. I was not very convinced by this method, since the intermediation was obviously based on some sort of monetary exchange, though not for the collaboration itself but for the consorts of flutes I bought. However, this facilitated practical learning sessions and, most importantly, opened up spaces to better get to know one other on a more trustful basis. Moreover, a continuous monetary income, which is necessarily linked to securing bamboo resources, is key for understanding one of the central factors determining the continuity of flute-making practices on the contemporary highlands. Therefore, buying consorts of flutes, in fact, contributed to maintaining these very precarious artisanal practices. During my ongoing fieldwork, some of my ethnographic relationships turned into trusting friendships and several maker friends later agreed to show me the various steps in the process of crafting a variety of flutes without monetary motivation.

Although I am inspired by Tucker's (2016, 2019) work in a *chinlili* guitar workshop in the South Peruvian Andes, I would not call what I did an apprenticeship. The word apprenticeship creates an image in my mind of a more formal, explicit, and hierarchical working relationship of a master and his apprentice. Flute making among Aymara Walateño flute makers, though, is transmitted intergenerationally alongside family lineages, rather informally and within a spectrum of broader kin relations. In this sense, I was lucky to have been part of these transmission processes in some cases since it is usually reserved for Walateño offspring. As they rarely participate nowadays in flute making (see Chapter Four), I sometimes felt as though I was treated by some flute makers as filling the place of a son.

Despite these differences between apprenticeships and more informal intergenerational knowledge transmissions, careful observation and practical imitation as forms of acquiring skills might be comparable. As Ingold (2000, p. 291) remarks, skills are not passed from one generation to another through the transmission of formulae but through practical "hands-on" experience.

> For the novice's observation of accomplished practitioners is not detached from, but grounded in, his own active, perceptual engagement with his surroundings. And the key to imitation lies in the intimate coordination of the movement of the novice's attention to others with his own bodily movement in the world. Through repeated practical trials, and guided by his observations, he gradually gets the 'feel' of things for himself – that is, he learns to fine-tune his own movements so as to achieve the rhythmic fluency of the accomplished practitioner. (Ingold, 2000, p. 353)

Although some maker friends showed and theoretically explained to me principal crafting techniques in their workshops, they often argued that flute making cannot be learnt quickly and only through a few theoretical instructions. Rather, it is a life-long task. Practically speaking, in many learning sessions, I was not able to immediately reproduce the specific crafting techniques, whose application looks so easy and smooth in the hands of skilled flute makers. My movements were rather clumsy and my hands simply untrained. I knew that I was not much help in any productive way at the beginning. I often broke bamboo tubes, obviously meaning a loss of money for flute makers. Additionally, as some of them were concerned about shortages of some musical bamboos, I soon felt very uneasy. Flute makers recommended me to meticulously observe them in order to later practice at home with my own bamboo tubes. Some flute maker friends gave me a variety of self-made knives with different purposes in the crafting process (see Gutiérrez, 1991a), and I started to train my hands at home, practicing the crafting techniques I had previously observed during my visits to flute making workshops.

My learning process was based on trial and error. Gradually my hands did become more skilled and nowadays I am able to craft a variety of autochthonous and professional Andean flutes myself (principally panpipes, notched flutes, and side-blown flutes, rather than the more complicated recorder-like duct flutes with their block and labium). I would say that in a way my own learning process reflected proper Andean ways of learning, which are not based on predisposition or talent but on meticulous dedication and practical training (very similar indeed to learning to perform autochthonous music in the Bolivian Andes).

Phytogeographic Study and Herbarium Research Visits

As part of my interdisciplinary multi-methodological approach, and as a bridge between the material-oriented ethnography among urban-dwelling Walateño flute makers and the multi-sited ethnography into musical bamboo sourcing, I prepared and carried out a phytogeographic study, which comprised an approach to species distribution modelling and a spatial analysis with a geographic information system. The reason for applying species distribution models in this thesis stems from the fact that highland flute makers use different species of native woody bamboos, with different ecological niches and therefore geographic distributions. In a multi-methodological manner, I complement my overall qualitative ethnographic approach with quantitative and scientific elements relating to the study of the geographic distribution of native woody bamboos.

Species distribution modelling is a methodology built on the foundation of central ecological and biogeographical concepts (such as ‘niche theory’) about the relationship between the distribution of a species and the physical, abiotic environment (Elith & Franklin, 2013, 2017; Franklin, 2013). It is a computer algorithm-based approach used to predict and evaluate the geographic distribution of a species in a given time and region. Species distribution models are quantitative and empirical models of species-environment relationships usually relying on species location data and environmental variables considered to influence the geographic distribution of a particular species. The rapid growth of the field over recent past decades materialised in the burgeoning of literature about the topic, mainly dedicated to the democratization and availability of large amounts of primary biodiversity and environmental data, technological developments like geographic information systems, and further computational tools and modelling software enabling a multitude of applications (Peterson et al., 2011).

My phytogeographic study required numerous research visits to the National Herbarium in La Paz (LPB), where I reviewed secondary literature about the ecology of American native bamboos (e.g., Judziewicz et al., 1999), gathered species occurrence records, and discussed my research with local botanists (both in informal conversations and formal presentations during official meetings). I created a data set of tropical native woody bamboos (*Bambuseae*) and modelled geographic distributions using the Maxent modelling software (Phillips et al., 2004, 2006). The Maxent modelling software, which is used in many disciplines such as sustainability studies, conservation and reserve planning, ecology, botany, epidemiology, and invasive species management produces continuous predictions and inductive models, correlating the reported presence of a given species with the environmental conditions of the sites where it occurs. In other words, it predicts the distribution of a species based on the correlation of occurrence data and environmental background information.

I modelled the potential distributional areas of each woody bamboo species of my data set, created binary predictions, and produced a species richness map of tropical climate native woody bamboos (biodiversity hotspots). In the light of what flute makers told me about the destruction of native woody bamboo habitats, I furthermore visualised extant distributional areas of musical bamboos and quantified their potential niche loss and habitat destruction resulting from deforestation. Finally, I analysed the relation between the musical bamboo distributions and the selection of central bamboo-sourcing regions/sites and explored the implications for musical bamboo sourcing and the conservation of musical bamboos.[28]

---

[28] A more detailed methodological description of the phytogeographic study can be found in Appendix Three. In 2017, I presented preliminary results of my phytogeographic analysis during the Annual Meeting of Ethnology in the Museum of Ethnography and Folklore (MUSEF) in La Paz, for which I also organised a round table discussion and further flute making workshops as part of the official conference programme (Hachmeyer, 2018b;

Flute Maker Typologies and Botanical Taxonomy

In my phytogeographic analysis, I have drawn both on flute makers' local musical bamboo typologies and botanical specimens of tropical woody bamboos. This was mainly linked to a methodological challenge with regard to my species distribution modelling approach. Species distribution models are usually based on botanical knowledge and species occurrence data of herbariums (see Appendix Three). However, from a botanical point of view, very little is known to date about taxonomic identifications of particular woody bamboo species used in highland flute making (see Chapter Five). To my knowledge, there is no systematic economic botanical study in the Andes (and beyond) about bamboo selection in flutes and other musical instruments, as there is, for example, for wood selection in guitars and other chordophones (e.g., Bennett, 2016).

On the one hand, botanists lacked particular flute-making knowledge about the diversity of musical bamboos used in contemporary highland flute making (the challenge of specialised disciplinary scientific knowledge). On the other hand, the collections of woody bamboo specimens in Bolivian herbariums, for example in the National Herbarium in La Paz, did not include all the musical bamboo types and varieties recognised by Walateño flute makers within their local musical bamboo typologies. This reflects the lack of botanical work in Bolivia on bamboos (*Bambusoideae*) more generally.

Hachmeyer & Mújica, 2018). This was more about incentivising a broader debate about sustainability in flute making and musical bamboo sourcing rather than being part of my methodology. Another article with preliminary results aimed at raising awareness about the topic was published in 2018 in the Bolivian Musicology Review called *Contrapuntos* (Hachmeyer, 2018c).

In the context of sparse botanical knowledge, my aim was to build dialogues between these different kinds of knowledge. Therefore, in my species distribution models, I employed species occurrence data, which I mainly gathered in the National Herbarium in La Paz. I complemented this botanical knowledge with my own musical bamboo sample locations, which I compiled in the principal bamboo-sourcing regions recognised by Walateño flute makers (see below).

However, these different kinds of knowledge and their underlying classification schemes were not always neatly compatible. For example, while comparing botanists' herborised bamboo specimens with the dried bamboo internodes used by flute makers, I realised differences in the way botanists and flute makers classify the materials they work with. Against this background, I would argue that the scientific classification system in botany is more rigid in the way it classifies plants into taxonomic ranks (species, genera, (sub)tribes, (sub)families, etc.) in a vertical-hierarchical classification. This contrasted with the musical bamboo typologies of flute makers, which are based on morphological differences in the dried internodes, and their geographic origins, in a more horizontal, non-hierarchical, and rhizome-like structure.

While a Bolivian botanist, who sporadically worked on bamboos during my fieldwork, once said to me that different internode types of flute makers could be different expressions from one and the same woody bamboo species, flute makers understand different types and varieties as distinct bamboo plants in different recognised sourcing regions. During my conversations and formal presentations in the National Herbarium in La Paz, I constantly argued for an epistemological dialogue, while the botanical bamboo specialist once defended his point of view with the particular universalist argument that "in botany, complete samples count, not just dried internodes"[29].

The term "particular universalism" goes back to critiques by the French philosopher of science Bruno Latour (1993, pp. 103-106). In line with cultural relativism, "particular universalism" maintains the idea that nature is universal and that there is only one nature common to all cultures. It is assumed that only one particular culture, namely that of the modern West, enjoys privileged access to nature by way of the natural sciences (Blok & Jensen, 2011). At large, this opens up discussions about the self-image of botany as a modern colonial science (Baber, 2016; Schiebinger, 2004; Schiebinger & Swan, 2005).

In a way, the botanist might be right in arguing that typologies are different among botanists and flute makers. In fact, they are hardly ever comparable due to the different kinds of knowledge on which they are based. However, against the background of sparse scientific botanical knowledge, it is worth asking what botanical work would look like if it considered local people's knowledge about flute making and musical bamboos.

Furthermore, I was very surprised that interpersonal tensions among botanist colleagues in the LPB were often caused by what I would call the 'primacy of discovery and naming', by which I mean that botanists still strive, in an overtly colonial manner, to discover and name 'new' plant species ('species nova') or first registers for Bolivia. Rather than being a natural law in botany, I would argue, as an outsider, that this idiosyncrasy has much to do with gaining recognition as a botanist in the "reward system of science"

[29] "En botánica, muestras completas valen, no solo entrenudos secos."

(Merton, 1973). According to the famous sociologist of science Robert Merton (1973, p. 297), "the institution of science has developed an elaborate system for allocating rewards to those who variously live up to its norms".

In the very detailed and meticulous process of sample gathering, compression, mounting, and storing, a plant is extracted from its natural environment and social context to become a herbarium specimen, forever archived in dark and dusty shelves, brought into existence by discovering and naming, ready to be analysed and studied by interested and detached scientists. However, very often, plants already have diverse local names given by people using them on an everyday basis before they are scientifically "discovered" and latinised by botanists. In some cases, botanists actively attempt to recognise these social uses when naming species and incorporating them in the botanical taxonomic system. In others, modern colonial attitudes prevail.[30] I would perhaps define my intention here as to raise critical awareness of structural tensions within a modern science moving between its colonial history and its responsibility for a postcolonial present.

Fieldwork in Musical Bamboo Sourcing Regions

Building on my ethnographic study into contemporary flute-making practices in the city, and using my species distribution models as a research guide about

[30] Discussing the possibility that the Bolivian bamboo specialist eventually accompanies me on my field research at bamboo collection sites, I further realised that our approaches to field research were very dissimilar too. While I, as a guiding principle of my ethnographic fieldwork, always aimed to talk to locals, delve into their lived realities and be part of their lives (even if only for a short while), thus leaving behind a trace of my ethnographic involvement, the botanist, on the contrary, regarded locals as a means to an end, recommending me once that "if we travelled together, we would have to pay for a local guide who takes us to the plants".

the distribution of musical bamboos and sourcing sites, I shifted my ethnographic focus to musical bamboo sourcing, where collection and trade became central topics. Despite the many transformations in contemporary urban contexts, highland flute making continues to be framed by the ecology of musical bamboos growing in their natural habitats in the tropical forests of the eastern Andean slopes. However, musical bamboo collection has recently come to be governed by the extractivist logic of capitalist markets, where local bamboo collectors have come to prioritise the commercial aspects of selling musical bamboos as commodities. Inspired by Tsing's (2015) study about matsutake mushrooms, I analysed the local commodity and distribution chains of musical bamboos, tracing back unsustainable mechanisms in flute making and bamboo sourcing to their root causes.[31]

Bamboo sourcing is a complex procedure in which several distinct protagonists are involved, mainly flute makers, highland bamboo traders, and local bamboo collectors, besides the myriad of other local actors shaping the conditions for it. This complexity and heterogeneity of involved actors called for an ethnographic approach which allowed me to 'follow' the bamboos from the flute making workshops in highland La Paz-El Alto to the tropical forests of the eastern Andean slopes, and back again. As an ethnographic approach, I draw here on techniques of constructing a multi-sited ethnography, which "is designed around chains, paths, threads, conjunctions,

[31] As very little ethnographic research has been done into processes of musical bamboo collection, both in Bolivia and elsewhere, this can be seen in part as an exploratory approach. For an ethnographical study into such processes in the Kallawaya region, see Langevin (1992). Matsunobu's (2013) work on how instrument making can be an integral part of music pedagogy offers some insights into the collection of *madaké* bamboos used for *shakuhachi* making in Northern Japan.

or juxtapositions of locations in which the ethnographer establishes some form of literal, physical presence, with an explicit, posited logic of association or connection among sites that in fact defines the argument of the ethnography (Marcus, 1995, p. 105). But I am also inspired by Gibson and Warren’s (Forthcoming) research on woods and guitar making, “tracing the grain back to the tree”. Drawing on Cook’s (2004) geographical methodology of “follow the thing”, human geographers Chris Gibson and Andrew Warren (Forthcoming) document the genealogy of resource extraction, processing, and instrument manufacture in an upstream geography of musical instrument making. In a similar vein, I delve deeper into the upstream part of flute making, tracing the bamboo fibres back to the culm.

The majority of flute-making activities on the *altiplano paceño* are nowadays centralised in urban La Paz-El Alto, which is a consequence of the unique cultural and economic history of Walata Grande during the twentieth century (see Chapter One and Three). Musical bamboos sourced in tropical evergreen forests find their way through some form of intermediation to the highland flute making workshops in urban La Paz-El Alto. While the central geographic focus of my ethnography into flute making therefore was urban La Paz-El Alto, the multi-sited character becomes especially visible in my ethnography into musical bamboo sourcing and my field research in the main bamboo sourcing sites, spread over the Bolivian moist broadleaf forests of the *yungas* and the Andean-Amazonian foothills.

In every place, there is a different reality to explore, a complexly knitted mesh of interrelated human and non-human actors: altitudes and climates, ecosystems and bamboo species, peoples and animals, economies and livelihoods, environmental conditions and social realities; in sum, different circumstances and conditions for the collection and trade of musical bamboos. Coming back from the evergreen tropical forests to the highland flute making workshops, I brought together my ethnographic data gathered at the collection sites in order to explore temporal bamboo shortages in the city and the set of arguments and economic strategies that makers link to them.

Fieldwork Settings and Techniques

I carried out ethnographic, phytogeographic, and botanical fieldwork at sourcing sites in principal bamboo-sourcing regions. Table 3 shows the visited sourcing sites in recognised sourcing regions, which can also be found in the map of the research context. During my field trips, I carried out informal conversational interviews with locals involved in musical bamboo collection about diverse topics including bamboo collection techniques, local livelihoods, and relationships to highland flute makers and musical bamboo traders.

Table 3: Fieldwork Sites in Recognised Souring Regions (Source: Own Elaboration)

Fieldwork Site	*Municipality*	*Department*	*Sourcing Region*
Boopi	Palos Blancos	La Paz	Alto Beni
Carijana	Charazani	La Paz	Northern Yungas
Chuspipata	La Paz	La Paz	Central Yungas
Diam Pampa	Comarapa	Santa Cruz	Carrasco-Amboró
Hernández	Alto Beni	La Paz	Alto Beni Region
Kara Wasi	Pojo	Cochabamba	Carrasco-Amboró
Palomani	Licoma	La Paz	Quime
San José	Sud Yungas	La Paz	Alto Beni Region
Tucupi/Cocochi	Sud Yungas	La Paz	Alto Beni Region
Zongo	La Paz	La Paz	Zongo Valley

These locals were furthermore my hosts and guides in these places. Together, we undertook day-long hikes to sometimes inaccessible musical bamboo populations and collection sites. With the guidance of these experienced locals, I explored the natural environments of the tropical Andes and got to know the musical bamboos, the living plants, from which the internodes derive that are used in highland flute making. I discussed and analysed with bamboo-collecting locals how local economic realities in preferred bamboo-sourcing regions impact on the viability of musical bamboos and how the shifting landscapes of flute making on the highlands exert increasing environmental pressures on bamboo collection sites in tropical forests further down the eastern Andean slopes. During these field expeditions, I took pictures of my field research and wrote in a fieldwork diary on a daily basis.

Additionally, I undertook botanical field research at bamboo sourcing sites. Against this background, it is noteworthy that my fieldwork centred on those sites which flute makers mentioned during my conversations with them. These central sourcing sites turned out to be places where botanists had not collected many specimens of native woody bamboos to date (see Chapter Five). Thus, equipped with a plant press and a guide to collecting bamboo specimens (Soderstrom & Young, 1983), I gathered botanical samples of musical bamboos, which I donated to the National Herbarium in La Paz (Figure 6).

Later, I made photographs of these samples and asked bamboo specialists from Colombia (Ximena Londoño) and the United States (Christopher Tyrrell) to help identify them. As a basic element of botanical field research, I took the geographical positions of the sample sites with a standard GPS receiver (Garmin GPSMAP 64s), valuable geographic information which I used as additional species occurrence records in my species distribution modelling approach (see Appendix Three).

Figure 6: Musical Bamboo Sample (Source: Own Photo)

‘Zongo’ *chhalla* Bamboo

Since I was based in La Paz-El Alto, I always returned to the city after each field trip and shared my experiences with my flute maker friends. They were always very interested to hear my stories. In some cases, I helped to establish contact between my maker friends in the city and local bamboo collectors encountered during my field trips. In that sense, I directly brought together local bamboo collectors with urban-dwelling flute makers, who nowadays usually rely on middlemen traders.

Intermediated bamboo resources are more expensive for flute makers, as the intermediary obviously makes his living by trading musical bamboos as commodities. One could argue that I actively intervened here in the supply chain of musical bamboos. However, it was simply an act of friendship and very natural to share information about musical bamboo collection sites and local collectors with my flute maker friends. Moreover, middlemen rely on usufruct rights and are not always reluctant to exploit local people's resources and labour, while always pushing down their payments for local bamboo resources in order to increase their own profits, selling bamboos to flute makers in the city at much higher prices. This is a common strategy in natural resource trading, for example, in Alto Beni, where lowland Indigenous people such as the Mosetén are involved in a system of debt slavery or peonage locally known as *habilito* (Ricco Quiroga, 2010; Sturtevant, 2016). Accordingly, the implications of such a form of exploitative intermediation for the sustainability of flute making and musical bamboo resources will be addressed in Chapter Six.

Particularities and Limitations

As a consequence of the multi-sited character of my ethnography in bamboo-sourcing regions, I only spent a short time in each field site; a common danger of focussing on breadth rather than on depth in multi-sited ethnographies (Bigenho, 2002, p. 15; Clifford, 1997, p. 57; Marcus & Fischer, 1986, pp. 77-110; Starn, 1999, p. 15). On my field trips, and during our lengthy day-long hikes crossing various altitudes, I got physically in shape so as to return to some selected sourcing sites at a later point in order to experience, through participant observation, the exhausting and dangerous collection of musical bamboos myself.

Participating in bamboo collection became particularly relevant in the light of possible over-exploitations in preferred areas of bamboo sourcing. Highland bamboo traders and local collectors often reside over several weeks and months in tropical forests in order to collect a sufficient amount of bamboo to make their investment in the long journey worthwhile (time, money, etc.). Although I did not consider this aspect beforehand, it was fundamental to reach the necessary physical strength for collecting bamboos myself, living over several days in dense tropical forests, exposed to the many threats, with local food and in the way musical bamboo collectors are used to (that is without any Western hiking equipment or the like; I also frequently wore sandals made from car tyres called *wiskhu* in Aymara).

I tried to return to as many collection sites as possible in order to undertake more ethnographic fieldwork into the collection of musical bamboos. As is often the case in multi-sited ethnographies, commitments at each field site are restricted in many ways with time being the most critical element. Even though I had rather short stays in each bamboo collection site, I always lived with locals involved in bamboo collection and tried to establish rapport with them (some became good friends who I continue to visit).

Although I managed to visit specific local bamboo populations in these collection regions, taking GPS data and botanical samples, and getting a feeling of how bamboo collection is undertaken, I could not always actively participate in bamboo collection. In some cases, musical bamboos were simply not mature, thus not ready for collection, while in other places, bamboos were already too mature, thus in the process of decaying. Another common obstacle was heavy rainfall, which often destroyed the infrastructure necessary for safe travel and bamboo collection (see Chapter Six). In other places, political turmoil and armed conflicts (e.g., among coca growers and the military in Sur Yungas, or among gold mining cooperatives in Arcopongo) prevented me from undertaking field research.

Despite these challenges, on one occasion I actively participated in the collection of *chhalla* panpipe bamboo in the Alto Beni region with a local collector, an Aymara settler originally from Cajuata in Inquisivi province.

Furthermore, I was part of a *tuquru* bamboo collection expedition in a particularly interesting sourcing locality in the Arcopongo canton in Inquisivi province, where I accompanied the *musiñu* maker Ignacio on his bamboo sourcing travels (a lucky situation as only very few Walateño flute makers nowadays source bamboos themselves).

It is further noteworthy that my Bolivian wife, Jesika Paredes, has accompanied me during almost all my field trips to central bamboo-sourcing regions. This has parallels with Seeger's (2008) fieldwork in the Brazilian Amazon, during which he was accompanied by his wife on almost all his research trips. Jesika and I often discussed her role, and we generally concluded that she gave me, as a foreign researcher, much more 'humanness' during my fieldwork at bamboo collection sites. For example, when we appeared together in a local *yungas* community and presented each other as a married couple, I had the impression that locals did not consider me as alien or strange as foreign researchers are often considered. They rather saw me as a normal human being, which is by no means self-evident in a research context where researchers (mainly anthropologists and ethnographers) have sometimes been regarded by their Aymara interlocutors as exploitative "monsters" (ay. *kharisiri*) (Burman, 2018).

I should further mention that our civil marriage godmother (*madrina*) and her family are traditional coca farmers from Lavi Chico in Irupana municipality in Sud Yungas (La Paz department). Her father has sporadically been involved in bamboo sourcing in former times, but completely abandoned it from the 1980s onwards as the more lucrative activity of coca growing expanded in the *yungas* of La Paz. During our field trips, we often passed by Irupana where we have always been given accommodation and treated with much love. It was simply a matter of family business to help harvesting coca leaves on family plots. Although this is not a specific study about coca growing in Bolivia[32], the expansion of the coca crop in the *yungas* of La Paz was a primary driver of the deforestation of subtropical *yungas* cloud forests in this recognised musical bamboo-sourcing region (see Chapter Five).[33]

I did not gather any direct, first-hand ethnographic information from the sourcing region in the Tucumán forests around Bermejo, in the southern Andean *yungas* close to the Argentinian boarder. In fact, I prioritised the central *yungas* cloud forest ridge for several reasons. The bamboo species collected around Bermejo has already been sufficiently sampled and identified by botanists, which made further botanical and phytogeographic work *in situ* secondary. Moreover, I could listen to personal experiences of highlanders involved in the collection and trade of *chhalla* panpipe bamboos from around Bermejo.

Indirect Information about Bamboo Sourcing

Adding to my field trips to musical bamboo-sourcing regions, I furthermore gathered second-hand information about musical bamboo sourcing from Walata Grande flute makers, who travelled to source diverse musical bamboos themselves in former times. This is similar to what Gutiérrez (1991a) did among Walateño flute makers in the 1990s, whose study serves

[32] See, for example, Pellegrini (2016) for an anthropological study about coca growing in the *yungas* of La Paz.

[33] I furthermore carried out informal interviews with other coca growers in their national organisation of ADEPCOCA in Villa Fátima in La Paz in order to understand the expansion of the coca crop in the region and their political struggles as coca growers in Plurinational Bolivia, especially regarding their conflictive relationship with coca growers from Chapare region in Cochabamba (see Hachmeyer, 2017c).

as a source of historical comparison. Almost every Walateño flute maker I conversed with told me intriguing and fascinating but also disenchanting stories about sourcing travels and their personal experiences in tropical forests, among them the dangers of travelling tiny paths meandering down the tropical Andean slopes of the *yungas*, bear encounters during extremely exhausting musical bamboo collections, poisonous animals and infectious diseases, the tricky negotiation with locals, or simply curiosities of everyday life in the *ch'umi* ('jungle') (see Chapter Six).

Furthermore, as part of my preparation for fieldwork in recognised musical bamboo-sourcing regions, I conversed with highland bamboo traders from Walata Chico in their rural community in early 2018. Many community members from Walata Chico, a neighbouring community of Walata Grande on the highlands of La Paz in Omasuyos province, have become central protagonists in the trade of musical bamboos (see Chapter Two and Three). One of the first Walata Grande flute makers who delegated musical bamboo sourcing to Walata Chico traders approximately at the turn of the millennium was one of my ethnographic interlocutors in El Alto.

In fact, I also intended to be part of their trading business. However, I could not travel with any highland bamboo trader, which had to do with ethnographic tensions with flute makers (which I will address further below). Against this background, it is noteworthy that the fact of not having travelled with highland bamboo traders had certain implications for my research. In my ethnography into bamboo sourcing, I lacked direct participant observations among them and their perspectives on musical bamboo collection and trade. However, I gathered valuable second-hand information during intriguing conversations with some of them in their rural community.

What I have heard from these highland bamboo traders was sometimes very different from what local musical bamboo collectors in *yungas* communities told me. These local bamboo collectors are still unheard today, so I therefore particularly focussed on their viewpoints. If I had travelled with highland bamboo traders, I would have never been able to talk with bamboo collecting locals as freely as I did without them.

Moving in the Field: Blurred Borders

Following the description of these more formal research areas, I turn now to the relationship between my research/fieldwork in Bolivia and my personal life. This is important from a methodological point of view as the former often dialogued and complexly overlapped with the latter. Many of my research activities did not feel like doing research in the sense of being a discrete sphere of action, something neatly distinguishable from other aspects of my life. Rather, they were part of – and naturally emerged out of – the unfolding of my life and my personal interactions with the research subject over the years of my residence in metropolitan La Paz. In a way, I do not consider my involvement in the 'field', particularly my ethnographic one, as a mere data collection of a distanced researcher wanting to study a particular group of people from a disembodied and disinterested perspective. With the words of McLean and Leibing (2007), I rather claim that the borders between my ethnographic work and my life became blurred.

Ethnography became a very important part of my life, while my life story is indispensable to understanding my research, and my embodied perspectives. I identified with many of my interlocutors, and I am very much concerned about the current environmental state of musical bamboos and the economic forces and structures engendering unsustainable practices in flute making and musical bamboo sourcing. However, as explained in Chapter One, I did not aim to implement more sustainability among flute makers or bamboo collectors in a kind of transdisciplinary approach. Such an endeavour would require different methodologies and an ongoing reflection about the role of the 'facilitator' of sustainability.[34] Instead, I analysed the struggles faced by urban-dwelling Aymara highland flute makers in securing their musical bamboo supply and confronting the challenges of unsustainability.

This certainly implies strong advocacy for more sustainability, which confronts me with certain ethical questions, especially regarding my ethnographic self-image. In fact, research efforts into sustainability issues can quickly end in a know-it-all-manner of a (foreign) researcher, who believes s/he knows how to transform unsustainable practices better than local people themselves. As discussed in the following sections, I followed strategies which helped protect me from such a narrow-minded, moralistic, and self-righteous position. I strongly believe that ethnographic researchers look for moments, in which possibilities are opened up to surpass their own foreignness, even if only for a short while. Indeed, my research became very meaningful to me. The research developments not only impacted on me in the realm of scientific endeavour, but also on a personal emotional level (see also Beaudry, 2008).

Although I came to Bolivia in 2014 for formal research purposes (at that time to conduct fieldwork for my master's dissertation in Human Ecology), I

[34] This is particularly relevant in the context of the many contemporary sustainable development projects in the global South intermediated by facilitators from the global North (see also Tucker, 2019).

decided to relocate the centre of my life to the city of La Paz in June 2015 (after my successful master's dissertation defence). From then, I lived together with my Bolivian partner, Jesika Paredes, who later became my beloved wife in a beautiful ancestral Andean *jaqicha* wedding ceremony. I became a new member of her family and mainly lived with her either in the adobe house of her family in the popular neighbourhood of former railroad workers on the western slopes of the Andean metropole of La Paz, or in the brick house of her mother in a working-class neighbourhood in the heart of the Altiplano city of El Alto. I often refer to these two distinct cities with their own municipalities as the metropolitan area of La Paz, as it conveys well the idea of a political, economic, and social centre around which life on the *altiplano paceño* is nowadays organised.

Jesika and her family became very important aspects of my research. They were not only the most important sources of emotional support during the many difficult moments of my research. Jesika also accompanied me during many research related activities and has therefore shaped them to a considerable degree. She has always been an enthusiast and lover of autochthonous music and got us actively involved in an urban autochthonous musical collective in La Paz (city), organised by young Aymara activists and former companions in the *Tawantisuyu* Indigenous University in El Alto.

Although our involvement in this urban collective was not motivated by my research in the first place (it rather naturally happened as our personal, musical, and spiritual life unfolded), it nevertheless became relevant to it in a broader sense. Referring to Hood's (1960) ethnomusicological research tool of "bi-musicality" or "musical literacy", I experienced "from the inside" contemporary autochthonous music making in metropolitan La Paz and the aesthetic and conceptual aspects of contemporary Andean, particularly rural Indigenous, or so-called autochthonous flutes, that is musical instruments made from those musical bamboos I was aiming to study during my research. Having said this, I would argue that our involvement in this autochthonous musical collective provided me with an intrinsic motivation for undertaking my research, as we have been playing flutes made from those musical bamboos which so many musicians and flute makers recently claim have become scarce. We discussed musical bamboo-related sustainability issues within our collective. In certain places, I will also draw in this thesis on some of our experiences in this urban autochthonous musical collective.

Soon, I began to identify with the highland Aymara way of life that Jesika and others taught me and set in motion a process to better understand myself and what it means to be human (ay. *jaqi*). During these years, we often visited the Andean shaman (ay. *amawt'a*) Carlos Yujra Mamani, who has guided our ancestral *jaqicha* ceremony in which my own life path became inextricably linked to Jesika's. The very humble and respectful *amawt'a*, who healed so many people throughout his life but tragically died himself at the end of my fieldwork in 2019, became a very important spiritual guide for us.

Because of his everyday commitment to attend his patients, seeking any kind of help for the problems of 'civilisation' he described to us on many occasions as inexistent in former times, he knew much about the complexities of contemporary modern, urban life in Bolivia. He wrote very critical books in both Spanish and Aymara about the temptations of modernity and the prospects of decolonisation from his spiritual *amawt'a* perspective (Yujra Mamani, 2005, 2009). Don Carlos was born in Achacachi municipality, in which Walata Grande is nowadays located. He often stressed to me how well he knew the Omasuyos people and their attitudes to life.

Negotiating Ethnographic Self-Image

In my early ethnographic encounters, flute makers were very careful about sharing information with me about their sourcing practices. Because of their overall mistrust, they withheld information about concrete places and sourcing localities. Some makers told me stories about foreign people (researchers and famous folklore musicians) who came to the community in order to "steal culture" and gain personal benefits from Walata Grande's collective making knowledge (see Chapter Four).

Early on in my research, in November 2016, some of the elderly Walateño flute makers working in Juan Granier street encouraged me to present myself in the general assembly in rural Walata Grande. I felt very reticent about following up on this invitation, although I could obviously imagine the reason for it. They aimed to incorporate my research under the social control of the community and therefore asked me to officialise it. I knew that my participation in the general assembly in rural Walata Grande would probably lead my research in a different direction. I initially wanted to collaborate with urban-dwelling flute makers in the cities of La Paz and El Alto on an individual basis, but as many of them maintain close links to their community of origin, I had to reconsider my plans.

My decision to participate was further determined by my wish to make my intentions transparent in order not to produce any kind of susceptibility in a historical and (post)colonial context, where highland Aymara communities often suffered exploitations and paternalisms from external actors. In a way, I also thought it could provide potential benefits for my research, for example strengthening my friendships with makers, getting in touch with *luriri* working at home, or contacting bamboo suppliers at a later point.

Furthermore, I saw the possibility to broaden participation in my research and to shift my role as a formal researcher towards that of a more active advocate for the concerns of flute makers. After initial conversations, I gained the impression that flute makers faced an existential struggle which involved tackling a social-ecological problem. This opened up possibilities for activist-type research, in the sense of Hale (2001, 2006, 2008), as a way through which to "affirm a political alignment with an organized group of people in struggle and allow dialogue with them to shape each phase of the process" (Hale, 2006, p. 97). Applied ethnomusicologists, too, have also argued for a more change-oriented and action-based stance within ethnomusicology. For example, Pettan and Titon's (2015) *Oxford Handbook of Applied Ethnomusicology* contains an entire section dedicated to advocacy and keywords such as "empowerment" (Pettan, 2008), "concrete problem solving" (Harrison, 2012), and "activist ethnomusicology" (Sherinian, 2015) have become doctrines for more action-oriented ethnomusicological research commitments.

I thought that I could actively ally with flute makers in their struggle and contribute to a solution of the problem. In a more activist type of doing research, I thought to advocate for the case of flute makers lacking voice in society, who then in turn would be more likely to accept me as an ally among them. I wanted to collaboratively produce socially robust knowledge that would be accepted and considered helpful, above all, by flute makers themselves. However, during the general assembly meeting, which dealt with diverse topics such as the implementation of a local irrigation system or the process of land redistribution (sp. *saneamiento de tierras*), I was given only a few minutes to present myself and explain my research ideas. In the vote that followed, my research was formally accepted by the assembly, under the premise of maintaining close contact to the following general secretaries over the coming years, to whom I promised to deliver updates and results of my research.

I was not really able to convey my argument that the research was aimed to be especially beneficial for flute makers. I rather vaguely presented my research ideas in the harsh Altiplano environment with strong winds which hindered the effective transmission of my words (the general assembly always meets outside on the main square of the community). Jesika accompanied me and also directed herself to the general assembly in order to support me and function as a witness of my non-exploitative intentions. Contrary to my expectations, I did not contact more flute makers, as the majority avoided me. Only one maker, the *musiñu* specialist Ignacio Quispe Katunta, approached me and later became one of my main collaborators.

I returned to the city, continuing with my routine of visiting urban-dwelling flute makers, remained patient, and built more alliances among my flute-maker friends, asking them to provide new contacts among colleagues they themselves trusted (in a kind of snowball selection system). This is how I finally got to know those urban-dwelling Walateño flute makers working in their private workshops at home.

However, with my participation in the assembly meeting I activated communitarian mechanisms of social control. In the following weeks, I continued visiting the political authorities in Walata Grande and assisted in their process of land redistribution, which I found was torpedoed by internal struggles and factionalisms, an organised resistance by land owning families, and an unofficial treaty with the new general secretary a year later. This is just one example of how collective action in a very divided and conflicted highland Aymara community was difficult to achieve, mainly because of internal rivalries and envy among community and family members.

As rural Aymara communities like Walata Grande annually change their political representatives, in this case in a peasant syndicalist structure, I dealt with four different general secretaries and their executive boards during my research. I would say that the first general secretary I conversed with overtly supported my research idea. The others instead maintained a critical distance. One of them, who I reported to as part of my commitment to the general assembly, once told me that he must deal with "more urgent things affecting our community"[35].

Critical Thinkers and Replicated Perspectives

In retrospect, my participation in the general assembly was politically and ethically correct but did not provide any further benefits for my research. To the contrary, it rather made my research much more complicated since I became subject to communitarian mechanisms of social control. All in all, with this new situation, my plans for a more activist type of research concerning the flute maker community became quite unfeasible. People considered me an unknown foreigner, who continued to be suspect even after officially presenting himself in the community assembly. But how could they

[35] "No tengo mucho tiempo de verdad. Tengo que atender cosas más urgentes afectando a nuestra comunidad."

do otherwise? I would have needed much more time in order to gain more trust within the community, which is probably more of a life task. However, I always was transparent and honest in all my research activities.

Indicative of the mistrust towards my person was one conversation with a Walateño flute maker who interrogated me with the sincerely held belief that I had already opened my own musical instrument shop in the neighbourhood of Miraflores, where our urban musical collective used to practice and organise social events. I always insisted that my motivations for learning to craft flutes were only scientific and not commercial. However, the practical parts of my ethnographic involvement into flute making must have been seen by some flute makers as evidence for my ‘real’ intentions to want to gain knowledge about flute making in order to make money with it (as so many others before have perhaps done).

Instead of counting on broad participation from the community, I returned to my initial idea of working individually with trusting maker friends who were intrinsically motivated and personally interested in participating in my research. Consequentially, they talked more openly with me about their life histories and visions about the future of their flute-making practices. Examples are the renowned Walateño flute makers Nicasio Quispe Mamani and Ignacio Quispe Katunta, two central protagonists in this thesis, who I would describe as knowledgeable and critical thinkers. Instead of using theoretical frameworks and analytical tools to explore their vantage points, I rather use their own critical analyses so as to think through aspects of multivalent and contested terms like cultural empowerment, artisanal development, cultural safeguarding, and musical sustainability (see Burman, 2016, drawing on Kirsch, 2006 and Taussig, 1980).

Against this background, I adhere with Tucker (2019) in arguing that projects in applied ethnomusicology and musical or cultural sustainability to date are mainly situated in the Global North or designed by scholars trained there. Reflecting on local political precedents of Western terms like advocacy, vitalisation, and sustainability can help situate one's ethnography within broader contexts of local Indigenous politics and struggles.

Ignacio, who maintains close but sometimes very difficult relationships with his community, never overtly supported me during community meetings. He once explained that he wanted to maintain distance to the possible critiques of his *paisanos* or 'co-members' of the community. He already had extremely conflictive relationships with very envious maker colleagues before I started my fieldwork. This was mostly because of his inexorable will to change things in the community concerning the future of flute making and the contemporary public image of the community as mass manufacturers of tourist flutes, which he described to me as one reason why musical bamboos came to be sourced according to an extractivist logic.

These ethnographic strategies of replicating critical viewpoints of flute makers themselves further resolves the intrinsic tension in my ethnography between the fiction or relativity in the textual representation of ethnographic data and the very normative concept of sustainability. The textualist critique of traditional ethnographic writing and the "crisis in representation" (Marcus & Fischer, 1986, p. 7) gave rise to the understanding of ethnography as a particular form of literature (Flaherty et al., 2002). In the ethnographic story, the narrator, in an overtly subjective manner, knits a red line guiding the reader throughout the chapters, an inner-textual leitmotif so to speak. However, the leitmotif of my ethnographic story reinserts into this subjective writing the highly normative and value laden concept of sustainability. It transforms my ethnography as a literary text into a critical social-ecological writing in itself. But rather than implementing my own categories with the potential threat of being narrow-minded, moralistic, and self-righteous, I followed flute makers in their own contextualisations and critical analyses, articulated from the perspectives of their local knowledge and often precarious life situations. Drawing on Tsing (2015), I hold that the point of ethnography is to learn how to think about a situation through one's collaborators. Inspired by the Melanesian ethnography of Marilyn Strathern (2004), my ethnography can be similarly understood as being constructed around the replicated perspectives of research collaborators in order to destabilise existing notions, evoking and displaying a vision of change from within the viewpoint of involved actors.

Internal Social Tensions and Turning Point

Because of my ethnographic unfolding in the city and the tensions within the rural community, I developed close friendships with more cosmopolitan flute makers, like the Mamani brothers, while my relationships to the autochthonous and elderly flute makers, for example from Juan Granier street, began to evolve in a more complicated manner. Cosmopolitan makers like the Mamani brothers, who occupy a central role in this thesis, do not maintain very close relationships to their community of origin. They do not regularly grow agricultural crops or fulfil community duties like communitarian *cargos* (authority positions in the communitarian government system in a rural Aymara community), and only attend general assemblies in extremely rare cases. Nevertheless, they draw on their community of origin as an economic brand in order to commercialise their professional flutes and proclaim to be knowledgeable and quality flute makers from Walata Grande.

Reflecting on this, I would say that my relationships to the elderly and more traditional makers in Juan Granier street possibly shifted as a consequence of my well-developed friendships with these more cosmopolitan makers. The moment they became aware of my friendship with the other flute makers, they closed off, while one elderly flute maker even recommended that I stopped talking to these cosmopolitan makers as I would probably have a more difficult standing within the community. As a general principle of collaborator participation, I wanted to give each maker an equal chance to be part of the research without giving preference to some over others. I did not negate my friendships with metropolitan makers, but neither did I want this to be a problem for my relationships with flute makers who maintained close links to their community of origin. Consequently, I have been thrown in the middle of internal social tensions between urban residents of a very divided and conflicted rural Aymara community, whose dimensions I only began to understand at the end of my research.

As my research proceeded, I realised that many flute makers considered me a potential threat to their interests. At the halfway mark of my research, I once more participated at the general assembly in Walata Grande. As part of my commitment, I presented a report of preliminary results of my research, which until then mainly focused on analysing the negative implications of deforestation and musical bamboo habitat destruction on contemporary flute making and bamboo sourcing; a topic which I thought could be of particular interest for flute makers. During the meeting, my presentation and the submission of my research report triggered an internal discussion about the usefulness of my research. Although I could not follow the entire discussion held in Aymara, I basically understood – which was confirmed to me by other participants afterwards – that some Walateños claimed that my research would not be in their interest. Others sustained that the general secretary should first read my report, talk to me about my research, and share his opinion in a subsequent meeting in order to then take a more considered decision. Unfortunately, this never happened, although I tried many times to arrange a meeting with the general secretary.

The assembly meeting was a turning point because what was discussed helped me better understand the possible root causes for their reluctance regarding my research. What was put forward was an overall concern about their economic incomes and increased prices for musical bamboo resources. As a matter of fact, the more direct interest of flutes makers is often economic income rather than cultural empowerment or a more sustainable bamboo sourcing. In this context, one must evaluate their economic actions in the light of the precariousness of their work and their immediate necessities in the short term, and the livelihood of their families. However, I tried to encourage flute makers to reflect on perspectives over the long term and stressed that other factors – beyond the economic realm – are key for the continuation of their flute-making practices (for instance, environmental aspects surrounding the viability of musical bamboos).

Moreover, my research could potentially make something public which for makers and traders better remains unknown; they are sometimes (willingly or unwillingly) involved in activities situated in a grey area of illegality, for example when bamboos are sourced in national parks and protected areas where deforestation rates are low, or when flutes are exported to Peru without involving the national custom office ('tax noncompliance' and 'contraband'). Moreover, the current economic structures of flute making on the highlands have changed the social organisation of bamboo sourcing, which has led to a more extractivist logic of bamboo sourcing in some areas and to exploitative and unethical treatments of local lowland Indigenous peoples involved in bamboo collection in others (the aspect of intermediation).

Considering the informality within their economic activity (from the Bolivian state perspective) and the precariousness of incomes sustaining local livelihoods (see Chapter Four), flute makers were worried that a more public discussion about musical bamboo sustainability could result in further state-imposed regulations such as the collection of taxes and more restrictive inspections of bamboo resources. These regulations could potentially increase prices, which makers categorically reject.[36] However, exploring the autonomy of Walateño flute makers in confronting challenges in musical bamboo sourcing obviously included the undoubtedly sensitive topic of analysing the consequences of makers' own economic actions, especially if

---

[36] As a matter of fact, every harnessing of non-wood resources like bamboo is already officially subject to environmental law in Bolivia, and is controlled by the Authority of Inspection and Social Control of Forests and Lands, called ABT in its Spanish abbreviation (*Autoridad de Fiscalisación y Control Social de Bosques y Tierras*), a decentralised institution of the Environmental Ministry. Not all bamboo trading routes are controlled though. Traders coming from Alto Beni towards La Paz sometimes pay taxes at a local ABT control station in Urujara on the road to the *yungas*, right before climbing the summit which leads into La Paz. A highland bamboo trader from Walata Chico once told me that he and his father-in-law had to pay taxes for bamboo resources in the local ABT control station in Montero in Santa Cruz department. Bamboo collection, nevertheless, is insignificant in relation to the land use change, or harnessing and sometimes illegal logging of trees happening all over the Bolivian Amazon. The ABT clearly sets priorities on wood resources, as the ABT Director of La Paz department explained to me in an interview in 2017.

national and international tourism contexts and the manufacture of souvenirs are involved (see Swanson & Timothy, 2012).

While becoming aware of the more extractivist logic of contemporary bamboo sourcing and unethical intermediation processes, I was uncertain regarding my ethical and normative standpoint. The heterogeneity of involved actors did not allow me to simply advocate for flute makers, since I also wanted to understand highland bamboo traders and especially local bamboo collectors. Their relationships to Walateño flute makers were not always very healthy, which is mostly connected to questions of economic exchange (see Chapter Six). I realised that within the very heterogeneous community of Walateño flute makers there was ambivalence towards the subject of musical bamboo sustainability. It seemed that many accepted the current problematic situation concerning musical bamboo intermediation as they were economically dependent on musical bamboo inflow to the city. I slightly misunderstood flute makers' lifeworlds at the beginning, which produced rather conflictive relationships towards the end of my research.

Musical Bamboo Traders and Clientelisation

I knew that musical bamboo sourcing was basically undertaken over the dry season months between May and October (see Gutiérrez, 1991a). Therefore, I had several months over the rainy season in 2017/2018 (November 2017 until April 2018) to concretise plans for my fieldwork into bamboo sourcing. My first idea was to accompany highland flute makers on their sourcing travels. However, finding Walateño flute makers who themselves still travel to source bamboos was a challenging task, as most urban-dwelling flute makers secure their urban bamboo supply via networks of musical bamboo traders. Therefore, I tried to establish contact with those Walateño flute makers who maintain direct contact to musical bamboo traders.

Strong internal competition apparently led some makers to persuade traders to work with them rather than with other makers. They simply offered more money, or other extra benefits, and the bamboo trader went over from one maker to another. In addition to a general secrecy about collection sites, flute makers nowadays take great care of their contacts and maintain close social bonds and reciprocal relationships with their bamboo traders through processes of clientelisation locally referred to as *casero*, a widespread organisational principle of economic networking in the Andes (Bradley, 1982; Tassi, 2017). These ties of personal loyalties may sometimes take forms of "fictive kind-relationships" (Bradley, 1982, p. 116) involving social relations over time.

Another internal organisational problem in contemporary bamboo sourcing is linked to resource dilemmas (see Chapter Six). When a maker shared too much information about new collection sites or mature bamboo populations in tropical forests, he always had to expect that other makers would establish contact with locals or collect all bamboos before he did himself. This is the reason why makers mistrust each other to a considerable degree, even among family members. The consequence of this lack of collective organisation of bamboo sourcing on the viability of bamboo populations will be discussed in Chapter Six.

Imaginaries about the Researcher

In addition to these internal organisational problems regarding bamboo sourcing, there was another challenge I, as a foreign researcher, had to face. This had to do with certain imaginaries projected onto my person.

Immediately after that aforementioned assembly meeting at the halfway mark of my research, I visited a maker friend in his house in Río Seco in El Alto. He also attended the meeting, which I asked him to contextualise for me. He explained in detail how the general assembly of Walata Grande had agreed years before I started my fieldwork that nobody should ever share any information about collection sites and traders with strangers and foreigners. Although my maker friend was always very helpful and courteous and explained to me the peculiarities and internal functioning of the community, he of course abided by this agreement, which was not the case for those makers who had already broken relationships with the community. I accepted his decision and listened to his recommendations. Being surrounded by all kinds of musical bamboos in his patio, he suddenly said to me the following: "Maybe you can study the charango makers in Aiquile [artisanal village in Cochabamba department], they are more open than we are and they are surely willing to help you."[37]

I was overwhelmed by his honest recommendation and simply nodded. He continued explaining that the reason for this protective step against foreigners had to do with a story about a French musician referred to by the name of Gil, who had been taken by some makers to the *chhalla* panpipe bamboo collection region in the Zongo valley. The valley of Zongo, close to La Paz city, is nowadays known as one of the most favoured collection region, where a particularly appreciated thin-walled woody bamboo for making high quality panpipes grows (see Chapter Four and Five). As the story goes, the Frenchman offered many times more money for these very musically

[37] "Tal vez puedes estudiar los constructores de Charango de Aiquile, ellos son más abiertos que nosotros y seguramente van a ayudarte."

appreciated thin-walled *chhalla* panpipe bamboos, than Walateño flute makers are able or willing to pay. Realising the high value of their thin-walled *chhalla* bamboos and how much they were appreciated by both flute makers and musicians, following the visit of the Frenchman, the *Zongueños* doubled the prices for their bamboo resources, so that local flute makers had to pay much more than previously. Those makers, who had taken the Frenchman to the Zongo valley, were apparently punished through communitarian justice (I was told through lashes with a whip) and almost expelled from the community.

A Moment of Conflict

Because of all of this, I explained in front of the general assembly with much clarity and transparency my further research intentions and my wish to contact highland bamboo traders from Walata Chico. As I had not heard any direct objections, I proceeded with the preparation of my field research in bamboo-sourcing regions and went to Walata Grande's neighbouring community of Walata Chico, whose members have become the main protagonists in the trade of musical bamboos over the last two decades. I wanted to contact these highland bamboo traders myself, although I knew that this could potentially worsen the tensions with the flute makers.

To my surprise, many Walata Chico traders were quite open to conversing with me and explained in much detail how and where they sourced bamboos. Some also talked with me about their conflictive relationships with Walata Grande flute makers, who were depicted to me as very envious about the fact that Walata Chico traders have recently started to craft flutes themselves. In turn, Walata Grande makers consider these recent developments as negative since they regard themselves as the legitimate and authentic bearers of the ancestral flute making culture on the La Paz highlands.

Walata Grande's application for national cultural heritage status in 2015 was in part motivated by the wish to forestall their colleagues from Walata Chico, who had already raised huge statues of panpipe players on their main square. This highlights the potential for the kind of "cradle" conflict which has become common in Bolivian heritage registration (sp. *patrimonialización*) (Bigenho & Stobart, 2016, 2018). Despite these disputes, these villages obviously depend on one another, so that relationships are nowadays characterised by opportunistic pragmatism and in some cases marriage and family relationships between these communities exist.

Following my first visits in early 2018, I travelled frequently to Walata Chico in the following months in order to intensify my contacts with these highland bamboo traders, locally known as *chhallero* or *tuqurero* in Aymara. My maker friends gave me contacts of traders they had worked with or who were family members.[38] Walata Chico traders nowadays organise themselves into groups covering different sourcing regions. This organisation apparently prevents competition and conflict within the community.

At the time of my research, there was a group of *chhalla* bamboo traders who constantly travelled to Bermejo, while another group covered the

[38] For example, I visited the son of a deceased bamboo trader who formerly sold bamboos to Ignacio. He only very sporadically travels to source bamboo nowadays and actually does not identify as a genuine bamboo trader. I have encountered a very similar situation within another trader family. I was given a contact of a bamboo trader who was the cousin of the Mamani brothers. While searching for him in Walata Chico, I met his wife, daughter, and son-in-law, who explained to me that the trader had died a year earlier. Although the son-in-law had since stopped trading bamboos, he shared with me interesting bamboo sourcing experiences he and his father-in-law had had during former sourcing travels.

collection sites in Alto Beni (both places provided mature panpipe bamboo in 2018, see Chapter Six). I tried to establish contact with these groups and talked to some of the members. One trader claimed that he stopped sourcing bamboos because of his advanced age. Another one was quite open and agreed to take me on his trips to the Andean-Amazonian foothills of Alto Beni. We arranged further meetings in El Alto and agreed to next meet in Palos Blancos (Alto Beni) once the heavy rainfalls in early 2018 had passed. Then, to my surprise, the highland bamboo trader, with whom I was about to develop rapport, started to avoid any further contact with me (e.g., rejecting phone calls). For me, this did not make any sense in that moment considering our former trustful conversations.

A few weeks later, I received a call from a maker friend telling me that a local bamboo trader from Cochabamba was on his way to El Alto in order to deliver a load of *tuquru* bamboos. I decided to meet the trader and left our house in El Alto at dawn in order to meet the bamboo trader at a gas station in Río Seco. From the distance I saw how Walateño flute makers began unloading the van. I initially thought it would be better not to approach the trader in their presence. However, as I spotted flute makers I had conversed with before, I decided to get closer and talk to the trader anyway. One of these makers saw me and approached me. It was the one who recommended me to study the Charango makers in Aiquile. He was extremely upset and very angry with me. Suddenly, he shouted at me and accused me of wanting to steal his *chhallero*, who I apparently had persuaded with money, food, and other goods in his house in rural Walata Chico. Other makers approached us, and he further claimed that I had told his *chhallero* that I wanted to export bamboos to Europe. I tried to calm him down, but I did not succeed. The situation did not escalate further because I left the place.

The maker was referring to my contact with the bamboo trader a few weeks earlier. Both apparently had strong trade relationships, of which I did not know before. Later, many rumours circulated among Walateño flute makers, which all had one aspect in common. While receiving his typical ‘payment in advance’ (sp. *adelanto*), the bamboo trader apparently told the flute maker that I was going to accompany him on some of his sourcing trips to Alto Beni. The flute maker got furious and threatened his *chhallero* to stop any further trade if he allowed me to travel with him.

I wanted to talk with the flute maker at a later point in order to clarify the situation, but he did not answer any phone calls. The whole story, however, explains why the bamboo trader suddenly changed his opinion and avoided contact with me. It articulates a worry of a flute maker in the light of internal organisational sourcing challenges. As he had also sold me bamboos sporadically, probably more expensive than usual, he must have further thought I was looking for cheaper bamboo purchase options. The accusation that I intended to export bamboos only added an additional defamatory aspect to the whole conflictive incident.[39]

In terms of clarifying to makers that exporting bamboos was never my intention, I always assured makers and traders that my motivations to travel to bamboo collection sites were merely scientific. There was no pressure or

[39] As a matter of fact, metropolitan makers well know that the export of any kind of natural products such as bamboo or even bamboo-made flutes is highly regulated by the Bolivian state (as well as the import to Europe by the European Union). Interestingly, makers like the more cosmopolitan Mamani brothers have already tried to export bamboo internodes to friends in Europe, which were then returned to them by the Bolivian custom service.

any kind of monetary persuasion.[40] At any time during my research, all interlocutors always had the free and autonomous decision to collaborate or not. However, the general problem was that, from the beginning, many flute makers did not welcome my research.

All these difficult moments catapulted me into a very self-reflexive state. The most difficult point to understand was the fact that the rejection of many flute makers was not only related to what I did, that is my research, but also to who I was, the foreign white researcher who always remained "other" irrespective of the many efforts I made to become more accepted. This forced me to turn the lens around and study myself. I reflected about my own decisions in the research process and the many things I would do differently if I could restart from scratch. I consider these tensions with flute makers as valuable fieldwork experiences always shaping my understanding of how to do ethnography.

Concluding Remarks

The fact that many Walateño flute makers themselves rejected any kind of research into musical bamboo sustainability issues opened up the very important question about the legitimacy of my research. If the principal stakeholders expressed such a deeply rooted aversion to it, what justification did I have for undertaking this research? This is far from a trivial question,

[40] Against this background, it is noteworthy that I paid a daily wage to some of my hosts/guides in sourcing regions, who interrupted their daily work schedule in order to guide me through dangerous subtropical forests and show me musical bamboo populations (see Chapter Six). For me and my hosts/guides in bamboo sourcing regions, this was clearly a form of reciprocating and a normal compensation for their dedicated time (which they could not spent on making their living and securing their livelihoods).

especially in relation to the shifting politics of ethnomusicological fieldwork, from neutrality to praxis, or from description to advocacy (Araújo, 2008).

I agree with Araújo (2008) that neutrality is problematic, and that knowledge should emerge from a truly horizontal, intercultural dialogue. I would basically argue that I do take sides in emphasising social-ecological questions of sustainability in musical bamboo use. However, the context of bamboo sourcing and highland flute making in the Bolivian Andes is exceedingly complex, since flute makers are implicated in unsustainable bamboo uses and sourcing practices. I stepped back from more activist elements concerning my commitment to the flute maker community and returned to critical social-ecological reflections, articulated from a formal outsider perspective. This provided a better ground for developing a multi-perspective view on the topic, which was fundamentally necessary in order to acknowledge the heterogeneity of personal, foremost economic interests of involved actors (many of which I consider my friends) and to reconfigure my own ethical and normative standpoint.

Citing Seeger (2008, p. 272) in his article about the joys, dangers, and potentials of advocacy in ethnomusicological research, I would say that I changed the “utilitarian extreme” of doing research into a more nuanced analytical kind, putting the struggle of musical bamboos itself at the centre stage of my inquiry. This was further inspired by a mind-changing conversation I had with the *amawt’a* Don Carlos, just at a time when problems with Walateño flute makers and highland bamboo traders reached a peak. After telling him about my experiences, he caused me to reflect on my initial motivations for undertaking my research and recommended me not to carry out research "for the personal interests of people"[41]. He used the word *gente* ('people') in Spanish, but I think this was rather meant in the sense of 'humans'.

He said that I should instead focus on broader contexts and the underlying destiny of my presence in the Andes. "Why have you touched these lands and why are you doing what you do?"[42], he asked me thoughtfully. In the Andes, there is no chance, and I indeed sensed a deeper meaning, for being where I was, for falling in love with my wife, for setting in motion a spiritual journey into a world of difference, and also for my research on musical bamboos, for which I had to go through very complicated moments in life.

With his questions resounding in my head, I left his *qulla uta* ('consultation room') in the popular neighbourhood of Pampahasi on the eastern slopes of the *chukiyawu* valley of La Paz city. I stopped any research related activities for a few weeks. His non-anthropocentric perspective of "not doing research for the personal interests of people" made me reflect on so many things. It has the potential to reform contemporary concepts of activism and advocacy in anthropological and ethnomusicological research going beyond the merely human sphere. Therefore, I consider studying and writing about the environmental sustainability of musical bamboos, in its narrow and wider sense as discussed in Chapter One, as an implicit activist goal of this research.

Deeply inspired by his political writings, I started to analyse mechanisms of unsustainability within flute making and bamboo sourcing and explored the current economic, social, and cultural forces driving flute makers and

[41] "No deberías hacer investigaciones para el interés personal de la gente."

[42] "¿Por qué has tocado esas tierras y por qué estás haciendo lo que haces?"

bamboo collectors to many unsustainable practices. Rather than critiquing people, following an undoubtedly doctrinal position, as so many urban *mestizo* environmentalists do in relation to Aymara people (see Burman, 2017), I rather tried to understand actors involved and comprehend the reasons for their current behaviours. In a first step, this meant understanding in depth the shifting modes of highland flute making and bamboo sourcing form a historical perspective, against which I discuss aspects such as craft specialisation, economic decontextualisation, urban migration, and shifting markets. This is something I will turn to in the next chapter.

Chapter 3

The History of Walata Grande

Craft Specialisation, Economic Disembedding, and Shifting Contexts of Highland Flute Making

I often visited the *musiñu* maker Ignacio Quispe Katunta in his house in the popular neighbourhood of Chijini on the western slopes of the *chukiyawu* valley of the city of La Paz. During our countless conversations, he often recounted aspects of Walata Grande's history as a flute-making centre, including peasant serfdom during hacienda times, the era of the craft cooperative, and experiences of urban migration. On one occasion, we were talking about Walata Grande's expansion as a flute-making centre on the Bolivian highlands and the contemporary relevance of another flute-making centre on the southern Altiplano in Oruro department, called Condo, when he suddenly stated that: "We have outshone Condo and nowadays fellow Walateño flute makers also live and work in Oruro."[43] What happened to Walata Grande over the twentieth century that Ignacio can make such a claim?

This chapter deals with the shifting modes of highland flute making and bamboo sourcing among specialised Walateño flute makers. It contextualises the research through a historical account of Walata Grande, against which I discuss aspects such as craft specialisation, economic disembedding, urban migration, and shifting markets. The chapter therefore historically creates

[43] "Hemos puesto a Condo por encima y hoy también paisanos viven y trabajan en Oruro."

context and outlines the social, economic, and cultural transformations that have impacted negatively on the sustainability in flute making as it relates to the use of musical bamboos (thereby linking back to the framework of sustainability). This historical embedding makes it possible, at the end of this chapter, to offer a detailed description of the contemporary flute-making spheres. This prepares the reader for the analysis of bamboo demand, urban bamboo supply, perceptions of scarcity, and musical values attributed to different bamboo types and variants (see Chapter Four).

I will begin this chapter with a brief archaeological excursus about the use of native woody bamboos on the Altiplano. This is necessary in order to contextualise the discussion of craft specialisation, developed by former Walata Grande scholars in relation to ethnohistorical literature and ecological verticality as a system of economic organisation of former pre-Hispanic Aymara nations. Critically engaging with this discussion, I argue that the ethnohistorical concept of craft specialisation is only partially suitable for understanding the rise of Walata Grande as a specialised flute-making centre on the Altiplano. I claim that Walata Grande specialised in flute making rather recently, thereby producing the nowadays widespread social division of labour between flute making and bamboo sourcing, which ultimately paved the road for the trade of musical bamboos as commodities.

A Brief Archaeological Excursus: A Musical Bamboo Perspective

In Chapter One, I introduced the musical bamboos of the Andes, namely *chhalla* panpipe bamboo and *tuquru* vertical/transverse flute bamboo. I furthermore argued that highland flute makers on the Altiplano additionally employ the giant reed known as *suqusa* in Aymara in some cases. Although some of the contemporary *suqusa*-made wind instruments (e.g., *jula-jula*, *waucu*, *ayarachi*) are perceived as being especially ancient (in part due their musical scales and distinct tonal organisations) and exclusively used in particularly rural ritual and ceremonial contexts (e.g., see Gérard, 1998, for the case of the *ayarachi* panpipes), the giant reed is not native to the Americas (Hachmeyer, Forthcoming). It was introduced after Spanish colonisation, that is post-1500. Its origin is obscure, but it is probably linked to the greater Middle East (Hardion et al., 2014), where it continues to be used to make *ney* flutes.[44]

Therefore, pre-Hispanic cultures on the Andean highlands must have used tropical native woody bamboos of the neotropical realm, such as *tuquru* (*Aulonemia*) and *chhalla* (*Rhipidocladum*), for making bamboo-made wind instruments. This raises important questions about the use of musical bamboos in highland flute making from a music archaeological perspective.[45] When did pre-Hispanic cultures on the highlands begin to use musical bamboos for making flutes? How and where were musical bamboos accessed and sourced in pre-Hispanic times? And what are the implications for flute-making specialisation in Walata Grande and contemporary musical bamboo sourcing?

Archaeological evidence of native woody bamboo-made flutes on the Altiplano is tremendously scarce (as opposed to flutes and other sound

---

[44] The giant reed, which was used until recently without any viable alternative to make reeds for reed aerophones, was also important for the development of musical culture in the Western world (Perdue, 1958).

[45] I am not a music archaeologist, and neither have I undertaken an extensive music archaeological study of bamboo-made flutes for this thesis. In the following section, I will only synthesise the current music archaeological knowledge and unfold some implications of my musical bamboo research for the study of archaeological bamboo-made flutes on the pre-Hispanic Altiplano.

producing instruments made from ceramics, bone, or stone). Various authors (e.g., Bellenger, 2007; Janusek, 1993; Pérez de Arce, 1993; Sánchez Huaringa, 2018; Sánchez & Sanzetenea, 2000, 2002; Stobart, 1996a) have linked this to poor climatic conditions and problems of conservation. The northern Altiplano, in particular, is indeed much more humid than the dryer southern Altiplano (for example, the intersalar region), where some pre-Hispanic bamboo-made panpipes have been preserved (see Lecoq, 1985) (Figure 7).

Figure 7: Archaeological Bamboo-Made Panpipes (Southern Bolivia)

(Source: Left Photo by Rosalía Martínez; Right Photo by Arnaud Gérard)

Left: *Siku* in ASUR, Right: *Siku* from Puqui

In Bolivia, four archaeological bamboo-made panpipes are known to date. Three were found in burial monuments in archaeological sites in the intersalar region, with two of them found by a Bolivian archaeologist in Puqui (west of Salinas de García Mendoza, Oruro department) and one found by Patrice Lecoq (1985) between Salinas de García Mendoza (Oruro department) and Llica (Potosí department). The fourth panpipe, which is kept in the Museum

ASUR in Sucre (Chuquisaca department), is uncontextualised since the *huaquero* (‘grave robber’) did not want to reveal its origin. Archaeologists assume that it also comes from the intersalar region.

Music archaeologists link the spread of native woody bamboos used in highland flute making on the Altiplano, exemplified with *siku* panpipes, to Tiwanaku culture and the Early Intermediate (100-600 AD) and Middle Horizon periods (600-1000 AD) (Sánchez & Sanzetenea, 2000).[46] Tiwanaku, in turn, is said to have been influenced by northern Andean woody bamboo-made panpipe traditions that expanded towards the South through the neighbouring Wari civilisation (Pérez de Arce, 1993, 2004). To date, there is no archaeological evidence (material or iconographic alike) for earlier uses of musical bamboos on the Altiplano.

Pérez de Arce (2004) suggests that woody bamboos replaced ceramic materials in the Tiwanaku period, which were still predominantly used in earlier Paracas and Nazca cultures. This hypothesis is further supported by Tiwanaku’s musical influence on local cultures in northern Chile (Cabuza and Maytas-Chiribaya), where woody bamboo-made panpipes from the Middle Horizon (not earlier) were preserved in more arid environments, for example in the Azapa valley in Arica (Chacama, 2004; Chacama & Díaz, 2011; Grebe, 1974; Pérez de Arce, 2004; Schampke, 2017, 2018) (Figure 8). Later, musical bamboos expanded over the Late Intermediate (1200-1450 AD) and Late Horizon (1450-1534 AD) periods. This included regional developments in the

[46] A monolith from Tiwanaku known as the panpipe player (“*zampoñero*”) and a ceramic vessel found in mesothermal valleys (Mojocoya) showing a panpipe player give evidence of the importance of this Andean emblematic musical instrument during the Tiwanaku period (Sánchez & Sanzetenea, 2000, 2002).

valleys of northern Chile (Chacama & Díaz, 2011; Schampke, 2017), as well as ancient Aymara nations on the Altiplano (Sánchez Huaringa, 2018; Sánchez & Sanzetenea, 2000, 2002).

Figure 8: Archaeological Bamboo-Made Panpipes (Northern Chile)

(Source: Photos by Andro Schampke, 2018)

Siku Panpipes found in the Azapa Valley, Chile

The bamboo-made panpipes found in the archaeological site in Puqui in Salinas de García Mendoza (Oruro) have not been dated exactly. The burial monuments in the region correspond to various periods, including Middle Horizon and Late Intermediate. The panpipes show some similarity with those single-rowed *siku* found in the Azapa valley. Thus, on the one hand, they could well belong to the Tiwanaku period.[47] On the other hand, it is also possible that they belong to much later *killaka* Aymara people (see Sánchez Huaringa, 2018). Lecoq (1985), for example, relates the panpipe found in a burial cave to the Aymara nations (1200-1400 AD).

[47] They are also exhibited next to other objects from Tiwanaku in the archaeological museum in Oruro (Gérard, 2020, pers. comm.).

If the expansion of tropical native woody bamboos as natural materials used in flute making on the Altiplano dates back to the Middle Horizon period, and assuming that the same native woody bamboos presently in use were used in former times (which is very likely in the light of the discussion above), this would mean that Tiwanakotas had access to musical bamboos growing (as they do today) in their natural habitats in tropical *yungas* forests on the eastern Andean slopes and Andean-Amazonian foothills (see Chapter Five).

From a music archaeological perspective (and linking to the research method of operational sequence), this is an important clue about the provenance of bamboo materials used in pre-Hispanic flute making. Thus, woody bamboos found tied up in archaeological raft panpipes are not local to the archaeological sites, for example in the Azapa valley or the intersalar region. Whether musical bamboos were traded as finished musical instruments or acquired as unprepared tubes which were then locally crafted into panpipes, is still a mystery. In the light of the political, religious, and cultural hegemony of Tiwanaku, where a complex sonorous system and technically sophisticated artisanal practices had developed (Janusek, 1993; Posnansky, 1957; Sánchez & Sanzetenea, 2000, 2002), it is easy to imagine the early existence of a centralised crafting tradition in Tiwanaku capitals like Lukurmata (see Janusek, 1993).

Were centrally crafted panpipes (and possibly other highland flutes such as notched *qina*) distributed around its territory as part of Tiwanaku's hegemonic (political, economic, and religious) expansion? Might this indicate a first specialised centre of highland flute making on the Altiplano? The existence of musical bamboos used in flute making on the Altiplano is only one more piece of evidence for Tiwanaku's expansion and the extensive trade relationships that existed during the Tiwanaku period. The typical llama caravans not only transported material goods from distant places to Tiwanaku's centre at the shores of Lake Titicaca but also ideas and ideologies demonstrating the political and economic power of regional and territorial integration.

Following the Middle Horizon period, many pre-Hispanic Andean cultures developed into complex agricultural societies with increasing requirements of labour. Social cohesion was needed in order to carry out labour-intensive agricultural tasks and broader participation in music-making practices could possibly have contributed to this (Schampke, 2020, pers. comm.). Additionally, seasonally organised music in relation to agricultural production and rituality, exemplified by contemporary Aymara and Quechua Andeans on the Bolivian highlands (Buechler, 1980; Solomon, 1997; Stobart, 2006a), could have possibly developed as well. It is well known that the Inca calendar already included a sequence of dance, song genres, and musical instruments performed as part of each month's ceremonies and linked to crop growth (Stobart, 2006a).

In this regard, it would be consistent to think of the origins of the "participatory tradition" (Turino, 1989, 2008) of rural Andean Indigenous music as being related to the expansion of musical bamboos used in highland flute making following the Middle horizon period. An increase in the number of flute players could have been a further driver of artisanal specialisation. Panpipes crafted from other materials such as stone, bone, or ceramics have been used either by individual performers (such as shamans) in contexts of hallucinogenic substances (such as *rapé*) (Pérez de Arce, 2004; Sánchez &

Sanzetenea, 2002), or by smaller groups, which could have still applied the interlocking technique between two complementary pairs of panpipes which is now widespread (Sánchez & Sanzetenea, 2000; Stobart, 1996a).

The use of musical bamboos in flute making implied certain crafting techniques and processes. Musical bamboos are naturally hollow and ideal resonator tubes.[48] Bamboos permitted Tiwanaku flute makers considerable acoustic precision and advanced control over sound (Sánchez & Sanzetenea, 2000). Following the Tiwanaku period, the emblematic and much debated second row of contemporary rural bamboo-made panpipes further spread on the Altiplano (Sánchez Huaringa, 2015, 2018; Schampke, 2017, 2018), which further allowed for an aesthetical modification of the timbre through adding more partials to the overall sound (Gérard, 2018).

The modality of accessing natural resources is an important question in the moment of artisanal specialisation. This could have been done through direct enclaves and typical Tiwanaku llama caravans. Tiwanaku had colonies in the eastern tropical regions and exerted musical influence in the mesothermal valleys of Cochabamba (Céspedes, 2000, 2002). It is well-known that later Aymara nations (1000-1438 AD) continued with similar economic patterns of ecological verticality (Murra, 1968, 1975).

In his Andean economic model of vertical archipelago, John Murra (1968, 1975) showed how Aymara nations on the highlands like the *lupaka* maintained control over a vast territory through establishing permanent

---

[48] Many pre-Hispanic panpipe makers perforated the nodes of the woody bamboos, which were themselves natural closures of the tubes, and modified the pitch with squash stoppers. In contrast, contemporary Walateño *sikuluriri* use the nodes as natural closures. For a more detailed discussion about changing crafting techniques as a consequence of the use of musical bamboos, see Hachmeyer (Forthcoming).

colonies (“islands”) on both sides of the Andes. This enabled a diversification of crop cultivation and the sourcing of natural resources in diverse ecological floors through vertical control, exercised from a political, social, and economic centre on the highlands. Murra (1975, p. 46) further suggested that some permanent “islands” could have fulfilled other non-strictly ecological functions, such as where specialised artisanal work developed. This was the case for Sunicaya (metallurgy) and Cupi (pottery) among the ancient *lupaka* Aymara people. Murra (1975), and later Bouysse-Cassagne (1987), argued that these “artisanal islands” emerged in localities within close proximity to natural resources.

In fact, the location of Walata Grande at the foot of Mount Illampu on former *pakaji* territory with its proximity to tropical *yungas* forests of Larecaja province (one/two-day hike) is tantalising in this regard (Figure 9). However, there is no proof for Walata Grande’s existence at this time (see below), even though Borras (2002) has argued that it shows many of the characteristics of a pre-Hispanic type of specialised artisanal centre.

More generally, there is no material evidence for any specialised centre of flute making on the Altiplano during the era of the Aymara nations, while Murra (1975) rather thought of ecological verticality as a means of enhancing communal self-sufficiency in separated moieties. The archaeological sites, where the above-mentioned bamboo-made panpipes were found in the intersalar region on former *killaka* territory on the southern Altiplano (it is not entirely clear however whether they belong to the Aymara nations), are strikingly close to a place where another contemporary Aymara flute-making centre emerged, namely Condo (Gutiérrez et al., 1999, 2001), nowadays largely eclipsed by Walata Grande’s expansions.

Figure 9: Village of Walata Grande (Source: Own Photo)

Omasuyos Province, La Paz Department (Mount Illampu in the Background)

In the middle of the sixteenth century, the *killaka* village of Condocondo was transformed by Francisco Toledo into San Pedro de Condo during the village reductions (sp. *reducciones*) in the Quillaca and Azanaques *encomienda*[49] (Abercrombie, 1998, p. 224; see also Bouysse-Cassagne, 1987; Domínguez & Presta, 2003; Espinoza, 1981; Harris, 1997; Saignes, 1986). These *reducciones* were part of a broader process later referred to as Andean "destructuration" (Wachtel, 1971), in which pre-Hispanic territorial, social, political, economic, architectonical, and ritual/ceremonial structures (*ayllu-marka*-structure, ecological verticality, etc.) were systematically destroyed.

In these *reducciones*, Indigenous peoples as well as the landscape were Christianised (religious indoctrination, extirpation of idolatry, and re-sacralisation of the landscape), following a civilising mission of colonial-religious authorities and the aim to transform the Indigenous population

[49] The *encomienda* was a Spanish system of communal slavery that rewarded conquerors with labour of Indigenous people in particular regions and communities.

towards Spanish norms of ‘good conduct’ (sp. *buena policia*) (see Gose, 2008). Churches were built in urban-like Spanish villages around a main square and on sacred Andean mountain sites or “place-beings” (Burman, 2016) called *wak’a* in Aymara. All these measures aimed at producing submissive and subservient subjects legible to the colonial state.

For the case of both recognised flute-making centres on the Bolivian highlands, that is Condo and Walata Grande, it is unclear when exactly flute-making practices developed. In this regard, more ethnohistorical research is urgently needed. Condo panpipe makers accessed *chhalla* bamboos in the Inquisivi *yungas* around Licoma (Gutiérrez, 2002), which is more than 300 kilometres away, thus a much greater distance to *chhalla* populations in the subtropical *yungas* forests compared to the journey from Walata Grande.

The fact that the archaeological bamboo-made panpipes from Puqui could have been crafted locally would make me rethink the importance of the proximity to natural resources in the development of artisanal practices. Even if secure access to prime materials is a necessary pre-condition, I more generally doubt whether this idea helps to understand the rise of Walata Grande as a specialised flute-making centre on the Bolivian Altiplano, as Gutiérrez (1991a) (perhaps indirectly) has suggested. I will further elaborate on this doubt in the next section, where I critically engage with the discussion about flute-making specialisation in Walata Grande. Concluding this archaeological section in relation to the sustainability framework developed in Chapter One, it is tantalising to think about former pre-Hispanic bamboo sourcing practices as an ancestral source for more sustainable bamboo resource uses. Yet, the argument is not straightforward and contains a potential for romanticisation. Very little is actually known about the specificities of pre-Hispanic bamboo sourcing from an archaeological or ethnohistorical perspective. While this thesis may provide a little clarification as regards the broader provenance of bamboo materials used in pre-Hispanic flute making, the general lack of knowledge and uncertainty do not permit us to draw parallels. However, one can certainly argue, as I do further below, that ecological verticality and related forms of animal caravans would have determined the number of bamboos that it was possible to collect and transport. I follow up on this argument later in Chapter Six in relation to the bamboos' capacity of natural reproduction and more extractivist forms of sourcing. However, in order to fully understand these shifting modes of bamboo sourcing at a later point of this thesis, I must firstly turn to questions of craft specialisation and move the attention from ethnohistory to the modernity of the twentieth century.

Walata Grande and Flute Making Specialisation

Ignacio, the *musiñu* maker mentioned at the beginning of this chapter, once recounted how his grandfather and others, together with animal caravans, made the journey of several days by foot from Walata Grande to *yungas* communities in the Sorata valley in Larecaja province (La Paz department) in order to source musical bamboos. This exemplifies well the Andean economic model of accessing natural resources described by Bouysse-Cassagne (1987) for the ancient Aymara nations, only that the direct access via the "vertical archipelago" (Murra, 1968, 1975) has been replaced over time with a system of ecological complementarities and series of exchanges between established highland and lowland communities (Gutiérrez, 1991a, based on Salomon, 1985). Another sourcing site for former Walateño flute makers was Chhallana (‘with *chhalla* bamboo’), an Aymara community in Larecaja province, situated at the ‘eyebrow of the forest’ (sp. *ceja de monte*), the transition region of the highlands towards the *yungas* cloud forests. Ignacio explained to me that Walateño flute makers walked several days with their mules, crossing the Cordillera Real and passing Mount Chachacomani (6074m) and other snow-capped mountain peaks, referred to as *achachila* (grandfather) and *awicha* (grandmother) by Aymara Andeans.

These ‘mountain spirits/guardians’ are wilful agents, who are likely to benevolently guide life if people know how to properly reciprocate with them (in the form of ritual offerings, libations, feedings, and remembering). If these strategies of social incorporation fail, they are very capricious beings sending various kinds of misfortune and harm to people and their communities (Gose, 2018). Gutiérrez (1991a, p. 138) gathered a local testimony of how elderly makers still used to make ritual offerings to mountain spirits in the 1990s in order to request permission to enter the *yungas* forests and ask for a safe journey and a successful bamboo collection. Gutiérrez (1991a) has linked these now largely abandoned sourcing practices to broader Andean economic organisational forms of ecological complementarity. However, is the ethnohistorical concept of artisanal specialisation (proximity to natural resources), to which this has been related, sufficient for understanding the rise of Walata Grande as a specialised flute-making centre, especially during the twentieth century?

In the ethnohistorical literature, the quantity of people involved in manufacture is often used as an indicator of artisanal specialisation. In this sense, Gutiérrez (1991a) has argued that almost all of the 220 families in the community were directly involved in flute making. This number reflects a level of specialisation in flute making at community level unique in the Bolivian highlands. However, in the context of monopolising Walateño flute makers, who over time have collected *tupu* measuring sticks of a great diversity of rural Aymara flute variants (Borras, 1995), the term specialisation is somewhat ambiguous. Walata Grande as an often idealised artisanal community did not specialise in making one particular flute type, as happened in other highland communities, where only certain individual specialists crafted flutes. This was the case, for example, with *pinkillu* flutes of Vitichi, in Potosí department (Stobart, 1988), or with *qantu* panpipes in Kallawaya communities in northern La Paz department (Langevin, 1992).

Instead, Walata Grande makers successfully incorporated almost all flute types of the Aymara Altiplano into their repertoire, especially bamboo-made flutes. This evidences expansion and diversification rather than specialisation as a narrowing activity. This is true even when individuals or families within the community indeed specialised in making one particular flute type (which had much to do with the former craft cooperative mentioned further below). Notwithstanding, there is no doubt about Walata Grande's exceptional history and significance for rural Indigenous flute making on the Bolivian highlands. However, when exactly Walata Grande became such a "specialised centre of flute making" (Gutiérrez, 2002), as it is often portrayed, is still quite unclear.

González Bravo (1936, n/p, quoted in Borras, 1995, p. 74 [my translation]) wrote about flute making of "the skilful Indians from Walatta [sic]" at the beginning of the twentieth century. To my knowledge, this is the earliest ethnomusicological document mentioning flute making activities in Walata Grande. He further adds that panpipes from Walata Grande "have spread a lot and they have been found even in Perú, in Lampa and Santiago de Pupuja, in the department of Puno" (González Bravo, 1936, n/p, quoted in Borras, 1995, p. 74 [my translation]). I would interpret this, as Borras (1995) did, as early evidence of the regionalisation of Walata Grande at the beginning of the twentieth century. However, the makers consulted by Borras (1995) owned *tupu* measuring sticks, inherited over several generations, which dated back at least to the end of the nineteenth century. Thus, Walata Grande makers appear to have made a wide range of rural highland Indigenous flutes from at least the late nineteenth century.

While talking about Walata Grande's origins, Ignacio once told me that

> Walata Grande is an ancient community, as is the whole sector, Warisata as well. We do not exactly know [its origins]. Our grandparents did not know it well either. We always wanted to figure out more about it, but we could not.[50]

According to Ignacio, Walata Grande was founded as a hacienda during the nineteenth century, through the initiative of a *mestizo*[51] family called Imaña (Eduardo and his son Daniel) joining together people from surrounding villages (Hachmeyer, 2021b; see also Gutiérrez, 1991a). However, little concrete information is known concerning such an 'official' history. From an ethnohistorical perspective, it would therefore be interesting to further look into parish records or colonial censuses in order to find out more about the early existence of Walata Grande and the conditions of its foundation. But history is different if seen from a local perspective, which is an equally valid source of historicity. Walateños themselves, as do many contemporary

[50] "Walata Grande es una comunidad antigua, como todo el sector, Warisata también. No sabemos muy bien. Nuestros abuelos no lo sabían bien tampoco. Siempre queríamos averiguarlo, pero no podíamos."

[51] In Hispanic America, denomination of a person with European and Indigenous American descent/heritage (nowadays used more in the cultural sense).

Aymara people, usually divide history in three major epochs: *chullpa pacha*, *inka pacha*, and *patruna pacha* (see Canessa, 2012).

According to people in Walata Grande, the existence of the *chullpas* ('ancestors') predates the origin of contemporary *inti jaqi*, or 'people of the sun', whose arrival combined with the emergence of panpipes. This origin myth was first described by Gutiérrez (1991a). Walateños explained to him how in *chullpa pacha* dawn governed life since the sun had not risen yet. They recounted that 'echoes' (probably a concept for *chullpa* by Walateños, see Gutiérrez, 1991a) playing panpipes walked by night on ancient stone trails towards Lake Ajuyani (vocalic change in Aymara: *ajayuni* meaning 'with spirit'), an enchanted place where people got lost. As these echoes played panpipes, nothing happened to them. But one day, so the myth tells, they threw stones into the lake, and suddenly the sun rose burning up the *chullpas*. They left behind their panpipes, which were found by Walateño *abuelos* ('grandfathers'). According to local accounts, since this time Walateño makers have been crafting panpipes, imitating the sounds of the wind and the feather grass (*Stipa* sp.) called *sikuya* in Aymara, the etymological origin of the Aymara name for rural-style panpipes called *siku*. Similar origin myths for other flutes, told by Walateño flute makers, have also been documented by Borras (2010). Many makers also claimed that former generations made flutes from clay and bone (Gutiérrez, 1991a; Mendoza, 2009).

For the Inka period, I was told by Ignacio that Walata Grande was an important place, through which many travellers would have passed, on the road to the tropical *manqa yunkas* colonies, highlighting again the importance of ecological verticality. One particular sector of the higher parts of the community is called *samarañ pata*, or 'high place for resting', where many people would have rested on their long journey to the lowlands. Ignacio also maintained that formerly Walateños took advantage of these Inka roads in order to source musical bamboos in nearby tropical *yungas* forests. Even today, some Walateños use the Sillutinkara and Choro pre-Hispanic trails in Cotapata in order to source musical bamboos. I was further told that Incas or even more ancient Tiwanakotas settled in Walata Grande during their caravan trading journeys to the *yunkas* territories (for similar accounts highlighting Walata Grande as a form of *tambo,* see Mendoza, 2009).

After the Spanish colonisation, the community received its current name: Walata Grande. It was named after the Andean geese (*Chloephaga melanoptera), jach'a wallata* ('large goose') in Aymara, which frequented nearby Lake Ajuyani, as they do to this day (Hachmeyer, 2021b; Mendoza, 2009). The hacienda period was perceived by many Walateños like Ignacio as a time of 'slavery' (sp. *esclavitud*), where the *patruna* or hacienda owner established a series of obligations (see also Hachmeyer, 2021b). There was exploitation of both people and land, with the owner maintaining order on the hacienda through physical violence, or 'whipping' (sp. *chicotazo*) (Gutiérrez, 1991a). As a result of uprisings against the hacienda owner, Ignacio's grandfather had to escape to the neighbouring valley community of Pakollo in Larecaja province (La Paz department). Ignacio also told me that Walateños did not have much time for flute-making activities on the hacienda, as former latifundial land tenure, the social hierarchical feudal system, and related servitude (sp. *pongeaje*) would not have allowed time for intensive dedication to flute making (Hachmeyer, 2021b). The hacienda owner always forced them to work in agriculture or tend livestock, complaining if people dedicated too much time to free activities. As serfdom in hacienda times was perceived as a form of slavery, the national revolution in 1952 initiated a process of emancipation. Since the agrarian reform, a year later, Walateños have worked their lands and organised their time freely. Ignacio's grandfather returned to Walata Grande soon after and claimed his land. As part of that emancipation process, Walateños destroyed their ancient burial towers (also called *chullpa* in Aymara) and Inka roads in the community (Borras, 1995, 2001). Borras (1995, 2001) argues that they even rejected making and playing some ancient *siku* panpipe genres (i.e. *siku mimula*), as their performance was part of the series of obligations imposed by the hacienda owner, who viewed such traditions as a means to control hacienda workers. However, Ignacio often mentioned in our conversations that Walateños spent much more time on flute making after 1953, which suggests an increasing dedication to flute-making activities in the second half of the twentieth century (Hachmeyer, 2021b). This increased dedication has resulted in highly specific flute making knowledge and profound crafting skills which are unique on the Altiplano.

Gutiérrez (1991a) has suggested that Walata Grande specialised in flute making because they could maintain access to natural resources (bamboos), which other formerly self-sufficient highland communities had lost as a consequence of the destructions of ancient Aymara territory and forms of economic organisation (ecological verticality/complementarity) under colonialism. However, this ideal of communal self-sufficiency linked to the Andean concept of ecological verticality was later challenged by economic anthropologists in contexts of Indigenous market interventions during the colonial period (e.g., Salomon, 1986; and various articles in Larson & Harris, 1995). Therefore, I consider Gutiérrez's (1991a) argument to be only one possible contributing factor. I will argue in the following sections that accessing new markets during the second half of the twentieth century has led to a specialisation in the sense of a modern social organisation and division of labour. While Walateño flute makers formerly sourced musical bamboos themselves and crafted flutes according to the seasons in which they were played (embeddedness), in the second half of the twentieth century makers increasingly transferred musical bamboo sourcing to external actors, and disassociated flute-making activities from rural Aymara traditional spheres of music making.

Embeddedness in Musical Seasonality

As an ecological framework for music-making practices in rural Aymara Indigenous communities, musical seasonality had direct implications on Walateño flute-making practices, i.e. the manufacture and commercialisation of flutes and musical bamboo demands. The key point here is that Walateño flute makers organised the making and marketing of flutes around these calendrically organised musical performance practices. Makers crafted and sold duct flutes in the rainy season (from November to April), while having crafted and sold ductless flutes in the dry season (form May to October) (Gutiérrez, 1991a).

In many parts in the Bolivian Andes, for example in Northern Potosí, ethnic calendars framed the collective organisation and distribution of productive resources, the local movement of goods and services, and the development of important interregional circuits of exchange (Platt, 1995). Stobart (2006a) has suggested that musical instrument makers in Pocoata, through the development of forms and decoration of peasant-style guitars (*charango* and *kitarra*), consolidated and strengthened music's connection with agricultural production and seasonal performance practices over the course of the twentieth century. Among others, he links this to the market and extended selling opportunities rooted in calendrically alternating music and the yearly ritual renewal of musical instruments.

Much of his argument concerning the market for musical instruments and the economic benefits of calendrically performed music also applies to the context of Walateño wind instrument makers. They were furthermore accustomed to the agricultural ecology of the Altiplano, as they also herded animals and worked the land, cultivating agricultural crops such as potato, oca, broad beans, barley, and alfalfa. They also performed calendrically organised music, and in some cases continue to do so to this day.[52] As they crafted flutes outside, in short rests during agricultural tasks and animal herding, in half-moon-shaped stone walls called *qamaña* or *utjaña* in Aymara, they integrated agricultural work, animal herding, weaving, and flute crafting in a very successful integrated symbiosis.

The classification scheme of musical instruments based on the musical seasonality of rural Indigenous music in the Bolivian Andes remains important in some local rural Aymara contexts today (see, e.g., Mújica, 2014b). However, the rigidness of such calendrically organised rural Indigenous music in the Bolivian Andes was sometimes outsider-imposed and idealistic, and many ethnomusicologists have noted local exceptions to these principles (Schramm, 1992; Solomon, 1997; Stobart, 2006a; Turino, 1983). In some rural contexts, local discourse and (individual or collective) memory about calendrically performed music is stronger than the actual

[52] Walata Grande has a well-functioning *alma pinkillu* ensemble, playing every year during *Todos Santos* (‘All Saints’) festivities in Achacachi and nearby communities.

practice. This deserves a closer look into underlying dynamics of musical change and cultural transformations – a topic dealt with elsewhere (Hachmeyer, 2015; Mújica, 2014b).

Musical seasonality was a widespread phenomenon in the Bolivian Andes, where the performance of musical instruments and genres was linked to specific festive occasions and seasons. The corpus of ethnomusicological literature on themes related to calendrically organised music in rural Indigenous communities in the Bolivian Andes is very impressive (Baumann, 1982; Buechler, 1980; Harris, 1988; Layme Pairumani, 1996; Mamani Pocoata, 1988; Martínez, 1996; Sánchez Canedo, 1989; Solomon, 1997; Stobart, 2006a; Turino, 1993, to mention just a few).[53] One spectacular example from the *altiplano paceño* on the shores of Lake Titicaca is Buechler's (1980, pp. 358-359) study of musical performance in the Aymara community of Irpa Chico, where he documented twelve different flutes and musical genres being played throughout the year, each linked to a specific calendrical activity related to agricultural production or animal hunting (vicuña hunting).

[53] As an influence of musical anthropology during the 1960s (e.g., Merriam, 1964), many ethnomusicologists were concerned with looking beyond Western systematic and scientific classifications of musical or sound-producing instruments (the Hornbostel-Sachs System) in order to understand the logic behind "native" classification schemes in a kind of "ethno-organology" (for a Bolivian case, see Solomon, 1997). These broader disciplinary tendencies manifested in Bolivia in local case studies about seasonally performed rural Indigenous music and musical instruments. I have contributed to this corpus of literature myself (Hachmeyer, 2015, 2017a, 2017b), yet not from a straightforward ethnomusicological perspective. Instead, I focussed on the interrelations of these climate and agriculture-related rural Indigenous musical performance practices in the context of local understandings and the realities of climate change.

Aymara communities, including Walata Grande, generally classify rural-style flutes according to two major classes, which are called *q'asa* ('notched'; non-duct flute families of *siku* panpipes, *qina* notched flutes, and *phala* transverse flutes) and *tapani* ('with block'; recorder-like duct flute families called *pinkillu*, *musiñu*, and *tarqa*) in Aymara. This binary distinction within the local organological classification of rural-style flutes is related to the "musical construction of time" (Solomon, 1997) or the "orchestration of the year" (Stobart, 2006a) where certain flutes appear according to the two main climatic seasons, the cold dry season (ay. *awti pacha*) and the mild rainy season (ay. *jallu pacha*).[54]

The seasonal performance of musical instruments has social and cosmological significances, which I cannot describe here in detail, and I refer the interested reader to the aforementioned literature for detailed studies of musical seasonality in different contexts of rural Indigenous communities in the Bolivian Andes. With much care to avoid essentialisms and the dangers of generalising overtly diverse local musical traditions, one might perhaps argue that there was an overall tendency among Aymara people to conceive of certain flutes as having influences on local weather, mainly wind and rain patterns.

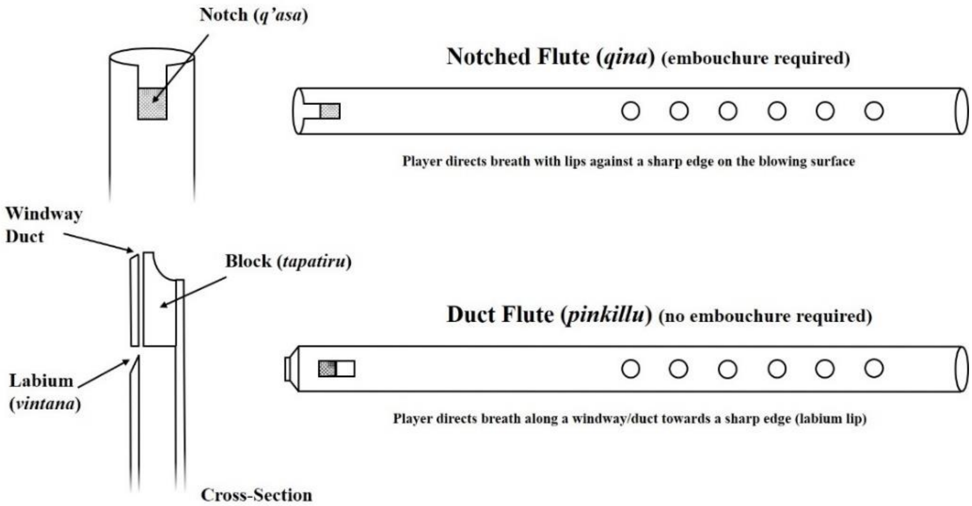
Ductless or notched *q'asa* flutes, like *qina*, tended to be performed in the dry *awti pacha*, while *tapani* duct or fipple flutes (with wooden block), like *pinkillu*, tended to be played in the wet *jallu pacha* (Figure 10). In many

[54] These climatic seasons have further internal subdivisions, for example, *juyphi pacha*, or the time of frost in the middle of the dry season, where specifically *siku* panpipes or *qina* notched flutes appeared, or *amaypacha*, the time of the dead, which marks the beginning of the rainy season, where *alma pinkillu* and other *pinkillu* duct flutes were played.

places *pinkillu tapani* flutes are said to attract rain and prevent frost (detain the wind), while *qina* or *siku* ductless *q'asa* flutes blow away rain carrying clouds and call frost (attract the wind).[55]

Figure 10: Diagram of Notched and Duct Flutes

(Source: Own Elaboration, based on Stobart, 2006a, p. 240)



These influences of local wind and rain patterns are related to agricultural tasks requiring a particular meteorological succession, which would otherwise be irregular when certain musical instruments are performed outside their specific season (Hachmeyer, 2015; Mújica, 2014b; Stobart, 2006a). In addition to these influences on local weather patterns, music is said to regulate human and non-human fertility, reproduction, growth, and the exchange and circulation (balancing or disturbing) of animating life energy (Hachmeyer, 2019; Hachmeyer & Stobart, 2019; Stobart, 2006a).

Ethnomusicologists have discussed morphological and anatomical differences of flutes, differences in sound patterns and structures they produce, and applied performance methods and techniques as possible explanations for the internal logic of the binary distinction into dry and rainy

[55] The Aymara saying that due to strong frosts during *juyphi pacha* ('time of frost') even vicuñas start to cry (ay. *wari q'asaya*) is very evocative in this regard (Borras, 1995, 2002).

season flutes. Schramm (1992), and later Solomon (1997), also discussed the origins of natural materials as a possible explanation. For the Aymara context of the Altiplano, Schramm (1992) maps the binary distinctions between high and low ecological floors onto the distinction between rainy and dry season flutes. He suggests that non-duct flutes like *siku* and *qina* are made from materials originating from low and humid environments, while duct flutes are made from materials originating from high and dry environments.

Solomon (1997, p. 183) interpreted this as a “symbolic inversion”, as the conceptually dry flutes are usually played in the rainy season, while the conceptually wet flutes are usually played in the dry season. In the context of Northern Potosí, Solomon (1997) suggests that the canes used in dry season instruments are naturally hollow and conceptualise the inability of the land to produce during the dry season, while the pithy centre of woods used for making rainy season duct flutes, such as the heavy wooden *lawuta* flutes (form of *pinkillu*), would be iconic of the moist conditions and plant growth of the rainy season.

I have not heard similar explanations expressed by urban-dwelling Walateño flute makers in metropolitan La Paz, and I think, as Stobart (2006a) does, that they do not help much to understand local meanings expressed through calendrically organised music. Furthermore, these accounts lack a coherent understanding of the ecological niches and natural habitats of different plants providing materials for flute making in highland Bolivia, whether bamboos, canes, or woods.

Bamboo sourcing has equally been embedded in the seasonal organisation of economic (agricultural) activity in the community and was preferably done in the dry winter months between May and October, which remain the ideal time window for musical bamboo sourcing/collection (see Chapter Six). In former times, musical bamboo demands were also musiculturally restricted to the number of flute performers (ay. *phusiri*) in rural Indigenous communities on the Aymara Altiplano. In order to cover this demand, Walateño flute makers sourced musical bamboos themselves using mule caravans. This medium of transportation, as my panpipe maker friend Andrés Mamani (who tragically died while I wrote up the thesis) often remarked during our conversations, also determined the number of musical bamboos that it was possible to collect and transport. Against this background, and referring back to the analytical framework of sustainability, the social and economic organisation of the new musical bamboo trade and the possibilities of large-scale collection and transport are fundamental to understand the rise of bamboo sourcing predicaments and sustainability problems, as will be seen in Chapter Six. In the next section, I address the shifting modes of Walateño flute making in more detail in order to contextualise the subsequent discussion of contemporary flute-making spheres.

Historical Transformations and Shifting Markets

Many economic anthropologists have shown over the twentieth century that economy and society became institutionally separated in the history of Western capitalism (Dumont, 1986; Godelier, 1972; Polanyi, 1957[1944], Sahlins, 1969; see also Ingold, 2000, p. 314). They have argued that economic relations, which are embedded in social life in precapitalist societies, become continuously disembedded under formalist market-oriented forms of economic exchange under the premise of rational choice. However, it would be inaccurate to argue that former Walata Grande community-based flute makers genuinely made flutes under a substantivist economic logic of provisioning, although I have shown above how former musical bamboo sourcing and flute crafting/marketing were nonetheless socially embedded in Aymara musical life on the Altiplano.[56] In fact, social relations and cultural values continue to govern the economic practices of today's Walateño flute makers. Furthermore, a whole branch has developed in Andean economic anthropology studying Indigenous market interventions and the incorporation and use of money during the colonial period (see, e.g., Larson & Harris, 1995).

Notwithstanding, the traditional markets of Walateño flute makers substantially shifted over the twentieth century. From the latter decades of the twentieth century, urban and tourism markets came to offer new sales opportunities for Walateño flute makers, who formerly – as itinerant traders – sold their rural Indigenous flutes to Aymara clients in local fairs and regional markets. At a time when new markets were accessed and demands for Andean flutes diversified, some Walateño flute makers began to spend more time on their labour-intensive flute-making practices. Such a specialisation of flute making (as an economic mainstay) led to semi-industrial productions, mechanisation processes, and the now well-established division of labour between flute making and musical bamboo sourcing, which has ultimately given rise to the trade of musical bamboos, not as valuable natural materials but as commodities (see Chapter Six).

[56] This contrasts with former local community-based *qantu* panpipe makers in the Kallawaya region, who indeed only made *qantu* panpipes for social use in their own communities (see Chapter One).

In this regard, two major historical developments are central to understanding the shifting landscapes of highland flute making in Walata Grande since the mid-twentieth century: migrations to the city and Andean musicultural developments surrounding the (neo)folklore movement, and the development of thriving Andean tourism markets and the boom of cooperatives in Bolivia. Both phenomena, that is the diversification of economic activities and urban migration, were linked to the problematic situation around access to arable land after the national revolution in 1952 (Albó et al., 1981-1987). With the agrarian reform a year later, latifundia were redistributed and each nuclear family received individual land parcels (so-called *minifundio*) (Choque, 1992; Morales et al., 2011). Furthermore, hereditary succession was implemented, which has led to strong inequalities concerning the access to land. In short, the demographic rise caused land scarcity and poor subsistence conditions for some families.

On the one hand, Aymara people started to dedicate more time to other non-agricultural occupations, which has led many Walateño makers to intensify their flute-making activities and participate in the craft cooperative. On the other hand, migratory flows to the city increased. Young Aymara not only looked for employment in the wage labour sector but were also motivated by the search for formal education, which was and still is scarce outside the city.

Craft Cooperative and Andean Tourism Markets

Nicasio, who I introduced in the previous chapter, once told me how Victor Hugo Cárdenas, an Aymara leader and former vice president in the first government of Gonzalo Sánchez de Lozada (1993-1997), was actively involved in the creation of the craft cooperative *Walata Grande Limitada* in the 1970s. This was a major new direction in the history of the flute-making village that laid the foundations for the now widespread mass production of flute souvenirs.

In one of our conversations, Nicasio recounted how he became actively involved in the *katarista-indianista* movement, which played an important ideological and organisational role in the rise of Indigenous consciousness from the 1970s and paved the road for the rise of power of first, so-called "Indigenous" president Evo Morales Ayma in 2005 (Burman, 2016; Dangl, 2019). The *katarista-indianista* movement was a local Aymara and Quechua Indigenous movement, which emerged in the early 1970s under prominent leader Genaro Flores Santos, later the founder of the *Confederación Sindical Única de Trabajadores Campesinos de Bolivia* (CSUTCB). Nicasio described to me in detail his close friendships with Felipe Quispe Huanca (known as *el mallku*) and Victor Hugo Cárdenas, two major protagonists of the movement in the 1970s and early 1980s.

Eventually, the movement disbanded in the 1980s. While Quispe, in a more radical stream of Aymara nationalism, envisioned the creation of a sovereign country (Republic of *Qullasuyu*), Cárdenas created a more reformist stream and helped institutionalise a state-led neoliberal multiculturalism. According to Nicasio, Cárdenas also saw the economic potential of flute making in Walata Grande and incentivised the creation of a craft cooperative.

The history of cooperatives in Bolivia is intimately linked to the capitalist and developmentalist ideological basis of the 1953 agrarian reform (Colque et al., 2016, pp. 71-73; see also Rodríguez García, 2012). The 1958 law of cooperative societies defined cooperatives in the economic development of the country as a means to increase productivity and to improve the life and working conditions of the new “working class”, in which formerly marginalised Aymara people came to be included. The economic organisation of Aymara communities like Walata Grande has been regarded romantically as a form of “natural cooperative” (Gianotten, 2006, p. 54), where collective production was anchored in Andean values of collectivity and reciprocity.

The craft cooperative in Walata Grande was founded at a time when Andean countries experienced prospering regional tourism, especially due to the Inca sanctuary of *Machu Picchu* in the Peruvian Andes (Borras, 1995), which was later proclaimed a UNESCO heritage site in 1983. Furthermore, the “Andean music boom” (Bigenho, 2002, 2009a, 2012; Ríos, 2008, 2020) occurred, which made emblematic Andean flutes like panpipes and notched flutes famous beyond the Andes, for instance in France and the rest of Europe. This gave rise to a context, in which Andean textiles, music, and instruments became commercialised transnationally (see, e.g., Meisch, 2002).

The craft cooperative in Walata Grande was aimed at collectivising flute-making activities in the community in order to produce higher revenues and incomes. It was organised according to a strict modern division of labour into sections of specialised makers of a certain flute type (*siku*, *tarqa*, *pinkillu*, and *musiñu*). The craft cooperative was an affiliated member of the *Qantati* craft association (sp. *Asociación de Artesanos Qantati*), where different craft cooperatives were united in order to collectively organise exports of Andean crafts to Europe, Asia, and North America.

Although the global transnational context appeared to be beneficial at first glance, international orders for Andean flutes made by Walateño makers remained low (Borras, 1995). Thus, income generated through the cooperative was not as significant as individual itinerant sales at local fairs and regional markets. However, *socios* or ‘members’ successively increased over time, giving rise to free riders, who failed to contribute to the collective production, or produced less than others, but nonetheless earned the same portion as everybody else.

Comparing such a Western cooperative organisation with rural Aymara systems of land management (ay. *aynuqa*/*sayaña*) perfectly discloses the aforementioned romanticisation of rural Aymara Indigenous ideals of collectivity and equality. The Aymara word *sayaña* refers to the nuclear family land parcel within a community, on which houses are built (Rivière, 1994). The Aymara word *aynuqa* refers to the system of nuclear family plots within communal lands, which are designated for agricultural production under a system of crop rotation, varying according to community between six and more than ten years (Rivière, 1994). Each nuclear family has equal rights to a *sayaña* and corresponding plots in the *aynuqas*. However, agricultural yield produced is not redistributed collectively among all community members. In fact, each nuclear family is responsible for its agricultural production, while systems of reciprocal labour exchanges between families, such as *ayni*, help facilitate very labour-intensive tasks.

The growing discontent of makers with high individual contributions to the collective production and the resulting conflicts around redistribution caused the dissolution of the craft cooperative around the turn of the millennium. In spite of this, the state-led multiculturalism of neoliberal governments between 1985 and 2005, which regarded culture as a resource for economic development, played an important role in the expansion of Walata Grande as a central economic player of monopolised flute-making activities on the Altiplano. Tourism has become one of the predominant components of Walateño flute-making practices nowadays, both in the rural community as well as in urban environments. As such, it is a double-edged sword. It provides makers with constant economic income without which they would have abandoned making flutes altogether (see Chapter Four). Simultaneously, it is a threat since it disassociates flute-making practices from musicultural backgrounds and inserts them into contexts of transnational capitalist markets, transforming musical instruments into tourism artefacts.

Moving to the City

Another historical development had to do with the urban migration to the city of La Paz over the second half of twentieth century. This was not only a development limited to Walata Grande since the entire Aymara Altiplano experienced urban migration. Young flute makers temporally migrated to the city of La Paz in order to sell flutes in central popular marketplaces until they finally established permanent residencies (see Borras, 1995, pp. 91-97). They adapted to the different urban environment and often had to face racist assaults. For example, Nicasio, who was one of the first migrating Walateño flute makers, once related how he sold his flutes on the sidewalks in 1960s urban La Paz. He described how people from the city would pass by "shouting at me: *Indio*, go back to the countryside with your *indio* flutes"[57]. As a consequence of these racist assaults, he abandoned flute making in the late 1960s to work in a textile factory, only to return to it later with even more conviction.

[57] "[…] gritándome: ¡Indio, ándate al campo con tus flautas indias!"

Since the majority of Aymara clients and traditional flute performers on the Altiplano also migrated to the city of La Paz, Walateño flute makers, on the one hand, followed their established clientele to the city. Thomas Turino's (1993) *Moving Away from Silence* tells such a story of migrating rural Aymara musicians from Conima, who moved to the Peruvian capital of Lima, where they adapted their musical practices to the particularities of the city. In the case of the *altiplano paceño*, one might possibly argue that Aymara people 'invaded' urban spaces. The creation of El Alto as an autonomous city and municipality in 1985 is basically the result of the Aymara Indigenous inflow from rural areas. Henceforth, urban spaces became 'indigenised', not only in terms of the physical presence of rural Indigenous people in the city, but also in terms of the renegotiation of key rural Indigenous practices in urban environments including music making practices (see also Baumann, 1984; Mendívil & Romero, 2018; Turino, 1988). This was not always free of struggle and conflict, and racism in the city surely contributed to the decrease of these key Aymara practices in urban popular neighbourhoods. Furthermore, rural migrants were ashamed of their rural background in some cases and stopped transmitting their customs to subsequent offspring generations.[58] In addition to all these factors undermining the reproduction of rural musical practices in the city, urban residents started to hire more expensive brass bands for patronal feast in their communities of origin in order to demonstrate their rise in status (Buechler, 1980).

However, rather than approaching their urban-rural relationship as a strict dichotomy, it would be more accurate to approach it in terms of blurred

[58] This is why many offspring generations of rural Andean migrants do not speak Aymara or Quechua as their mother tongue, or at all.

borders (Heredia, 2016).[59] The majority of today's urban-based Walateño flute makers continue to maintain close links to their rural community of origin. For example, many families return to Walata Grande at frequent intervals in order to work the land, attend community councils, fulfil authority duties, celebrate patronal and civil feasts (involving the investment of vast sums of money), or to simply visit remaining family members, mainly the elderly and school-age children. Additionally, many urban-dwelling Walata Grande makers draw on a historically constructed image of their community of origin as an economic brand indicating authenticity of being skilled flute makers from Walata Grande. This image contrasts nowadays with Walata Grande's widespread image as mass producers of tourist flutes. Yet, although flute making became their economic mainstay, agrarian production is still the backbone of economic life of many flute maker families in the city, especially in today's precarious flute-making contexts and the scarcities and sourcing difficulties of musical bamboos (see Chapter Four). The principal community meetings of the year are organised to coordinate with key agricultural tasks and relatively few urban-dwelling Walata Grande makers have completely cut relationships with their rural community.

The city has also offered new markets beyond the traditional flute performers from the *altiplano paceño*. Urban *mestizo* people recreated and reinvented formerly rural Indigenous flute music, which came to be known as 'autochthonous music' (sp. *música autóctona*) in the city (Rios, 2010,

[59] Many social scientists studying internal migration in Bolivia have shown that patterns of double/multiple residence are more satisfactory to describe the movement of people in the Bolivian Andes (Antequera, 2011, 2017, 2019; Cortes, 2004; Heredia, 2016; Mazurek, 2008; Salazar, 2009; Zoomers, 2012).

2012). For example, urban popular classes and university students reclaimed autochthonous music for political purposes and community building (Bigenho, 2009b; Turino, 1993), and cultural centres and urban autochthonous music groups were created by first- or second-generation migrant offspring with a sense of 're-validating' (sp. *reivindicación*) rural Indigenous music.[60] In the light of the progressive abandonment of autochthonous music-making practices in rural Aymara communities, these urban autochthonous music groups in the cities of La Paz and El Alto now represent a significant market for some autochthonous flutes made by Walateño flute makers (see Chapter Four). That rural Indigenous autochthonous music became accepted in formerly rather hostile urban environments was one of the central merits of the (neo)folklore movement.

The term 'autochthonous' is nowadays employed in the city in order to distinguish these Aymara Indigenous flutes and the music played with them from national (neo)folklore music. Rural-style autochthonous flutes, especially panpipes and notched flutes, were adapted to Western scales and tuned in standard equal temperament for playing and performing in Andean (neo)folklore music. These adaptations are often related to Andean *conjuntos* or pan-Andean style bands such as *Los Jairas* and to Bolivian folklore orchestras like *Música de Maestros* (Bigenho, 2002, 2012; Céspedes, 1984; Rios, 2012, 2020).[61] They were developed by urban *mestizo* and European

[60] This process has finally led to the foundation of many so-called cosmopolitan *sikuri* groups in principal capitals in South America (and beyond) (Castelblanco, 2018, 2019).

[61] The nephew of former *Los Jairas* vocalist Edgar "Yayo" Joffré, Jorge Malaga Joffré, who nowadays continues the legacy of his uncle by performing with *Antología Jairas*, is my wife's uncle. On one occasion during a family festivity, Malaga emphasized the importance of Swiss jazz clarinettist Gilbert "Gringo" Favre in the development of the modern urban *quena* (see also Bigenho, 2012), alongside with other Bolivian musicians who gathered

musicians in the 1960s, at a time when the Bolivian state funded and promoted musical folklorisation (Rios, 2010). At the same time, Walata Grande initiated the process of becoming mass producers of flute souvenirs. Thus, Walata Grande flute makers have started to make these adapted panpipes and notched flutes rather recently, approximately two decades ago (see also Borras, 2000).

These adaptations required learning processes among Walateño flute makers, which often occurred alongside generational shifts. For example, the already late *sikuluriri* (‘the one who makes *siku*’) Sebastián Mamani was a specialist in rural-style *siku* panpipes, whereas his sons Andrés, Antonio, Julio, and Favío nowadays mainly craft professional urban *zampoña* and *quena*. They learnt how to use electronic pitch meters, acquired basic knowledge in Western music theory and acoustics, and started to craft modern urban panpipes destined for (neo)folklore (or other Western) music markets.

From Rural Luriri to Urban Artisan

While moving from the countryside to the city, the significance of what it meant to make flutes shifted significantly on a semantic scale. Among Aymara clients, Walateño flute makers were referred to as *luriri* meaning ‘the one who makes’ in Aymara, wind instruments (ay. *phusa*, ‘that which is blown’) in this case. In Spanish, on the contrary, making musical instruments is referred to as to ‘fabricate’ (sp. *fabricar*) or ‘build’ (sp. *construir*).

during the 1960s in the *Peña Naira*, the first (neo)folklore music bar in the centre of La Paz. In fact, the (neo)folklore movement had an important francophone impulse (Borras, 1992; Gérard, 2012; Rios, 2005, 2008, 2020). Another important person was Rolando Encinas, the founder of the Bolivian folk orchestra *Música de Maestros* (Cavour, 2010). For more details, see Arauco (2011), Bigenho (2012) and Rios (2020).

I will leave the decision to the reader whether this marks an ontological difference in the sense of Ingold (2013), suggesting that ‘building’ musical instruments is the mere imposition of preconceived form onto raw, inert, and passive matter (hylomorphic model of creation), while ‘making’ them would rather allude to some correspondence with materials and process of growth and becoming, where sensorial and material engagements are central. The fact that makers developed a detailed typology and special knowledge of different musical bamboo types (see Chapter Four) is indeed the result of “a lifetime of close engagement in a particular craft” (Ingold, 2012, p. 434).

In the rural Aymara context, the word *luriri* does not imply the modern sense of profession. As shown above, flute making was integrated into other economic activities such as agriculture, animal herding, and weaving. In fact, in the rural economic environment, which articulates multiple economic activities, there was no conception of ‘professions’ as such. However, the city is different in this regard. A profession in the modern sense usually presupposes specialised knowledge and some form of professional development (titles, licences, etc.). Walateño flute makers came to the city with highly specialised flute-making knowledge but without any formal recognition as skilled flute makers. The only professional category which modernist urban society kept ready for them was ‘artisan’. This is far from unproblematic since the concept of artisan does not convey the same meaning as *luriri*.

The clear-cut separation between fine art and craft/artisanship is a product of dichotomising (intellect and manual labour, mind and body, creative imagination and mechanical repetition), dating from eighteenth-century European society (Ingold, 2000; Shiner, 2003). The Greeks and Romans did not distinguish between artisan/artist (their terms *techne* and *ars* referred to skill nowadays associated with craftsmanship), rather this separation came with the European Enlightenment.

> Whereas the ideal qualities desired in an artisan/artist in the old system combined genius with rule, inspiration with facility, innovation and imitation, freedom and service, these qualities were finally pulled apart in the course of the 18th century. As this happened, all the 'poetic' attributes – such as inspiration, imagination, freedom, and genius – were ascribed to the artist and all the 'mechanical' attributes – such as skill, rules, imitation, and service – went to the artisan. (Shiner, 2003, p. 111)

This separation has remained persistent in twenty-first century Plurinational Bolivia, notably for the case of the National Academy of Fine Arts Hernando Siles. One of my sisters-in-law graduated from the academy with a specialisation in 'artistic pottery'. Pottery was taught as an 'Indigenous art', so that one might think at first glance that the academy somehow intended to crosscut the modern divide on an official level. However, through the word 'artistic' the modern fine art meaning of beauty and aesthetic is imported through the backdoor. At the same time, those practicing 'artistic pottery' have been informally disparaged and denigrated among other art students as *chuweros* ('plate makers') in Aymara, referencing the supposed applied and practical functionality of the work they produce.

In the area of music, the artist/artisan divide manifests itself in another guise. While musicians are seen as artists, musical instrument makers are considered artisans. The former can register themselves in the Plurinational Register of Artists organised by the Ministry of Culture and Tourism, while the latter in the Craft Register organised by the Ministry of Productive Development and Plural Economy through Pro-Bolivia, a unit of registration and accreditation of productive firms. In the context of lacking official educational opportunities, the emission of certificates of artisanal (craft) competencies is a step towards facilitating professional credentials to those who have learnt their craft practices (such as flute making) through intergenerational knowledge transmission. Indeed, many Walateño flute makers have collected a multiplicity of institutional recognitions since moving to the city.

However, Shiner (2003, p. 114) shows how musicians, despite poetic attributes such as spontaneous creativity, must also develop facility and skill, and comply to rules and forms of repetition (usually attributed to artisans) when it comes to harmony and melody (or metre and rhythm). Moreover, Walateño flute makers are constantly recreating and reinventing flutes, ensemble combinations, or sound aesthetics in order to compete in local and wider markets. Many are furthermore performers of autochthonous flute music in renowned autochthonous musical ensembles. A clear-cut distinction between artisan and musician is empirically not tenable in the Walateño context.

Additionally, Lehm and Rivera (1988, pp. 141-150) show how rural Aymara "artisans" have been viewed by some *mestizo* craftsmen in the city as a threat to their 'cultured' urban craft tradition and identity since migrating Aymara peasants would not have followed established quality standards and work ethics (see also Rodríguez García, 2012). Interestingly, many urban artisans interviewed by Lehm and Rivera (1988) mentioned mechanisation processes as having been one reason for artisanal decline in Bolivia.

Nowadays, the 2012 law on the development and promotion of crafts portrays mechanisation rather as an opportunity. It classifies craft practices according to certain areas such as 'popular art', 'utilitarian craft', 'service craft' and 'urban and rural craft with cultural identity'. Musical instrument making could be potentially classified as popular art or craft with cultural identity. However, I have not encountered any Walateño flute maker taking advantage of this law or the accreditation through Pro-Bolivia, although some are affiliated members of particular craft associations that aim to advocate for or protect rights in the informal craft sector (see Goldstein, 2016).[62]

Another important aspect of the theme of craft and linked to the aforementioned law is markets. Craft, as an economic occupation, implies an intimate connotation with commerce. Commerce becomes especially evident in the flute-making sphere in relation to tourism markets. The majority of contemporary Walateño flute makers mass-produce flutes as "tourism art and souvenirs" (Hume, 2013) in a mechanised and semi-industrial manner. The scale and repetitive patterns employed in such production mean that these flutes are no longer individually crafted artefacts (see below).

Tourism commerce and implied semi-industrial manufacture turned out to be quite controversial issues in Walata Grande's national intangible cultural heritage application (see Chapter One). However, Walateño flute makers economically move within more than one sphere of flute making, which further complicates the picture. In those spheres where individual musical instruments are crafted, aspects surrounding the transmission and reproduction of specialised knowledge about flute making as a cultural activity are as important as economic commercialisation. However, these

[62] Despite these recent legal developments, micro- and small enterprises including craft entrepreneurs – which are even grouped in the same tax regime as large and industrial firms – are marginalised in the Bolivian economy, although they are the fundamental basis for the subsistence of many families.

questions are often overshadowed by an all-encompassing focus on markets and economic development.

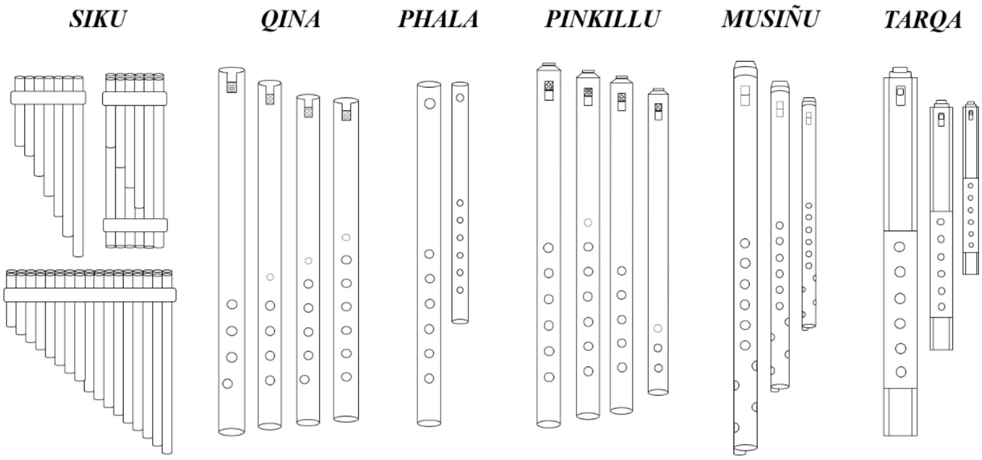
Contemporary Spheres of Flute Making

As a result of these historical transformations and shifting markets, different but interrelated contexts of flute making have emerged. In Chapter One, I outlined the theoretical underpinnings of what I identified as contemporary spheres of flute making, which I employ as an analytical tool. These spheres reference different modes of flute-making manufacture and circulation, as well as specific musical and sociocultural backgrounds for their commercialisation. As will be seen in the next chapter, bamboo demand and perceptions of scarcities also vary according to each flute making sphere. I distinguish between three flute-making spheres: the 'autochthonous', the 'professional', and the 'touristic'. This analytical distinction goes back to Walateño flute makers' own categorisations.

The Autochthonous Sphere

Within the autochthonous flute-making sphere, Walateño flute makers craft a variety of 'autochthonous aerophones' (sp. *aerófonos autóctonos*), which are destined for the traditional market of 'autochthonous music' (sp. *música autóctona*). These Aymara Indigenous or autochthonous flutes have been widely studied from an organological perspective by Borras (1995). Walata Grande makers continue to use the same (more or less stable) local classification scheme of six generic autochthonous flute families for classifying the organological flute diversity on the *altiplano paceño*. They distinguish between three 'notched' (ay. *q'asa*) flute families including *siku* raft panpipes, *qina* notched flutes, and *phala* transverse flutes, and three families of recorder-like flutes with internal duct (ay. *tapani*) called *pinkillu*, *musiñu*, and *tarqa* (Figure 11).[63] These flutes are collectively performed in large consorts, a performance characteristic which downplays individual virtuosity in favour of a sense of social participation and belonging (Stobart, 2006a; Turino, 1989, 2008). Usually, only flutes of the same autochthonous family are played together, typically accompanied by specific percussion instruments (*bombo*, *wankara*, etc.).

Figure 11: Diagram of Autochthonous Flute Families (Source: Own Elaboration)



Autochthonous *siku* are mostly played in complementary pairs using interlocking technique (ay. *irpaña-arkaña*, 'to guide/to follow'; sp. *contestarse*, 'to answer each other'). They are either single-rowed or double-rowed. The second row, which have either closed, semi-closed, or open tubes crafted at different intervals (fifths, octaves) or at the same length of the first row, are timbre modifiers (Gérard, 2018). Depending on the *siku* style, the numbers of tubes in raft panpipes vary between 3-4 (*Chiriwano*), 6-7 (*Qantu*), 7-8 (*Jach'a Siku*), 10 (*Mimula*), or 17 (*Suri Siku*).[64]

[63] For more organological information, see Appendix One and Two.

[64] Uniform *siku* ensembles like *suri* or *mimula* are not played with complementary pairs (*arka-ira*), but with a performance technique called *kupi-ch'iqa* in Aymara ("right-left"). *Kupi phusiri* play notes onbeat, while *ch'iqa phusiri* play notes offbeat.

While *qina* with their notches (ay. *q'asa*) are more difficult to play, recorder-like duct flutes with their fipples (ay. *tapatiru*) and complicated labium (ay. *vintana*), especially *musiñu* and *tarqa*, are more difficult to craft. This is especially true for wooden *tarqa* flutes, which have internal bores with complex inner conical shapes producing the typical pulsating and multiphonic sound phenomenon ('roll effect') called *richi* or *richa* in Aymara (or *tara* in Quechua) (Gérard, 2015; Stobart, 1996b, 2006a).[65] Although former organological studies have classified *musiñu* and *tarqa* as varieties of *pinkillu* (Baumann, 1980, 1982; Gérard, 2010; González Bravo, 1937), Walata Grande makers classify them as separate families, as their manufacturing requires different making processes and levels of specialised skills and manual dexterity.

Since *tarqa* duct flutes are nowadays made from woods like mahogany (see Chapter One), they are not central to the discussion in this thesis. All other flutes are made from the musical bamboos presented at the beginning of this chapter: *Siku* panpipes are made from a native woody bamboo known as *chhalla* in Aymara, while *qina*, *phala*, *pinkillu*, and *musiñu* flutes are made from a native woody bamboo known as *tuquru* in Aymara.

These generic flutes have manifested themselves over time in diverse local variants, differing in tube numbers, diameters and lengths, as well as positions

[65] The only duct flute played in La Paz department, which specialised Walata Grande flute makers do not craft, is the wood-made *chhaxi* played in Aroma province. The *chhaxi* resembles the *pinkillu* from Vitichi studied by Stobart (1988). The name derives from the Aymara word *chhaja* or *chhaxa*, meaning 'hoarse voice', which may point to the peculiar sound aesthetics of the *chhaxi* duct flutes, being made from wattle wood called *takamayu* (probably *Acacia sp*.) in Aymara.

and numbers of fingerholes.[66] Over time, rural Aymara flute makers from Walata Grande meticulously engraved this organological information onto *tupu* measuring sticks, which Borras (1995) studied among a small group of urban-dwelling Walateño flute makers in the city of La Paz (see Chapter One).

Certain changes have taken place since this French ethnomusicologist undertook fieldwork in the city of La Paz in the 1990s. From the former localities where Walateño flute makers had initially settled in order to sell their flutes (see Borras, 1995, p. 97), Juan Granier street, close to the Garita de Lima, is the only one left by today. It can be considered the main place in the city of La Paz where a variety of rural-style autochthonous flutes can be bought.

The area around Tumusla street was historically part of old commercial routes which connected the city of La Paz with the Peruvian cities of Cuzco and Lima, whereas the Garita de Lima ('the sentry box of Lima') was the central control point where the in- and out-flow of wares and commodities was supervised. Walateño flute makers explicitly settled close to the Garita de Lima so as to take advantage of the movement of people and popular commerce.

[66] Some of these autochthonous flutes are named after their local rural origins, such as the *pinkillu* styles *comancheño* or *waycheño*, while others are called after the typical dance they are performed in, like *qinaqina* (*qina*), *pacoche* (*qina*), *ayawaya* (*qina*), *phuna* (*pinkillu*), *chuqila* (*qina*), *mokolulu* (*qina*), *qarwani* (*pinkillu*) or *qhachwiri* (*pinkillu*). Some are further called after the morphology and form of the flutes, for instance the rural *qina* style *phusi p'iya* ('four hole') or the *jach'a siku* ('huge panpipe') style. These local variants differed from one region to another. For example, the *qinaqina* played in Tiahuanaco was slightly different from the one played in Mollo Grande, the *phusi p'iya* from Santiago de Llallagua slightly differed from the one in Wili Rojo, and the *qina llano* from Colquencha was a little smaller in size than the one played in Collana (Borras, 1995).

By the late 2010s, most of the mobile street stands (ay. *qhatu*) of these urban-dwelling Walateño makers in Juan Granier Street had been abandoned, only a handful of makers still occupying the crowded streets of the Garita de Lima. One of those who remained, Laureano Mamani, became an especially important autochthonous flute maker in the city. He was described by Borras (1995) as a *siku* specialist, but nowadays mostly makes *musiñu* flutes. Laureano seemed to have followed the boom of large, brass-band like *musiñu* ensembles in recent decades, while he generally diversified his repertoire over time in order to produce more sales opportunities. His personal economic development, which other Garita-based Walateño makers watch with scepticism, allowed him to rent a small shop on the ground floor of a building, while the rest of the elderly flute makers in Juan Granier street arrive every morning, put together their *qhatu*, and make and sell their flutes on the sidewalk.

Those who frequently visit these remaining autochthonous flute makers in Juan Granier street over the course of several years might realise that elderly makers in particular still follow remnant patterns of musical seasonality and the linked sales calendar within their urban flute-making practices. For example, they specifically prepare rural *pinkillu* duct flute types for the rainy season, and rural *qina* notched flute variants for the dry season. However, even elderly makers never reject orders for autochthonous flutes outside of their specific rural performance context and festive season, especially in the light of contemporary economic precarity (see Chapter Four). Furthermore, many urban autochthonous musical groups/collectives, a central market niche for selling autochthonous flutes nowadays, mostly do not follow these former rural performance patterns of musical seasonality.[67]

The Professional Sphere

The term ‘professional’ in the context of contemporary flute-making practices in the city of La Paz is not meant in the sense of flute makers making their living with what they do. Autochthonous flute makers also came to be ‘professional’ in this regard. When the term ‘professional’ is used in order to describe certain flutes, people mean the aforementioned adaptation of rural-style autochthonous flutes to Western scales and standard equal temperament, especially modern urban panpipes and notched flutes. While autochthonous flute makers refer to the autochthonous flute styles by their local names, the discourse of modern urban flute makers focuses on pitches and scales.

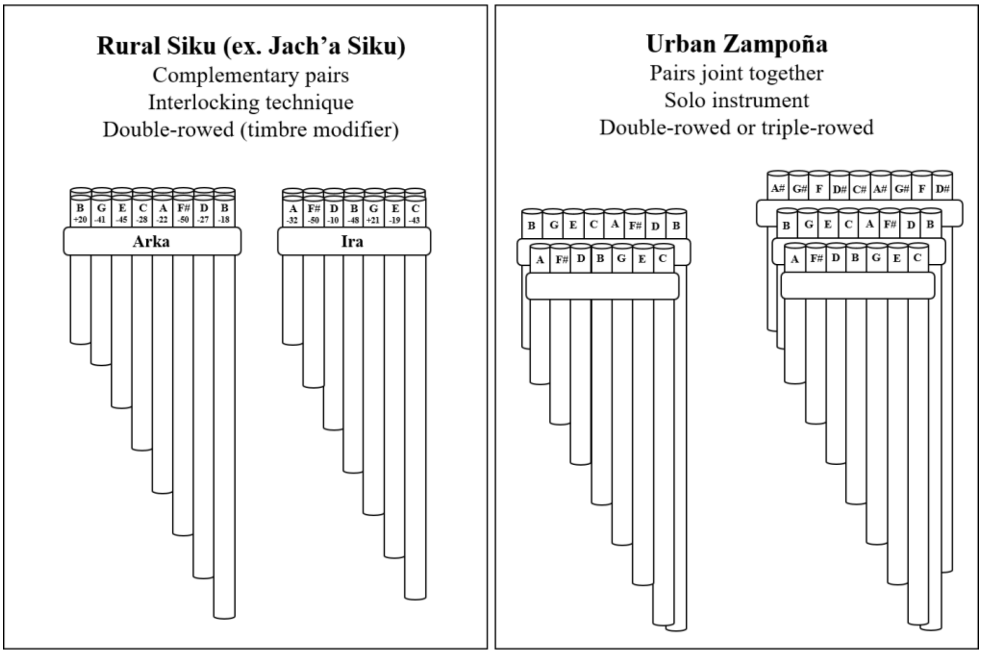
These urban-style flutes are often played in more presentational performance contexts in the sense of Turino (2008), where (semi)professional musicians might make money with performing music. However, this also occurs nowadays in more professionalised and presentational contexts of

[67] This opens up questions for further ethnomusicological research into how autochthonous music is nowadays renegotiated and reproduced in the city. As these seasonally embedded musical practices were mainly related to the agricultural ecology in rural communities in highland Bolivia, I would suggest that the discontinuity in the city and elsewhere is linked to shifting socioeconomic structures. In a way, Aymara ritual practices have adapted to the new economic lifeworlds in the city, where Andean wisemen or shamans (ay. *amawt’a*, *yatiri*) are nowadays asked to evoke nurture spirits (ay. *ajayu uywiri*) or protector mountains (ay. *achachila, awicha*) to be able to earn more money, materialist possessions, and business success, instead of, say, suitable climatic conditions for agricultural production, a good harvest, and an abundance of food and water, as happened in more rural areas. The transformation of the *fiesta de las alasitas* in the city is another striking example of these renegotiated ritual practices in the urban environment.

autochthonous music making (Hachmeyer, 2018a). Musical seasonality does not play any role in the crafting and marketing of these urban style flutes.

Urban panpipes (sp. *zampoñas*) are nowadays crafted in a variety of sizes between *malta* (G_4), *sanqa* (G_3), and *tuyu* (G_2). Like many other Andean panpipes, including rural *siku*, these instruments are constructed in pairs, with alternate notes of the scale divided between the two rafts (Figure 12).

Figure 12: Diagram of Rural and Urban Panpipes (Source: Own Elaboration)

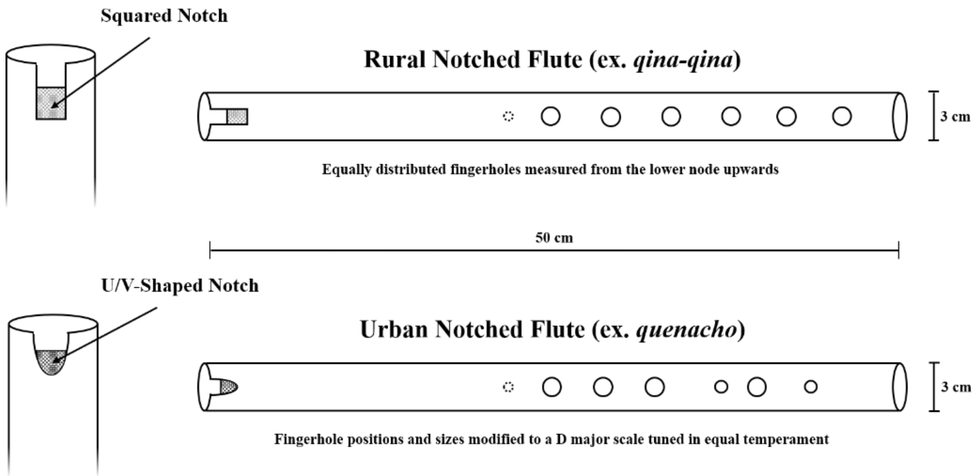


Left: Tuned with *tupu* (approx. G Major); Right: Tuned in Equal Temperament (G Major)

However, unlike rural-style ensemble performance, in which these complementary rafts are divided between two people and played using the interlocking technique, urban *zampoñas* are solo instruments (the two panpipe rafts placed together and played by a single person). They are crafted double-rowed, because the two complementary voices of the *siku* are joined enabling individual performance. Chromatic *zampoñas* are usually tripled-rowed, allowing the professional panpipe player to access the notes on the chromatic scale. As a solo instrument, the urban *zampoña* requires fast and precise lip coordination over the rafts of tubes and a different embouchure and blowing technique from their rural counterparts (Barragán, 2002).

Urban *quena* notched flutes (in its Spanish spelling, as opposed to rural *qina* spelt in Aymara) are also tuned in standard equal temperament. In contrast with the rural *qina*, on which it is based, and which usually has equally distributed fingerholes measured from the lower node upwards (and traditionally calculated with the width of two or three fingers), the positions and diameters of the fingerholes of the urban *quena* have been modified to a Western major scale tuned in standard equal temperament (Figure 13).

Figure 13: Diagram of Rural and Urban Notched Flutes[68] (Source: Own Elaboration)



Modern urban quenas are mostly in G_4 and produce pitches within the fourth, fifth, and sixth octave, although urban *quena* makers also craft them in any other feasible key. The lower key variant in D_4 is called *quenacho*, while the lowest bass *quena* in G_3 is called *mama quena*. Modifying pitches with specific blowing, embouchure, and tapping techniques allows the urban *quena* player to further access the full range of the chromatic scale.

[68] The smaller circles with a dashed line are thumbholes (on the back of the flute), while the circles with a solid line are fingerholes (on the top of the flute).

While rural *qina* mainly have squared notches, modern urban *quena* have U/V-shaped notches, requiring slightly different blowing techniques and embouchures (as do rural and urban panpipes). A professional urban *quena* maker has the knowledge and techniques to deal with the following interrelated factors and their impact on acoustics: tube length, internal tube cavity, and fingerhole size/shape/position/undercutting. Longer tubes and greater diameters produce lower keys. Positioning a fingerhole closer to the head joint produces a higher pitch, as does making a fingerhole larger.[69] Similar aspects concerning keys, pitches, and tunings apply for the urban *phala*, which is simply called *flauta traversa* ('transverse flute') in Spanish. Urban *phala* transverse flutes sometimes have an additional bamboo-made lip plate like Western concert flutes.

Until recently, only notched *q'asa* flutes had been 'westernised'. On the one hand, some rural fipple flutes, like *tarqa*, are crafted in order to produce a pulsating multiphonic sound phenomenon (i.e. stress on timbre rather than pitch), whereas the adaptation to a Western scale tuned in standard equal temperament would make little sense. On the other hand, the *quena* is related to imaginaries as being a truly Andean instrument, which is linked to the expressivity of especially Andean urban *conjuntos* and (neo)folklore ensembles (for a discussion about rural and urban sound aesthetics linked to rural *qina* and urban *quena* notched flutes, see Chapter Four).

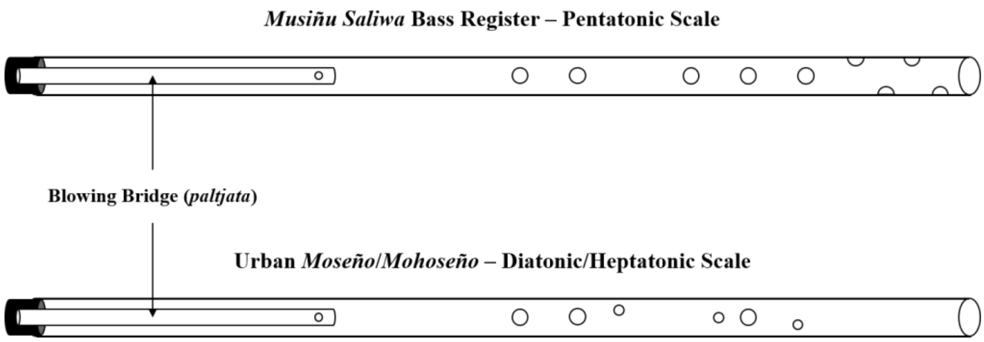
Only very few makers in La Paz, among them my Walateño maker friend Favío, craft urban *moseño*/*mohoseño* flutes (also in its Spanish spelling, as

---

[69] An urban quena in G_4 is about 38 cm long and has a tube diameter (internal cavity) of 2 cm, with the following fingerhole positions, distance (in mm) from the foot joint: 45-77-99-133-165-193-223, with fingerhole diameter (in mm): 9-12-9-12-12-12-6.

compared to the rural *musiñu* in its Aymara spelling), an instrument adapted from the large, bass register/size *musiñu* called *saliwa* in Aymara. The *saliwa*, like the modern bass *moseño*, incorporates a mouthpiece extension tube (blowing bridge), called *paltjata* ('placed upon') in Aymara, which enables the player to reach the fingerholes (Figure 14). While *saliwa* bass registers have a pentatonic scale and are tuned in different keys depending on the local *musiñu* ensemble type (consisting of various registers/voices) (see Borras, 1995), the modern *moseño* has a diatonic/heptatonic scale and is mostly in G_3, like the *mama quena*, resembling the sound of a modern bass flute. However, urban bass *moseño* are also crafted in higher and lower keys, according to the demands of the client.

Figure 14: Diagram of *Musiñu Saliwa* and Urban *Moseño* (Source: Own Elaboration)



The Touristic Sphere

Within the touristic flute-making sphere, Walateño flute makers craft flutes destined for national and international tourism markets. These flutes – if the term is still valid – have often entirely lost their musical purpose and are transformed into souvenirs, perhaps the epitome of the commodity. The commodification of handicrafts and the change in material culture in contexts of tourism has received much scholarly interest (Cohen, 1989; Graburn, 1976, 1984; Grünewald, 2006; Henrici, 1999; Hume, 2009; Nason, 1984; Parnwell, 1993; Swanson & Timothy, 2012).

While flutes within the autochthonous and professional spheres are individually made quality musical instruments, standard flutes as tourism art and souvenirs are made in a semi-industrial mode of manufacture. This mode of manufacture is sometimes even based on a division of labour facilitating mass production, which is further supported by mechanisation processes. For example, former rural Indigenous *luriri* principally worked with hand-tools such as different self-made knives (each knife had a particular purpose in the crafting process of particular notched and fipple flutes) (Gutiérrez, 1991a). Contemporary urban-dwelling flute makers – basically in all flute-making spheres but most notably in the touristic one – have incorporated mechanical devices such as standing drills and electric sanders.

Against this background, I would basically follow Ingold (2000, p. 289), who argues that within such a development of mechanisation “the relations between workers, tools, and raw material have been transformed, such as to replace subject-centred skills with objective principles of mechanical functioning”. Ingold’s (2000) distinction between the perception involved in handling of a hand-tool within the “skilled system” and the fixed motions of the machine in the “determining system” is an interesting point of departure for discussing transformations within flute-making practices in terms of perception, skills, and production.

For example, formerly rural *luriri* used a knife with a short triangle blade called *kilaña* (the ‘opener’), which was used to perforate a first small aperture on the outside body of the *tuquru* bamboo tube. Then, another knife with a short and slightly inclined blade called *p’iyaña* (the ‘hole-maker’) was employed to enlarge and round the apertures to form and undercut fingerholes (Figure 15). Each fingerhole was individually perforated, where “the intended result is achieved through a continuous process of modification and adjustment, requiring constant visual attention” (Ingold, 2000, p. 306). As Ingold (2000) would probably argue, the *luriri* handled the *kilaña* as an exercise of skilled constraint, coupling the technically effective gesture with immediate sensory perceptions, thus, feeling and responding to the work of the tool upon the material.

Figure 15: Hand-Tools and Machine-Tools of Flute Makers (Source: Own Photos)

Kilaña (left) and *P’iyaña* (right) Standing Drill

Perforating small apertures with a *kilaña* required an understanding of the longitudinal movements of *tuquru* fibres, to which the effective use of the *kilaña* was adapted. Working against the *tuquru* bamboo, the *kilaña* would have lost its effectiveness as an ‘opener’ and would have only caused the tube’s cracking alongside these longitudinal fibres, especially in the small distances between fingerholes.

Over time, the *kilaña* has been replaced by an electric stand drill machine (Figure 15), whereas the movement of the maker became much more mechanically determined. He only places the bamboo tube in the right position under the rotating drill bit and turns around the turnstile so that the sinking bit perforates the *tuquru* tube in a perfectly rounded shape, which is only slightly cleaned and undercut with the *p'iyaña* afterwards. Yet, flute makers usually do not dedicate time to undercutting fingerholes in tourist flute-making contexts, where flutes do not have a musical purpose.

In fact, the natural exigency of *tuquru* fibres is secondary to this mechanical movement. However, as a "machine-tool" in the sense of Ingold (2000), the electric standing drill does not entirely decouple action from perception, since it still requires a certain skilled use, though with less attention to the material. Adding to these transformations in perception and skills, the shift from hand-tools to machine-tools had further implications on the scale of production, and consequentially material relationships in terms of musical bamboo demands. One could possibly argue that mechanised tools such as electric standing drills carry out the same operation that the *luriri* manually carried out with his *kilaña*, while the difference between hand-tools and machine-tools is therefore one of degree (see Ingold, 2000). In other words, the shift to mechanical devices facilitated an increase in the scale of production, especially in the touristic flute-making sphere, consequentially manifesting itself in higher bamboo demands (see Chapter Four). Thus, the economic advantage of a touristic flute maker over an autochthonous one lies within the number of flutes produced and sold in a certain period of time.

One example is a Walateño flute maker, anonymised in this thesis, who crafts high numbers of souvenir panpipes for national and international tourism markets, mainly for those in Peru. He has a small humpback, which was described to me by other makers as a result of his mass manufacture, an infirmity caused by his ceaseless work around the clock to fulfil his orders on time. He usually pre-cuts large numbers of *chhalla* tubes in each note of the predefined scale of the tourist panpipe (mostly G major scale), wraps all tubes of one specific note together and sells separated packages of pre-cut tubes for each note to Peruvian merchants from Juliaca and Cuzco. In Peru, these pre-cut tubes are selected, panpipes of different qualities are tied up, and then sold at different prices on local Peruvian tourism markets.

As revenues are much higher in Peru, merchants quickly recover their investment and are then even able to flood local Bolivian markets with these panpipes, undercutting the prices of Walateño flute makers. Many Walateño flute makers complain when cheaper panpipes, made using their Bolivian pre-cut tubes, return to the country, branded ‘Made in Peru’. Additionally, several Walateño flute makers told me that Peruvian merchants have often blatantly rejected tubes or flutes branded by Walata Grande makers with ‘Made in Bolivia’.

Many Walateño flute makers protest about this situation, as they perceive themselves to be a small, exploited part in the value chain of tourist flutes. They blame the Bolivian government for not protecting them as important cultural bearers, and for failing to produce internal markets, which would avoid them needing to enter into exploitative exchanges with foreign merchants. In this regard, many flute makers were disappointed by the Morales administration, which they had hoped to be more supportive for their concerns as Aymara flute makers.

Morales himself has often been depicted to me by flute makers as being particularly “Indigenous”. However, the interpretation among some of Walateño flute maker friends was that the MAS (*Movimiento al Socialismo,* or ‘Movement to Socialism’) government uses a particular autochthonous style of Andean music to generate an image of Indigeneity on the symbolic stage, while actually not caring much about the problems faced by Aymara flute makers once the stage lighting is turned off.[70]

Despite these claims, the mass production and inflow of money from touristic souvenir merchants offer Walateño flute makers a relatively stable monthly income, which is in most cases considerably higher than the otherwise precarious earnings of autochthonous flute makers (see Chapter Four). This exemplifies well how crafted souvenirs provide an important source of a self-sustaining employment (Evans, 2000). As one of the two strategies to cope with the historical decline of autochthonous music (see Chapter Four), crafting touristic flute souvenirs has not required a specific adaptation and learning of Western musical knowledge as is the case for crafting professional urban flutes.

The historical roots of this mass production of cheap standard flutes and flute souvenirs, as we have seen above, can be dated back to the foundation of the craft cooperative in the 1970s. This has significantly contributed to shifting economic rationales towards a more liberal market orientation (individualism, self-interest, etc.). Crafting flute souvenirs remains the mainstay of many of the makers who continue to live in the rural community of Walata Grande, just as it is for the majority of urban-dwelling Walateño flute makers in the cities of La Paz and El Alto.

Qantati's successor organization *Asociación Artesanal Boliviana Señor de Mayo* (ARBOLESEM), a member of the International Fair-Trade

[70] In fact, critiques that the Morales administration would only use Indigeneity on the symbolic stage have been uttered from various angles and perspectives in Bolivian society (see Burman, 2020). However, on public events organised by the MAS party, it is also very likely to hear more (neo)folklore bands in the *conjunto* style (like Kjarkas or Awatiñas), since these are often said to musically portray a constructed national identity (see Bigenho, 2002).

Organisation, nowadays mainly exports Andean weavings and textiles. Some Walateño makers continue to contribute to the overall product range, for instance with small reed-made souvenir flutes, which makers call *jisk'a pinkillu* (Figure 16). ARBOLESEM's sales manager, Juan Carlos Moscoso, told me in an interview that:

> European countries do not have the cultural context. That is why we do not export many flutes, which actually are more decorations and souvenirs. You cannot play any music with them.[71]

Figure 16: Flute Souvenirs (Source: Own Photo)

jisk'a pinkillu ("small *pinkillu*")

[71] "Países europeos no tienen el contexto cultural. Por eso no exportamos muchas flautas, que realmente son más decoraciones y recuerdos. No puedes tocar música con ellas."

The image of being mass producers of flute souvenirs rests heavily on Walata Grande makers today. One story is particularly telling in this regard. Out of curiosity, I once conversed with an employee in the shop of famous musical instrument maker Juan Achá, who mainly offered professional urban panpipes and notched flutes, alongside their main product line of urban *charangos*. We were talking about musical bamboos and Walateño flute makers, when he suddenly tried to convince me that Walateños would "only produce in large quantities", while adding the question: "Do you think they make professional quality flutes like we do?"[72]

What the employee seemed to be unaware of is the fact that Aymara Walateño makers of urban flutes, like the brothers Andrés and Julio, used to work for Achá not too long ago. Towards the end of my fieldwork, Julio told me that he stopped collaborating with Achá and company precisely due to the pretentious attitudes and veiled discrimination towards Aymara flute makers.

It is worth noting that the word 'professional' has shifted its semantic meaning in the way the employee employed it here. While normally used by Walateño flute makers to simply designate flutes tuned in Western scales and standard equal temperament, without any connotation of superiority, it now appropriates an overtly colonial if not racial undercurrent. Apparently, it is only a certain urban *mestizo* people, the creators of these adapted urban flutes, who are able to craft "professional quality flutes" tuned in standard equal temperament.

Against this background, the very mindful autochthonous Walateño *musiñu* maker Ignacio always assured me that dedicated autochthonous flute

[72] "Ellos solo producen en cantidades. ¿Tu piensas que ellos hacen flautas profesionales de calidad como nosotros?"

makers also craft genuinely quality flutes in their own right. On countless occasions, I heard him explain that:

> I do not have a degree from a higher education institution or something similar [note the aspect of the category of economic profession]. However, I am a master maker of quality *musiñu* and many other autochthonous flutes. I am proud, and I have a curriculum, too, of life experience as a maker of autochthonous flutes. Many of my *paisanos* [fellow Walata Grande flute makers] miss the point.[73]

It is noteworthy that making autochthonous or urban flutes requires different kinds of knowledge (e.g., about sound aesthetics and musical scales) and crafting skills (e.g., using *tupu* measuring sticks or chromatic pitch meter to tune instruments), which are hardly ever comparable. Interestingly, some of today's Walateño makers perfectly incorporate these two kinds of knowledge in one single practice, where Andean Indigeneity and Western modernity, manifested as forms of flute-making knowledge, are juxtaposed in a creative and emancipating tension.

The Bolivian sociologist Silvia Rivera (2012, 2020) has conceptualised this image of practice (possessing a genuinely decolonising potential in her view) with the Aymara word *ch'ixi*, literally meaning 'grey'. However, this colour is a combination of tiny, juxtaposed dots of black and white, which are only perceived as being totally blended, merged, or melded together from a distance.

As Ignacio explained in the above quote, many of his fellow flute makers would not appreciate the value of what they do. As an epistemological legacy

---

[73] "No tengo un título de una institución superior o algo similar. Pero, soy un gran maestro luriri de musiñu de calidad, y de muchas otras flautas autóctonas. Soy orgulloso, y tengo un currículo también, de experiencia de vida como un constructor de flautas autóctonas. Muchos de mis paisanos no lo entienden."

of colonisation, they still seem to perceive their valid flute-making knowledge as subaltern or even as ignorance (see Howard et al., 2002). Interestingly, the first so-called “Indigenous” government declared an era of decolonisation (Burman, 2016). However, its rather superficial and symbolic state policies (see Chapter Seven) rarely seemed to reach or challenge those sites where “colonial difference” (Mignolo, 2000, 2002) and the dominant discourse of knowledge have been interiorised by Aymara people.

Conclusions

This chapter contextualised the research in an historical account of Walata Grande and Andean flute making on the La Paz highlands. After exploring the archaeological panorama of the use of musical bamboos on the pre-Hispanic Altiplano, I have critically assessed the concept of artisanal specialisation in relation to Walata Grande. I argued that the ethnohistorical concept of artisanal specialisation is insufficient to explain the rise of Walata Grande as a flute-making centre on the Bolivian highlands. Furthermore, I demonstrated that such a perspective is at odds with a more nuanced understanding of the ways in which multiple economic occupations are integrated and articulated in historical and contemporary Andean life.

In the sense of a modern society based on labour divisions, one might say that Walata Grande specialised in flute making (as a primary source of income) rather recently, while relinquishing musical bamboo sourcing to external actors. Linking back to the analytical framework of sustainability developed in Chapter One, this well exemplifies how social and economic aspects, here the social organisation of flute-making and craft specialisation processes, influenced the organisation of bamboo sourcing. Another important economic factor in these recent changes in bamboo sourcing was the increase in flute-making activities as a consequence of accessing new markets and economic diversification. As will be shown in the next chapter, these aspects have increased and shifted musical bamboo demands and renegotiated musical meanings and values attributed to different bamboo types and variants.

The formal division of labour between flute making and musical bamboo sourcing will occupy us in more detail in subsequent chapters. It has contributed considerably to shifting bamboo collection practices, which has had negative consequences for the sustainability of musical bamboos in their natural habitats in the tropical forests of the eastern Andean slopes and Andean-Amazonian foothills. However, this is but one explanatory factor for musical bamboo scarcities in highland flute-making workshops among others (such as musical bamboo phenology, deforestation, resource dilemmas). Before I turn to these issues, I first describe in detail bamboo demands, urban bamboo supply, perceptions of scarcities, and musical meanings attributed to different musical bamboos in the contemporary flute-making spheres.

Chapter 4

Musical Bamboos in Flute Making Workshops

Bamboo Demands, Urban Supply, Perceptions of Scarcities, and Musical Values

This chapter deals with musical bamboos in contemporary highland flute making workshops and explores material demands, urban bamboo supplies, perceptions of shortages, and musical values attributed to different musical bamboo types and varieties. It will analyse the contemporary flute-making culture/economy in metropolitan La Paz, which is a precondition for understanding its musical bamboo demands and material requirements. I will explore social and economic dynamics within the contemporary flute-making culture on the *altiplano paceño*, followed by a description of musical bamboo distribution mechanisms of urban-dwelling Walateño flute makers. Before turning to musical values and meanings attributed to different musical bamboo types, I ethnographically unfold flute makers' experiences of musical bamboo scarcities in different flute-making spheres. Understanding these critical issues concerning shifting musical bamboo demand in contemporary flute-making spheres creates the necessary context for understanding the human-environment relationships of flute makers, and how their own economic actions have triggered unsustainable bamboo sourcing practices. Moreover, the chapter addresses responses of flute makers to scarcities/sourcing difficulties and raises important questions concerning the continuation of flute-making practices as they link to broader economic, social, and cultural aspects of sustainability. It is argued that within the assessment of a viable future for highland flute making, sight should not be lost regarding the environmental sustainability of musical bamboos. It becomes obvious that securing livelihoods is a key motivation for getting involved in tourist commerce, which has also facilitated the continuation of more traditional flute-making practices. However, more critical flute makers also see the negative environmental impact of this shift in the economics of flute making and bamboo sourcing. I begin this chapter with two ethnographic vignettes, which are descriptive of current dynamics within the highland flute-making culture.

Story One: **“With me, everything dies [out]!”**

One early morning in August 2017, I left our adobe-made house in the Ferroviario neighbourhood in the Pura Pura area on the north-eastern slopes of La Paz city in order to make my way via the crowded Vita square and the Buenos Aires street, passing the famous popular Huyustus market to the right, towards the Tumusla street, leading uphill to the Garita de Lima. I often walked along this same route, departing from our family’s house in the popular rail workers neighbourhood to Juan Granier street in order to spend time with urban-dwelling Walateño flute makers and share some coca leaves or eat some fresh *salteñas* or *tucumanas* (varieties of Bolivian baked or fried empanadas) together.

At that time, many La Paz *gremiales* or merchants’ associations were vociferously protesting a form of registration process introduced by the municipality, referred to as *carnetización*. This required official commercial permit holders to use electronic chipcards which contained their personal information. The *gremiales* feared losing control over their commerce on public streets, which they had autonomously organised and for which they had struggled for so long (Tassi, 2017). The municipal government of La Paz defended the process, as the regulation of commerce on public streets would facilitate controls and decrease the potential threat of robberies and illegal occupations.[74]

Flute makers with their mobile street stands called *qhatu* in Aymara received their *patentes municipales* ('municipal permits') in the 1970s as a means to give official status to their former habitual and sporadic commerce of rural-style flutes on the public streets of La Paz (Mamani Aruquipa, 2006). To my surprise, Walateño flute makers did not participate in any of these protests or blockades, although they were equally affected by the registration process. They continued to work as usual; a situation which can be related, as we will see, to their precarious economic incomes as makers of autochthonous flutes. In fact, the earnings of these flute makers in Juan Granier street are small compared to the profits made by merchants around the Garita de Lima and the Gran Poder area.

The remaining elderly Walateño flute makers working in Juan Granier street knew me by now. Some were always happy to see me, such as the humble *tarqa* maker Valentin Chipana. He is one of the last renowned *tarq luriri* on the entire Altiplano and probably to date the last descendent in his family lineage. Others did not talk much with me, and, on the contrary, were

[74] Many municipal governments in the past have tried to change the entrenched patterns of popular commerce and free public streets from commercial occupation, which would interfere with the circulation of public and private transport. As an incentive, the current municipal government has built new skyscrapers in several parts of the city, which aim to serve as new marketplaces for otherwise street occupying merchants. However, these formal and centralised markets are not well accepted by popular merchants in La Paz and El Alto and stand empty most of the time.

rather reserved, like the rural-style *qina* and *pinkillu* specialists Felipe Torres and Esteban Quispe. Back in the 1990s, Esteban's father Pascual was one of the main collaborators of French musicologist Gérard Borras, who worked among urban-dwelling Walateño flute makers from Juan Granier street on *tupu* measuring sticks (see Chapter Two). I came to know Esteban as a quiet and not very sociable person. We did not usually talk a lot, but when we did, he always mentioned how things were better during the time of his father.

On this particular morning, I approached his *qhatu* and he was very talkative. He was complaining about his decreasing sales, and that he would not earn well. Suddenly, he held up a bundle of bamboo-made *tupu*, the number of which was unidentifiable to me by a single glance, and said: "Look, do you know what these are? These are the *tupu* of my father"[75]. "Yes", I responded, followed by an explanation that I have read about them in Borras's (1995) work. Esteban could well remember the French researcher. He must have been in his late 20s by the time Borras had visited La Paz. He raised another smaller bundle of about half a dozen *tupu* only and said: "I don't use the *tupu* of my father anymore. I only use these ones, if at all"[76]. He continues to explain that he actually does not earn well precisely because of "only" making autochthonous flutes. In his own words:

> Those who make professional *zampoñas* and *quenas*, they can perhaps earn well and survive. But I, I cannot! I only make these autochthonous flutes that nobody wants![77]

---

[75] "Mira, ¿sabes que son? Son los tupus de mi padre."

[76] "No uso los tupus de mi padre. Solo uso estos, en todo caso."

[77] "Los que hacen zampoñas o quenas profesionales, ellos quizá puedan ganar bien y sobreviven. Pero yo, ¡yo no puedo! ¡Yo solo hago esas flautas autóctonas que nadie quiere!"

I was used to his frankness. When I consulted him about collaborating on my research, mentioning the cooperation between his father and the French musicologist in the 1990s, he honestly said that he had no interest, although he assured me that it would be an important topic. He mentioned several reasons, for example, that he was "too old for these kind of things"[78], and that he does not see any sense in collaborating in research about the sustainable future of musical bamboos and highland flute making when he would not even recommend his own children to continue with what he does.

"With me, everything dies [out]"[79], he succinctly put it. He did not sound very concerned, but rather resigned, or even at peace with himself. I well remember how I, on the contrary, returned home with a deep feeling of sadness, telling my wife and my mother-in-law about my conversations with Esteban. His reference to his children and the future of flute making was a direct response to my constant intention to make Walateño flute makers reflect on the fact that musical bamboos are the material basis, not only for the current generation of makers, but most importantly and in the sense of sustainability as intergenerational justice, for future generations.

Story Two: "You cannot earn anything from this!"

I got to know the Walateño maker Gilberto Huallpa through my maker friend Andrés Mamani. Having been assigned the task to purchase a consort of *alma pinkillu* flutes for our urban autochthonous musical collective, I asked Andrés to recommend a good maker of such instruments to me. Without much

[78] "Vas a disculpar, pero ya soy demasiado mayor para esas cosas."

[79] "Conmigo todo muere."

hesitation, Andrés suggested that I visit Gilberto, who lives a few blocks away from Andrés's house in Villa Ingenio in El Alto.

As Andrés was a mutual friend, Gilberto and I quite easily developed a good rapport. During all my visits, Gilberto was always very busy making large numbers of souvenir flutes (Figure 17). He regularly received orders from Peruvian merchants (approximately ten dozen decorative *qina* and *pinkillu* flutes each month) and therefore had a relatively stable income of up to 2500 Bolivianos (BOL) (~250 GBP), which is considerable compared to other Walateño flute makers I got to know during my research.

Figure 17: Decorative Flute Souvenir Making (Source: Own Photo)

Semi-Industrial Crafting of Decorative *pinkillu* (above) and *qina* (below) Flutes

His style of mass manufacture can certainly be defined as semi-industrial. Firstly, he saws all *tuquru* bamboo internodes to a standard length, drills all holes into the tubes, and cuts all notches or collocates all fipples in a sequential succession. These souvenir flutes have no musical purpose at all, whereas sonorous and acoustic characteristics are secondary and stand behind visual aesthetic aspects (see also Mamani Aruquipa, 2006). Once he finished crafting these flutes, his daughter and wife then paint and decorate them with typical Andean images and landscape paintings. Once a month, Gilberto takes his wares to the Peruvian city of Juliaca (which is connected to the rest of Peru through its airport), where Peruvian merchants, mostly from Cuzco, wait for him.

Because of his petty commodity production, i.e. a semi-industrial mode of crafting decorative flutes for tourism markets, Gilberto has a much higher demand for *tuquru* bamboos compared to autochthonous *pinkillu* or *qina* makers like Esteban in Juan Granier street. During my research, he constantly received new deliveries of musical bamboos from many different sourcing regions, directly to his house.

We always had good conversations, including about topics not related to flute making in any direct sense, for example, about his spiritual journey of becoming a *yatiri*, an Andean wiseman. Once he told me that he regularly undertakes so-called *pagos* or ‘spiritual payments’ to *pachamama*, the Andean female goddess of earth, in order for his commerce to bear fruit. Despite our close friendship, he never wanted to share any contacts for his personal musical bamboo suppliers with me, or specific information about the places of origin of the musical bamboos he used. By that time, I was already used to this secrecy related to bamboo suppliers and sourcing sites, which was a widespread trend among Walateño flute makers (see Chapter Two).

It is noteworthy that Gilberto also knows how to make good quality autochthonous flutes, which he demonstrated many times in front of me. While picking up the excellently made rural-style *alma pinkillu* flutes that I demanded for our musical collective, we chewed coca leaves together and began talking about contemporary flute-making practices in metropolitan La Paz, when he suddenly said that

> I do not understand how my *paisanos* [other Walateño flute makers] survive only making these autochthonous flutes. What do they live from? You cannot earn anything from this![80]

There are striking similarities between Gilberto's and Esteban's statements. Like Esteban, Gilberto also talked about the decline of autochthonous music and referred to decreasing sales of autochthonous flutes which furthermore would not provide sufficient income. Gilberto's example perfectly shows why economic stability and securing livelihoods are a key argument for getting involved in tourism markets, the principal flute-making sphere for the majority of Walateño flute makers nowadays.

Dynamics in the Andean Music-Culture

The making of rural-style autochthonous flutes was often described to me as being at a historical low point, and not only by the flute makers presented in the two stories above. Today, there seems to be a discrepancy between the income of mostly elderly autochthonous flute makers and the necessities of these makers and their families to sustain their livelihood. This discrepancy has led the great majority of Walateño flute makers to access tourism markets

[80] "No entiendo como mis paisanos sobreviven solo haciendo esas flautas autóctonas. ¿De qué viven? ¡No puedes ganar nada con esto!"

over time, focussing on the mass-manufacture of tourist souvenirs providing relatively stable monthly incomes. Those, who were able to learn the fundamentals of Western music theory and acoustics (pitch, scales, tuning) craft professional urban *zampoñas* or *quenas* destined for markets of Andean (neo)folklore, or other Western popular music (jazz, rock, reggae), in which Andean flutes tuned in equal temperament are performed (see Chapter Three). Very few makers solely make autochthonous flutes because sales fluctuate, and incomes are precarious.

This indicates a trend whereby autochthonous flute making is decreasing, which in turn is often related by autochthonous flute makers to a general decline in autochthonous flute music making and thus the number of performers of these flutes. It is true, in the sense of Titon (2009a), that sustaining autochthonous flute making means sustaining autochthonous flute music making, which in turn must imply sustaining people buying and playing autochthonous flutes.

However, the idea of 'sustaining' has become very slippery in the context of autochthonous music on the *altiplano paceño*, especially against the background of the many transformations it has experienced over the last century, both in rural and urban performance contexts (performance style, social significance, cosmological underpinnings, political statements, sound aesthetics, to name just a few). Questions about the dynamic transformation of autochthonous flute music seem quite far away from the immediate necessities of flute makers like Esteban, who would be happy if he could only sell a few more flutes, regardless of the client.

Decline in Autochthonous Flute Making?

The overall impression given to me by makers still involved in crafting autochthonous flutes was that autochthonous flute music and by extension the number of performers buying such flutes was in decline. This was often mentioned in addition to the fact that autochthonous flutes are much cheaper than their modern urban counterparts. Many urban musical collectives – including the one in which Jesika and I participated – claim to be motivated by a sense of revitalising, recuperating, or defending (sp. *reivindicar*) rural Aymara flute music, their social significance (participatory tradition), and cosmological underpinnings (rituality, seasonality, spirituality).

In fact, there are many urban musical communities playing autochthonous flute music in metropolitan La Paz nowadays, who all play some sort of autochthonous music, thus producing demand for certain kinds of rural-style flutes.[81] However, despite these diverse recreations of autochthonous music in the city (in Bolivia and beyond), which nowadays is one of the main markets for some autochthonous flute makers, I do not doubt a general trend of decline in autochthonous flute music on the *altiplano paceño*.

For example, the study of *tupu* measuring sticks allowed Borras (2002) to formulate a hypothesis about musical dynamics within the main autochthonous flute families (*siku*, *qina*, *phala* – *pinkillu*, *musiñu*, *tarqa*). Although he argued that *tarqa* and *musiñu* ensembles enrichened their sound structure over time, adding new voices to the homophonic texture of consorts

[81] This is not only limited to Bolivia, as Castelblanco (2014, 2018, 2019) has shown, referring to various cosmopolitan *sikuri* groups in principal South American capitals such as Santiago (Chile), Bogotá (Colombia), or Buenos Aires (Argentina). Some of them even buy autochthonous flutes from Walateño flute makers in La Paz (Castelblanco, 2020, pers. comm.).

comprised of registers tuned in different intervals, processes occurred within the other flute families that he defined as "impoverishment" or "standardisation". Some traditional scales became predominant over others, particularly the *segunda taquiña*[82] in the context of urban mestizo *sikureadas*, while many rural flute styles formerly played on the *altiplano paceño* were simply abandoned (recall the statements of Esteban above).

Reasons for the loss of more traditional Andean music-making practices in rural Aymara communities are multiple, including shifting livelihoods, urban migration, formal education, loss of social significance (seasonality, rituality), and transculturation. In that sense, the most far-reaching form of standardisation of rural-style flutes is linked to their adaptation to Western scales and standard equal temperament.

Twenty years ago, Borras (2000) described how urban-dwelling Walateño flute makers were starting to adapt to these new urban musical environments and had begun to craft these modern urban flutes. As argued in Chapter Two, Walateño flute makers accessed new markets beyond the traditional autochthonous flute-making sphere as a response to the decline in autochthonous flute sales and a way to broaden sales opportunities. This allowed them to satisfy, in a kind of "dual economy" (Geertz, 1963, p. 50), the needs of both sociocultural and musical worlds. This consisted of a 'traditional' one demanding rural autochthonous flutes with local cuts and sound aesthetics and a 'modern' one demanding flutes adapted to Western scales and tuned in standard equal temperament on the one hand, and tourism flute souvenirs on the other.

[82] A local panpipe style played on the Aymara Altiplano, based approximately on a G major scale.

In a reconciling fashion, Borras (2000, pp. 178-179) claimed that the most interesting aspect is that these different making practices coexisted side by side, a coexistence which further materialised in the *tupu* measuring sticks that Walateño makers used to tune these instruments (before they ultimately changed to electronic pitch meters). Ten years later, taking up Borras's (2000) argument, the son of a Walateño flute maker Edwin Mamani Aruquipa (2006) argued for a "border thinking" and "an-other-paradigm" (Mignolo, 2000, 2005; Mignolo & Escobar, 2010), explaining the intersection with globalised modernity in urban spaces linked to capitalist markets.[83]

Much like Borras (2000) and Mamani Aruquipa (2006), I was initially convinced that within a diverse "musicultural ecosystem" –applying Titon's (2009b, p. 129) analogy once more – autochthonous flute and music-making practices could coexist in its sociocultural niche alongside these modern urban flute and music-making practices. However, the mutual coexistence does not seem to be as peaceful as depicted by these authors. Might there be an interrelation between the growth of the latter and the decline of the former?

In this context, I am reminded of an earlier article by Bolivian ethnomusicologist Ramiro Gutiérrez (1991b), who argued that a colonialist reality in Bolivia generates conflict between a rural Andean Indigenous society in possession of an Andean musical system and urban modernity with its Western musical system. This relation would result in processes of "acculturation" and the creation of a new social stratification of the *mestizo*, constructing its musical identity with elements of both poles.

[83] For a similar theoretical discussion into the intersection of Indigeneity and modernity, with a particular focus on Indigenous peoples in Amazonia, see Halbmayer (2018).

In another article, Gutiérrez (1990, p. 293) understands this process as a form of "alienation" which implies the "total extinction" of more rural autochthonous forms of Andean music making. Lomax (1968, 1977) has called this "cultural grey-out", and Seeger (2013) reminds us – in line with Titon's (2009b) analogy – that diverse music-cultures disappear as a result of other actions in the musicultural ecosystem of which they are part.

However, music-cultures are dynamic, and Walateños themselves were not passive receivers of these musicultural transformations, even though Andean peasant communities and economies, as Platt (1982, 1995) and Sánchez (1982) argued, were often depicted in former times as resisting cultural globalisation, the market economy, and capitalist modernity. Rather, they took an active part themselves in these musicultural dynamics, which opened up new opportunities to survive economically as highland flute makers. However, at the same time, this process also diminished their own historical significance as a flute-making centre of particularly rural-style or autochthonous flutes.

Controversial Folklore Music

Whether the widespread and common habit in rural Aymara communities on the *altiplano paceño* (including Walata Grande[84]) of contracting folklore brass brands and popular music orchestras (e.g., *música tropical andina* or *chicha*) for patronal feasts has also contributed to the decline of autochthonous music-making practices is controversial. Based on my own experiences, I would argue that autochthonous music-making practices in

[84] In 2018 and 2019, the rural syndicalist authorities of Walata Grande invited Dina Condori and Yarita Lizeth Yanarico (both Peruvian singers of *música chicha*) to perform during Walata Grande's main community feast of the *Señor de Exaltación* (14.-16. September).

rural communities are getting replaced by other music-making practices, or simply by playback devices such as radios or tape music (see also Stobart, 2014, p. 434). On the contrary, Bigenho (2002) remarked how Quechua people from Yura, Potosí during feasts play flutes throughout the days and enjoy dancing *cumbia* into the night, thus stressing coexistence.

In any case, the insertion in rural festive contexts of folklore brass bands in particular has also produced new creative musical transformations (Mújica, 2014b, 2017). Furthermore, views of cultural contact (e.g., through colonialism) and *mestizaje* as a negative process of acculturation have been largely critiqued in ethnomusicology as highly pejorative and essentialist (Kartomi, 1981; see also Grant, 2014). For Bolivian society, the sociologist Silvia Rivera (2012, 2020) argues instead for a more nuanced understanding of *mestizaje* from an Andean Aymara perspective (*ch'ixi*) as an emancipating process where Andean indigeneity and Western modernity are juxtaposed (do not mix entirely) and therefore produce constant tensional and creative interchanges of mutual affection and learning (see Chapter Three).

In fact, urban folklore musicians heavily drew on their rural Indigenous counterparts in order to construct a global romanticised and reified image of Andean musical Indigeneity, to which rural Indigenous musical lifeworlds, epistemologies, and sound aesthetics have contributed very little (Stobart, 2013a, 2016). This is perhaps what Krister Malm (1993) referred to as being unwillingly involved in transculturation processes, losing specific properties, and ending up as a component in some sort of 'world music' style.

However, I think it would be mistaken to insinuate hostile attitudes from (neo)folklore musicians towards rural-style autochthonous forms of Andean music, or a conscious intention to undermine their ongoing reproduction.

Historically, the (neo)folklore movement in Bolivia was motivated by a strong attitude of valorisation of Indigenous musical ways of life, through their incorporation into a national identity of a *mestizo* nation (Bigenho, 2002, 2005; Stobart, 2019a). These attitudes aimed at valorising rural Indigenous musical practices in a time, where urban environments were reluctant to accept any form of rural Indigeneity and racist towards Aymara people like Walateño flute makers (remember Nicasio's story in Chapter Two). However, it is also true that these musicultural transformations have significantly contributed to structural changes in the flute-making culture/economy and to shifting markets (see Chapter Three). And in some cases, advocacy has turned into or been later reinterpreted as appropriation (Stobart, 2019a, p. 205f).

In this regard, I have also heard critical attitudes of Walateño flute makers towards some Bolivian folklore musicians. For example, one autochthonous flute maker was convinced that a former *quena* player of the band *Rumillajta*, Adrian Villanueva, who learnt how to craft flutes from Walateño flute makers in Juan Granier street, had stolen valuable flute-making knowledge. It was claimed that with this knowledge he became famous as a professional urban *quena* maker, building on the fame he had acquired during his musical career.

Another maker mentioned the famous *charango* player and the icon of the Bolivian (neo)folklore movement, Ernesto Cavour. He complained that Cavour only visited Walata Grande to undertake studies, then disappeared without sharing his fame and success, to which Walateño flute-making knowledge had contributed. This maker further claimed that the *tupu* measuring sticks that Cavour exhibits in his museum of native instruments in Jaén street should be returned to Walata Grande, where the community's own musical instrument museum should be built. Similar political attitudes have been raised against foreign researchers, who have studied Walata Grande and their flute-making practices in former times.

These examples give evidence of a changing political consciousness of Aymara Indigenous urban-dwelling flute makers in 21st century Plurinational Bolivia. Personally, I would relate such a reinterpretation of national musical history and these political attitudes towards the intrusion into Walateño making affairs to the rise to power of first so-called ‘Indigenous’ president Evo Morales in 2006, his shifting political rhetoric, and the intent (whether successful or not is another question) to incorporate Indigenous aspects into the national political agenda (see also Stobart, 2019a).

Urban Bamboo Supply and Distribution Mechanisms

Understanding these musicultural dynamics, their impact on the flute-making culture/economy on the *altiplano paceño*, and the rise of inequality between these different flute-making spheres is fundamental for understanding contemporary musical bamboo demands and urban distribution mechanisms. Within the contemporary spheres of flute making, Walateño flute makers use native woody bamboos for making a variety of Andean flutes. Yet, material demands significantly differ between them.

In the light of the increasing population in Walata Grande over the second half of the twentieth century and the diversification of flute purchasers, also beyond the Bolivian borders, Walata Grande as an expanding flute-making centre on the *altiplano paceño* surely experienced an increasing demand for bamboo until the turn of the millennium. However, especially over the last two decades, bamboo demands have tended to develop quite unequally within these different flute-making spheres. This is linked to the musicultural dynamics discussed above.

Generally speaking, if there are fewer people buying autochthonous flutes nowadays, it is only logical in a dialectical sense that musical bamboo demands within the autochthonous flute-making sphere will have tended to decrease in correspondence with a reduction in sales of autochthonous flutes. Accordingly, as already suggested, there has been a shift in demands for musical bamboos towards the professional and touristic making spheres.

Only very few urban-dwelling Walateño flute makers nowadays source their musical bamboos through more traditional sourcing journeys themselves. The majority of contemporary urban-dwelling Walateño flute makers depend on musical bamboo traders and wholesalers for obtaining their bamboo resources in the city. Besides the impacts on current bamboo-sourcing practices, which will be addressed in Chapter Six, this division of labour between flute making and bamboo sourcing and the shifting of markets have engendered the development of certain hierarchies within the urban bamboo distribution including mechanisms of bamboo retailing.

Bamboo Wholesalers and Bulk Purchasers

Certain Walateño flute makers maintain direct and regular contact with bamboo traders, who bring wholesale musical bamboos to flute makers' homes or sell them at central distribution locations in the city. One such example is Río Seco in El Alto, a neighbourhood in which many Walateño flute makers now live. Some flute makers buy large quantities of musical bamboos, which they either store and use themselves, depending on demand, or further distribute around the city. Thus, besides flute making, musical bamboo retailing has become an additional economic activity for some urban-dwelling Walateño flute makers.

When flute makers purchase musical bamboos in bulk directly from traders, they usually get a much lower unit price. The regular unit price for a *chhalla* panpipe bamboo tube during the time of my research was up to 0.25 BOL (~0.025 GBP), whereas the common traded bundle (ay. *qhiwi*)[85] containing 1000 or 1500 *chhalla* tubes cost between 250 and 350 BOL (~25-35 GBP). These bundles of unselected culms (with four or five internodes each) contain *chhalla* tubes with different diameters and lengths. In lucky cases, 80-90% of the tubes are usable. In unlucky cases, tubes are broken, cracked, rotten, immature, or infested with insects, and thus unusable.

Collectors usually dry *chhalla* culms for a few weeks at collection sites in the appropriate subtropical climate in order to avoid cracking (see also Langevin, 1992, p. 408). However, lately it has frequently been the case that humid and green *chhalla* culms arrive in the city, often with immature culms among them (Figure 18). Makers themselves must then dry them on their patio or on their corrugated iron roofs. In some cases, *chhalla* culms crack during the drying process in the unfavourable highland climate with strong solar irradiation, very dry humidity, and high diurnal-temperature variations.

Avoiding resource loss, Walateño flute makers usually prefer to buy ready dried, golden-yellowish culms, which are normally more resistant to the Altiplano climate and the variations in altitude, humidity, and temperature. In fact, the climate on the highlands poses a constant challenge for flute makers, who have developed special bamboo treatment practices such as toasting

[85] The Aymara word *qhiwi* derives from the verb *qhiwiña*, which means ‘to carry over the shoulder a large and heavy thing’.

tubes in order to render them more robust and resistant.[86] As compared to *chhalla* tubes, *tuquru* tubes are generally much more susceptible and responsive to changing climates, humidity, and temperatures. They must necessarily be dried in subtropical regions, and toasting is an indispensable part of the pre-crafting preparation of *tuquru* bamboos.[87]

Figure 18: Drying of Musical Bamboos in El Alto (Source: Own Photo)

Left: Green *chhalla* Culms; Right: Drying of *chhalla* (Background) and *tuquru* (Front) on Patio

Tuquru tubes are sold per unit, and not in bundles like *chhalla* panpipe bamboo. The unit price of a *tuquru* bamboo tube varies according to diameter and length. At the time of my research, a regular wholesaled *tuquru* bamboo tube of an approximately half a metre in length and a diameter of two centimetres cost approximately five Bolivianos (~0.50 GBP), with prices continuously increasing for longer tubes with greater diameters.[88]

---

[86] Stobart (1988) has documented the same practice among *pinkillu* makers in Vitichi. See also Roda (2014, p. 366) for another example of how climate impacts on musical instrument making (*tabla* tuning in Banaras, India).

[87] I myself took a variety of undried, green *tuquru* tubes from collection sites home and all broke during transport, drying, or storing. Cracking occurred during drying because I exposed them too much to the strong Altiplano sun on our corrugated iron roof, or due to inadequate storing conditions and great overnight temperature drops in El Alto.

[88] A *tuquru* bamboo tube with a maximum length of up to two metres and a diameter of up to five centimetres, for example used for making lower *musiñu* bass registers called *saliwa*, cost up to 20 BOL (~2 GBP).

As *tuquru* bamboo tubes are sold per unit, flute makers select suitable tubes depending on the flute types. For example, *musiñu* duct flute and *tuyu* bass panpipe makers require a variety of *tuquru* tubes with different lengths and diameters, while most autochthonous *qina*, *phala*, or *pinkillu* flute types usually vary between 30 and 60 centimetres with diameters of around two or three centimetres.

Resource loss remains low since flute makers normally do not select unusable *tuquru* tubes, in many cases immature bamboos. Sometimes makers negotiate to reduce prices for these immature bamboos and buy them anyway. Immature tubes, which shrivel during drying, are then soaked with water for a few days before being rapidly and strongly toasted with a blow torch. These prepared immature *tuquru* tubes are much lighter than mature ones and are often rejected in professional and autochthonous flute-making contexts. They are therefore predominantly used for making souvenir flutes with no acoustic and sonorous requirements. From an ecological perspective, immature bamboos should not even be collected in the forests in the first place. However, recently it has become more common for immature *chhalla* and *tuquru* bamboos to be traded as a consequence of shifting musical bamboo sourcing and collection practices (see Chapter Six).

All in all, Walateño flute makers invest approximately one third of the regular prices for autochthonous (15-20 BOL; 1.5-2 GBP) or decorative souvenir flutes (5-10 BOL; 0.5-1 GBP) into bamboo materials, which is just one of many frequent and infrequent input factors (knives, saws, machinery, rents, municipal permits, and other materials like yarn or woods).

There is a trend for makers of souvenir flutes to be regular bulk purchasers, as they have a much higher and continuous musical bamboo demand. They constantly create networks of musical bamboo traders through processes of clientelisation (locally known as *casero*) and ties of personal loyalties involving social relations over time (see Chapter Two).[89] However, exceptions occur, and flute makers moving within the other flute-making spheres might have direct contact with musical bamboo traders or local collectors as well.

This is often an economic question because resale bamboos are simply more expensive than wholesale ones. Therefore, autochthonous flute makers with precarious incomes also often procure their musical bamboo resources directly from wholesaling traders. They save money to spend on new musical bamboo resources over a period of certain months or join economic forces with other family members in order to sporadically purchase musical bamboos in bulk, which they then store over decades to supply their needs as makers (Figure 19). Despite the competitive situation in procuring wholesale bamboos (and also selling flutes), it is interesting to observe how the word rapidly spreads among envious Walateño flute makers when a wholesaling bamboo trader approaches the city with a load of musical bamboos.

Bamboo Resellers and End-Users

Certain professional urban *zampoña* or *quena* makers purchase their materials from other maker colleagues who act as bamboo retailers. The reason for entering these kind of dependency relationships are diverse and multiple. For

[89] Economic relationships of supply and distribution sometimes include kin-relationships between flute makers living in different Bolivian cities. For example, the tourist flute maker Eugenio lives and works in El Alto, while his brother resides in Cochabamba, where he can more easily establish contacts with locals in the *yungas* of Cochabamba or Santa Cruz, for example towards Villa Tunari or alongside the *camino viejo* ('old road') towards Pojo, Samaipata and finally Santa Cruz.

example, my urban *quena* maker friend Favío prefers to buy pre-selected and cleaned *tuquru* tubes, rather than unprepared ones. His reseller, a souvenir flute maker, buys variously shaped *tuquru* tubes in bulk and pre-selects them according to their quality. He reserves low-quality tubes to make decorative flutes himself, while reselling top-quality tubes (mature, dried, straight, thick-walled, with non-oval and round cavities) to Favío for a much higher unit price (~30 BOL; 3 GBP).

Figure 19: Storing of Panpipe Bamboos (Source: Own Photo)

Hoarded *chhalla* Culms

In turn, Favío sells a professional urban *tuquru*-made quena for up to 100 BOL (~10 GBP) to retailing musical instrument shop owners, for example in the touristic Linares or Sagarnaga streets in the centre of La Paz city. Thus, as in the other flute-making spheres, one third of the final price of urban professional *tuquru*-made flutes are material costs.

Although unit prices for pre-selected bamboos are much higher, Favío enjoys certain advantages within this supply mechanism. He has less resource loss since he only purchases pre-selected top-quality tubes. Additionally, the reseller brings him the *tuquru* tubes directly to his house. He simply has less inconveniences, for example bargaining with wholesalers over unit prices or competing with other Walateño bulk purchasers over traders and wholesale bamboos.

Other examples are Favío's older brothers, the urban panpipe makers Andrés and Antonio. Although Antonio explained to me that he had stored various types of *chhalla* bamboo tubes in his house, he often procured *chhalla* tubes from a souvenir flute maker, who is one of his cousins. I once accompanied and helped him select and saw tubes on his cousin's patio. His cousin sells the tubes to him at cost price, which is more of a kinship deal.

Antonio, however, told me later that his cousin pre-selects *chhalla* tubes according to their length and sells the much-appreciated long tubes at a different price. As the lengths of internodes vary according to different *chhalla* types (see below), long internodes for making panpipe bass registers like *sanqa* are not always available. Walateño panpipe makers have therefore learnt how to join two or three smaller *chhalla* tubes together.

Andrés is another urban panpipe maker who bought resale bamboos during the time of my research. I visited him many times in his house in Villa Ingenio, while his nephew passed by, handing in pre-selected, sawed, cleaned, and sometimes even pre-cut *chhalla* tubes in each note of the G major scale of urban *zampoñas*. Andrés paid his nephew one Boliviano (~0.10 GBP) per tube, thus four times more than wholesale *chhalla* tubes. However, this seems to be convenient as he only fine-tunes each tube individually with his chromatic pitch meter, ties them together into the typical double-rowed raft of urban *zampoñas*, and brands them with his Walata Grande seal.

Such a division of labour, complementary tasks, and outsourcing of steps within the crafting process allows Andrés to accept more orders at the same time. Such an organisation of labour is almost exclusively possible in the professional flute-making sphere, where professional musical instruments tuned in standard equal temperament produce higher incomes as compared to autochthonous flutes costing approximately five times less.

Perceptions of Scarcities and Flute Makers' Responses

The prices for *chhalla* and *tuquru* tubes mentioned above are general prices in times of material availability, which might significantly vary in times of shortages. Against this background, it is noteworthy that, in my conversations with them, flute makers articulated quite different perceptions of musical bamboo shortages. To my surprise, some Walateño flute makers, particularly those working in the autochthonous flute-making sphere, actually argued that there is no 'scarcity' (sp. *escasez*) of musical bamboos as such. This can only in part be related to the present decrease in musical bamboo demands. They rather linked temporal bamboo shortages to the maturation cycles and 'seasons' (sp. *temporadas*) of different native woody bamboo species growing in their natural habitats in tropical forests. Consequentially, cyclical musical bamboo shortages are nothing new for Walateño flute makers, who have adapted to musical bamboo life cycles by storing and hoarding mature bamboos in order to bridge these musical bamboo ecology-induced shortages (see Chapter Six).

On the contrary, souvenir flute makers, who have a much higher musical bamboo demand, quite often expressed their concerns about scarcities. In this case, to put it bluntly, this concerned nothing other than a threat to their mass manufacturing and petty commodity production. This does not mean, in turn, that they are making huge profits or an unethically large amount of surplus. Their making practices are surely geared to the particular market niche, in which they economically situate themselves. Furthermore, their motivation to get involved in tourism markets is mainly based on their wish to sustain their family's livelihood ('necessary product') and enable their children to access higher education, like so many Walateño flute makers nowadays. However, it is also true that many Walateños were able to buy their lands and built houses in El Alto or La Paz simply through having been involved in tourism markets over the twentieth century. And in some cases, surplus made by urban-dwelling flute makers is conspicuously spent to organise prestigious patronal feasts in their rural community of origin.

Their perception of scarcity is predominantly linked to the accepted or potential mass orders of decorative souvenir flutes, which they must deliver to their clients in a certain period of time. In the touristic flute-making sphere, musical bamboo scarcities might therefore be considered "demand-induced" (Homer-Dixon, 1999), as higher demands for bamboo resources temporarily surpass the possible musical bamboo supply. Souvenir flute makers always try to balance out their high demands by procuring more bamboos, which is, however, restricted by their 'seasons', that is maturity periods, and the degree and continuity of musical bamboo trading and collecting practices in recognised sourcing regions.[90]

[90] Both aspects have become a problem for local *qantu* panpipe makers in the Kallawaya region, causing *chhalla* bamboo shortages in a local panpipe making context with relatively low *chhalla* bamboo demands. The single bamboo species used for local *qantu* making was usually immature and bamboo collectors in Kallawaya *yungas* communities additionally

Against this background, makers have established measures in order to keep their musical bamboo supply stable over time, such as the diversification in the use of different musical bamboo species with intersected growth and maturation cycles (thus shortening bamboo ecology-induced scarcity periods) (see Chapter Six), or lately the creation of informal networks and reciprocal relationships of mutual dependency with musical bamboo traders, locally known as *chhalleros* and *tuqureros*. In this context, it is significant that many Walateños told me that one of the touristic flute makers I frequently talked to, anonymised in this thesis, was the first one to delegate musical bamboo-sourcing practices to highland bamboo traders from Walata Chico around the turn of the millennium, establishing in this way the now common division of labour between flute making and musical bamboo sourcing. Referring back to the theoretical discussion about sustainability and critical social-ecological theory in Chapter One, I would even argue that these trends in the tourist flute-making sphere have evidenced a kind of *bamboo rift*. Relating to the concept of metabolic rift developed by Foster (2000), I argue that increased commodity production of souvenir flutes demanded larger amounts of bamboos, which has triggered new modes of musical bamboo sourcing in order to keep urban bamboo supply stable over time. These unsustainable modes of sourcing have disrupted the natural reproduction capacity of musical bamboos and have produced bamboo degradation and resource depletion in recognised sourcing regions.

This interpretation also concurs with critical observations of some flute makers I interviewed during my fieldwork. For example, I once talked with

started to dedicate themselves to other economic activities such as gold mining or growing cash-crops (Hachmeyer, 2015; Langevin, 1992).

my cosmopolitan maker friend Julio about *chhalla* bamboo shortages. He also argued that there is no scarcity as such. However, almost with the same breath in which he mentioned naturally recurring bamboo ecology-induced shortages and *chhalla* bamboo ‘seasons’, Julio remarked that in former times *luriri* like his father Sebastián had known how to collect *chhalla* bamboos in the forests correctly. Most of these *chhalla* bamboos, he noted, have now almost completely disappeared from their former habitats. Additionally, he went on to explain that *chhalla* bamboos were once easier to access, for example, growing much closer to roads and communities. Today’s collectors, he asserted, must delve for hours into the extremely dense *yungas* vegetation in order to search for widely dispersed bamboo veins in the topographically difficult to access cloud forests. Moreover, they would lack appropriate knowledge about the ecology of gathering musical bamboos. What he told me alluded to shifting sourcing practices where mass extraction has replaced seemingly more selective modes of musical bamboo collection conducted by Walateño flute makers themselves in former times. This has presumably led to a situation of overexploitation, depletion, and mismanagement in areas of musical bamboo sourcing (see Chapter Six).

Additionally, Nicasio often stated during our conversations that deforestation, land use change, and the conversion of native vegetation for agriculture and cattle rearing would continuously destroy musical bamboo habitats in recognised sourcing regions, mentioning predominantly the coca-growing *yungas* of La Paz and the agricultural region of Alto Beni (see Chapter One). These recent trends mentioned by Walateño flute makers such as Julio and Nicasio would certainly increase “supply-induced” (Homer-Dixon, 1999) scarcities of native woody bamboos as forest resources and produce situations of potential struggle and conflict over environmental resources. What are the responses of Walateño flute makers to this precarious situation?

Musical Instrument Retailing

A number of Walateño flute makers have started to run shops in Linares street, a relatively recent trend not mentioned by Borras (1995). For example, when I visited Nicasio and his son the first time in 2014, they mainly offered Andean flutes and percussion instruments like *bombo* and *wank'ara*. Over time, they diversified their ware and today also retail a variety of string instruments, like guitars, *charangos*, mandolins, Venezuelan *cuatros*, and Cuban *tres*.

In this case, becoming retailers of musical instruments is an economic strategy in order to be less dependent on the fluctuating sales of both rural and urban-style flutes, and to be more resilient if supply-induced musical bamboo scarcity worsens. Many of the musical instrument retailers with shops in the touristic Linares street do not craft musical instruments themselves but have developed the infrastructure to sell them, including contacts with national and international clients.

At the upper end of Linares street is located the famous 'witch market' (sp. *mercado de las brujas*), which is a major tourist attraction in the centre of La Paz. Shops and stalls offer Andean ritual paraphernalia and supposed Andean shamans read coca leaves for astonished tourists. Linares street is full of tourist shops offering diverse forms of Andean industrial and hand-made crafts, including Andean textiles, alongside souvenir flutes.

Andrés first moved with his mobile street stand to the nearby Mariano Graneros street, before moving to a small, rented shop in the more popular

Linares street a few blocks further south. He left Bolivia to make his living in Chile a few years later, where he hoped to earn more money through making professional urban *zampoñas*. His brother Antonio took over his shop, where he crafts and sells professional urban *zampoñas* and *quenas* nowadays.

During my fieldwork, Antonio changed to a smaller shop with a lower rent, which is situated off a side alley of Linares street. Andrés's former shop assistant, Marsico, one of the few non-Walateño flute makers in the city I got to know, became independent and started to rent his own shop in the patio of a small adobe brick building. Over recent years, he has entirely specialised in making high-professional urban *zampoña* and *quena*. It must have gone well for him, as he recently changed to a more visible shop with a more expensive rent in one of the modern galleries.

Opening shops in the touristic Linares street was strategic, since Walateño flute makers like Nicasio and Andrés hoped to take advantage of the central locality and the inflow of international clients and tourists with higher purchasing power. However, tourists often lack the musicultural background to perform these flutes. Moreover, increasing rents and reduced revenues led Andrés to hand over his shop to his brother Antonio because, as he put it, "you only work for the rent, which 'eats' all your money"[91].

Although Antonio and Nicasio mainly offer professional high-quality urban flutes such as *zampoña* and *quenas* nowadays, their product range also includes tourist-targeted souvenir flutes, which other Walateños distribute in the musical instrument shops in Linares street.[92]

---

[91] "Solo trabajas para el alquiler que come todo tu dinero."

[92] These touristic flutes – which circulate on national tourism markets, fairs in the cities of La Paz and El Alto, and all over the country – are probably all made by Walateños. During

Continuity and Transmission of Making Practices

Some of the children of Walateño flute makers told me that increasing bamboo shortages and sourcing difficulties, which worsen precarious working conditions for flute makers, incentivised them to search for other work. This further accords with statements by parents who do not want their children to continue with flute making (recall Esteban's story at the beginning of this chapter). For this reason, many children nowadays dedicate themselves to other economic activities, which were described to me by both children and parents as more profitable and occupying higher socioeconomic status.

In general, Walateño flute maker families have much greater social mobility today and manage their formerly rural economy from the urban centre. They practice what Bolivian sociologist Antequera (2011, 2017, 2019) calls a vertical control of socioeconomic floors, an analytical concept that he developed in relation to Murra's (1975 [1972]) ecological verticality. This idea of socioeconomic verticality offers an excellent image with which to approach social mobility dynamics among Walateño flute maker families. Grandparents remain in Walata Grande and take care of family properties and land. Parents are agriculturalists and flute makers and want their children to access more privileged professions and employments, which are perceived to be of higher socioeconomic status (for instance in state institutions, state education, but also in businesses in the private sector and financial

one of my visits in Sucre I talked to a musical instrument shop owner who had just, at the time of my visit, received huge packages of standard tourist flutes and flute souvenirs made by Walateño makers. He explained to me that he deposits money in a bank account and receives flutes in return via the postal service.

institutions). First generation offspring, however, often still work in the informal sector as caretakers, drivers, bricklayers, or mechanics.

Although bamboo shortages and sourcing difficulties are mentioned as key motivations, this kind of socioeconomic verticality was further fostered during the Morales government (i.e. since 2005), following a long history of economic pauperisation and political marginalisation of the country's majority of rural Indigenous peoples. This enabled many Aymara people to take part more actively in the political, social, and economic development of the country. In a way, it seems ironic that some policies of the so-called 'Indigenous' government have rather contributed to the discontinuity of more traditional, rural Indigenous practices in some cases.

Despite the general trend to abandon flute-making practices over the long term, during their free time and as an important part of the Aymara idea of family economy, many children of contemporary Walateño flute makers continue to help their parents in making flutes, broadly construed, including decorations, paintings, carvings, and varnishing. I will give some examples:

Antonio's oldest son studies Business Administration and Economics at the San Andrés University of La Paz and earns money assisting his father. One of Laureano's sons is a military musician while another is a mechanic. Both help their father to craft flutes and manage international sales over the internet. Ignacio's youngest daughter studies graphic design, while his son crafts modern urban *charangos* (where a luthier was presented as higher social status than a *luriri*). Basilio's son is a college music teacher and semi-professional musician in several Andean (neo)folklore bands, who worked during the weekend in a musical instrument shop in Sagarnaga street.

Eugenio's daughter temporarily worked in the Municipal Secretary of Cultures of La Paz. One of Vicente's sons is a bank employee.

The case of Vicente is interesting in this regard. He is possibly one of the oldest and most experienced autochthonous panpipe makers in Juan Granier street today, possessing knowledge of how to make rural-style *siku* in particular. Unfortunately, he suffers from an eye disease, causing him gradual blindness. As he told me, his sons will not continue with his legacy, as "they already have better jobs"[93]. Vicente therefore started to teach one of his sons-in-law, who until recently lived in the rural community of Walata Grande and, as I was told, dedicated himself to agriculture and other economic activities (not to flute making).

The Turn to Plastic

When polyvinyl chloride (PVC) came to be used in panpipe making on the Bolivian Altiplano is not entirely clear.[94] Gutiérrez (2002) interviewed several panpipe makers both from Walata Grande and the specialised panpipe making village of Condo on the southern Altiplano in Oruro department about plastic panpipes in the 1990s. Neither community used plastic tubes for making panpipes at that time, even though it was already in use by other musicians and urban panpipe makers.

Nowadays, these plastic panpipes are predominantly used in the context of autochthonous music education in Bolivian colleges. This has produced a new clientele since the 1990s, where Indigenous languages, crafts, and music

[93] "Ya tienen trabajos mejores."

[94] Mardones and Ibarra (2018, p. 340) have argued that *lakita* panpipes in Northern Chile were already made from PVC tubes in the 1960s, among others, with imported PVC tubes from Bolivia.

entered the classrooms all over the country during neoliberal governments (see also Burman, 2020, p. 8).

Many Walateño flute makers insist that it was not their invention and that they only adapted to it much later as the demands for plastic panpipes increased (see also Gutiérrez & Gutiérrez, 2009). Many Walateño flute makers, among them foremost autochthonous ones, took advantage of this new market niche in order to diversify their sales opportunities and stabilise, at least a little bit, their precarious incomes.

Bolivia's 2010 education law, *Ley de la Educación Avelino Siñani - Elizardo Pérez*, named after the founders of the first Indigenous school 'Ayllu Escuela' in Warisata in 1936, further fostered autochthonous music education in the curriculum as a form of "intracultural knowledge". Many of these standard plastic panpipes (in G major scale, more or less exactly tuned in equal temperament) are made from PVC tubes in the colours of the national flag. In terms of storing, PVC tubes are much handier and slightly (though not significantly) cheaper than bamboo tubes. Against this background, one might speculate whether the turn to plastic was a direct response to *chhalla* bamboo shortages or sourcing difficulties.[95]

This might be the case for the Lahuachaca-based *musiñu* maker Francisco Quispe, who sells plastic panpipes to local musical instrument merchants in Oruro and Cochabamba outside of the high-demand season for *musiñu* duct flutes (especially around December and Carnival). In one of our conversations, he said that he finds it more convenient to travel to one of the

[95] In the context of *lakita* panpipes in Chile, Sánchez (2018, p. 30) as well as Mardones and Ibarra (2018, p. 340) argued that the material change was induced by a difficulty in transporting delicate *chhalla* bamboo from Bolivia to Chile.

plastic factories in El Alto to purchase plastic tubes than to compete with maker colleagues for *chhalla* bamboo resources.

However, this was not directly related to musical bamboo scarcities, their disappearances from former collection sites, or the deforestation-induced habitat destruction. Having talked to many Walateño flute makers, I would basically argue that the turn to plastic was incentivised by musicians or other clients, for example parents of school-aged children asking for more durable materials in these new performance contexts. In other words, it was not primarily a consequence of *chhalla* bamboo scarcity issues. In fact, these standard instruments can also be purchased made from *chhalla* bamboos.

However, plastic tubes are still largely rejected in both autochthonous and professional music-making contexts. Professional, very exclusive high-quality urban panpipes are nowadays made from one particular extremely thin-walled *chhalla* bamboo type, as we will see in the next section. Regarding the autochthonous context, motivations for rejecting plastic materials differ depending on the sociocultural background of autochthonous panpipe musicians.

For example, in urban autochthonous music groups, sometimes with an urban *mestizo* background, one often hears environmentalist claims (i.e. plastic is harmful for the environment) mixed with a romanticised use of Andean Indigenous ideals about harmony with nature and intimate relationships (i.e. spiritual significance of bamboo sound) with the pantheon of Andean deities/spirits.

Interestingly, such an environmentalist impulse manifested itself in our urban autochthonous musical collective in a different guise, since we have been playing and teaching panpipe music with consorts of PVC-made panpipes in our urban group. These were crafted by a non-Walateño flute maker, who predominantly uses plastic to craft panpipes and notched flutes. Many of the more established group members argued that we should not use up and consume valuable and scarce *chhalla* bamboo resources for teaching panpipe music to people, who would participate only a few times at the beginning and then abandon playing panpipes after a short while anyway.

These motivations to use plastic panpipes might be comparable to the reasons behind the invention of modern lightweight plastic shopping bags by Swedish engineer Sten Gustaf Thulin in the early 1960s, who apparently followed a similar environmentalist impulse (Hachmeyer & Stobart, 2019). Initially, durable plastic bags were invented for multiple use and as an alternative to paper bags whose production was causing forests to be chopped down. The current environmental disaster of plastic contaminating the planet's oceans, especially these lightweight shopping bags, was a result of shifting consumer habits and the rise of single-use bags. Undoubtedly, these environmental concerns about the disposal of plastic artefacts are also highly relevant in the context of plastic panpipes in Bolivia.

However, in more ritual contexts motivated by an impulse of reclaiming rural Indigenous musical practices, where spiritual relationships with Andean spirits played a central role, our urban autochthonous musical collective predominantly used bamboo-made flutes as these were said to better establish communication and contact. A similar idea was suggested when I once conversed with the elderly *sikuluriri* Vicente at his *qhatu* in Juan Granier street about different *chhalla* bamboo types and plastic tubes. Explaining the difference between bamboo and plastic materials, he stated that "the plastic *siku* does not cry"[96]. This is a widespread view among especially elderly highland Aymara panpipe makers, and similar statements about plastic tubes and panpipes were collected by Gutiérrez (2002) in the 1990s. In fact, in the Bolivian Andes not only panpipes are said to 'cry' (ay. *jachaña*) but also other flutes and string instruments.

The framework of this thesis does not allow me to delve deeper into issues related to the 'cries' of musical instruments and I refer the interested reader to the pertinent literature about the topic (e.g., Hachmeyer, 2018d; Hachmeyer & Stobart, 2019; Stobart, 1996a, 2006a). In short, since rural Aymara music was first and foremost performed for non-human ears in former times, the 'cries' of musical instruments mediate interspecific relationships and communication between humans and powerful non-human beings guiding life in the shared and cohabitated multiverse better known as *pacha* by Aymara Andeans.

Don Vicente's statement can therefore be interpreted as if plastic is considered an inorganic material that is not part of cyclic life and the web of reciprocal relations (ay. *ayni*) sustaining the cosmos (Hachmeyer & Stobart, 2019). Interestingly, different people involved in autochthonous music-making practices in La Paz and El Alto, also those more inclined to Aymara ritual life and spirituality, claimed that plastic tubes do not have *ajayu* ('spirit'), while bamboo tubes would apparently possess this animating quality or life spirit.

In fact, *ajayu* is a very complex concept, which has posed a challenge to generations of anthropologists. With the threat of over-simplifying, one might

[96] "El siku de plástico no llora, janiw jachkiti."

say that *ajayu* can be understood as a life-giving quality that all living beings permeate and unite, an animating energy. Although everything that is alive, subjective, and agentive must have *ajayu*, living beings (humans and non-humans alike) do not individually own but rather share it (Burman, 2016). After death, some immaterial components reintegrate into the broader web of *ajayu*, while those more related to the body (ay. *jañchi*) disintegrate.

Although the notion that plastic tubes are spiritless and bamboos are alive would certainly provide a strong ethical argument for preserving musical bamboos grounded in Andean lifeworlds and cosmological ideas of rural Andean music making, I strongly believe that these are essentialist and that Aymara Andeans with a more rural background do not think about *ajayu* in the same way.

I once conversed with *amawt'a* Don Carlos over a *tari* ('small hand-woven textile') of coca leaves about the *ajayu* of musical bamboos, and what happens to it when bamboos are cut. He explained to me that collecting bamboos is tantamount to killing them, since they are removed from the broader web of life. "The *ajayu* then leaves the bamboo"[97], he said. Thus, the bamboo dies, which manifests itself in losing water and drying up. Don Carlos remarked that the same would happen to humans when they lose their *ajayu* (for similar statements of Andean wisemen in the Kallawaya region, see Bastien, 1985, p. 601). I then told him about the urban discourses I have heard that bamboo-made flutes are alive and have *ajayu*. He looked at me astonished and responded that bamboos become flutes which are then blown

[97] "Su ajayu sale pues del bambú."

by *phusiri* ('the one who blows'). With their breath, they would fill or recharge the flute with their *ajayu*.

In fact, *ajayu* is intimately related to the lungs (ay. *chuyma*) and respiration (ay. *samaña*) (Burman, 2016). New-borns are said to receive *ajayu* with their first breath and dying persons emit their *ajayu* with the last one. What Don Carlos expresses here is a relational (non-essentialist) understanding of *ajayu* and by extension of life. This suggests that a flute turns into an integral body part of the *phusiri*, who brings the bamboo – having become a flute – back to life through breathing into it. In turn, the dried-up bamboo tube does not have *ajayu* itself, as much as the unblown flute, or the plastic tube, which can also be potentially charged with *ajayu* if we follow this relational logic.

In a way, new Andean spiritualities developed in the city around the performance of autochthonous music. And although these sometimes highly reified and romanticised practices can be considered to a certain degree urban "invented traditions" in the sense of Hobsbawm & Ranger (1983), we are only beginning to understand the ritual role and cosmological significance of musical bamboos from an Aymara Indigenous music-making perspective. In this regard, further ethnomusicological and music anthropological research is indispensable.

Musical Values of Bamboos

What also occurred in the urban environment was a renegotiation of musical values and meanings of different bamboo types, especially in the context of *chhalla* bamboo and professional urban panpipe making. This has manifested itself in increasing prices for these professional musical instruments, attributable to the exclusive use of a single favoured thin-walled *chhalla* bamboo type that is sourced in the subtropical valley of Zongo, close to the city of La Paz.

Chhalla Bamboos

In this context, one must know that Walateño panpipe makers use a variety of distinct *chhalla* types, which are collected in different regions in Bolivia (see Chapter Five). They basically distinguish between four main types corresponding to key *chhalla* bamboo-sourcing regions: *chhalla de Zongo*, *chhalla de Quime*, *chhalla de Alto Beni*, and *chhalla de Bermejo*. 'Zongo' is a community in a subtropical *yungas* valley of the same name northeast of the city of La Paz. 'Quime' is a village and municipality in Inquisivi province (La Paz department) through which makers access the central Inquisivi *yungas* municipalities of Licoma and Cajuata. 'Alto Beni' is the name of a geographic region between the departments of La Paz and Beni, denominating the tropical valleys of the Andean foothills around the middle course of the Beni river. 'Bermejo' is a city and municipality in Aniceto Arce province (Tarija department) at the southern Bolivian border to Argentina (for a detailed explanation see Chapter Five).

According to the local *chhalla* typology of panpipe makers, in their dried state, these different *chhalla* types have tubes with particular characteristics which vary in length, diameter, wall thickness (or cavity), and consistency (Table 4).

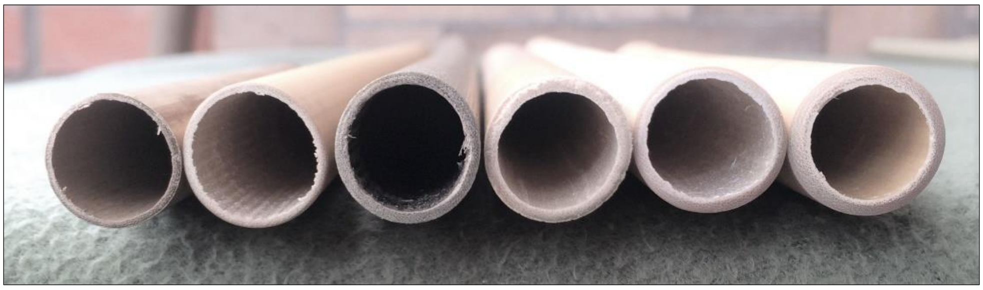
Table 4: *Chhalla* Types and Characteristics (Source: Own Elaboration)

Type		***Lengths***	***Diameters***	***Walls***	***Consistency***
Zongo		various-long	various	very thin	very fragile
Quime		various-long	various-small	thin-middle	fragile
Alto Beni	*lluq'a*	short/curved	middle-big	thick	robust
	qhipu	short/straight	middle-big	thick	robust
Bermejo		short	middle-big	very thick	very robust
Kjirki		very long	middle	middle	robust

While 'Zongo' *chhalla* is particularly thin-walled and therefore fragile (locally referred to as *cáscara de huevo* in Spanish meaning 'eggshell'), 'Bermejo' *chhalla* is the complete opposite, in that it is extremely thick-walled and robust (locally referred to as *carnoso* in Spanish meaning 'meaty' or 'pulpy'). While 'Alto Beni' and 'Bermejo' *chhalla* only have short internodes, 'Zongo' and 'Quime' *chhalla* can produce long internodes which are highly appreciated. 'Quime' tubes have especially small diameters, while 'Alto Beni', 'Bermejo', and 'Zongo' *chhalla* usually produce tubes with varied diameters.

The 'Alto Beni' *chhalla* has two very similar subtypes, which is a *lluq'a* ('smooth') type with a glabrate tube surface and a *qipu* ('spine') type with a minutely spinous-like trichomic or hairy tube surface. Makers often treat them as a single type ('Alto Beni'), although they are two different native woody bamboo species (see Chapter Five). In addition to these four main *chhalla* types, makers nowadays also use (although not very frequently) a *kjirki* ('rough') *chhalla* type which has a rough surface texture and very long internodes. In sum, Walateño panpipe makers employ up to six different *chhalla* panpipe bamboo variants which, in particular, vary in wall thickness (Figure 20).

Figure 20: *Chhalla* Bamboo Varieties (Source: Own Photo)



From Thin to Thick: 'Zongo', 'Quime', 'Kjirki', 'Alto Beni (*qipu*)', 'Alto Beni (*lluq'a*)', 'Bermejo'

Material selection and preferences differ according to the flute-making spheres. Furthermore, they have shifted over time and have changed in the city. For example, professional panpipe makers like Andrés and Antonio use the very thin-walled 'Zongo' *chhalla* only for making very exclusive and high-quality professional urban panpipes (sp. *zampoñas*). This is more of a client-induced preference, as professional panpipe musicians, usually *mestizo* people, argue that it is easier to produce a good and clear sound using thin-walled panpipes made from 'Zongo' *chhalla*. By contrast, thicker-walled *chhalla* types are said to produce an opaque sound and require more air.

Moreover, smaller tube diameters are employed in modern urban *zampoña* making. These instruments are doubled-rowed, consisting of two rafts that combine to produce a full scale, and which are bound together in complementary pairs (not to be confused with doubled-rowed autochthonous panpipes, see Figure 12). These thinner-walled and smaller diameter tubes decrease the distance between tubes, thereby minimising the overall size of the instrument and permitting faster lip coordination over the raft of tubes in soloistic performance contexts.

The larger diameters and thicker walls of other *chhalla* types, like 'Alto Beni' or 'Bermejo', increase the space between tubes and thus the overall size of the instrument, making it more difficult to individually perform a melody (in contrast, autochthonous panpipe melodies are played with complementary pairs using interlocking technique). Consequently, Andrés and Antonio usually employ thicker-walled *chhalla* types for making more regular urban *zampoñas* or autochthonous *siku* consorts (if autochthonous musicians do not explicitly ask for thinner-walled *chhalla* bamboos).

Depending on the *chhalla* type, modern urban *zampoñas* in the *malta* size (G_4) cost between 40 BOL (~4.00 GBP) for non-exclusive panpipes with thicker-walled *chhalla* tubes and up to 150 BOL (~15.00 GBP) for very exclusive professional panpipes made from thin-walled 'Zongo' *chhalla* bamboo. By way of comparison, a pair of autochthonous panpipes with thick-walled *chhalla* bamboos cost about 25 BOL (~2.5 GBP). If autochthonous musicians ask for *siku* made from thinner-walled *chhalla* bamboo ('Zongo' or 'Quime'), prices for these musical instruments increase up to four times.

In sum, there are nowadays two levels of price difference, one being related to the material, the other to the crafting practice. Makers justify price difference between autochthonous and modern urban musical instruments with the "professional" and "exact" tuning (in standard equal temperament) requiring certain "advanced" skills and knowledge. Furthermore, the Mamani brothers explained to me that they have worked on improving visual aspects of their panpipes, such as clean cuts and sandpapered edges, a more balanced bamboo tube toasting with a blowtorch, and more stable modern panpipe bindings with bamboo bridges and resistant nylon yarn instead of traditional bindings with bamboo fibres and wool (Figure 21).

Price difference between thick-walled and thin-walled *chhalla* bamboo must also be related to a current scarcity of the latter types. As a matter of fact, I could literally watch prices for these thinner-walled *chhalla* bamboos rise during my fieldwork. Among other consequences, this has caused socioeconomic exclusions regarding the use of thinner-walled *chhalla* bamboo types ('Zongo' or 'Quime'). For example, Julio once told me that his father Sebastián made rural *jach'a lakita* panpipes played in Ilabaya (Larecaja province) exclusively from 'Zongo' *chhalla* bamboo in former times. He mentioned several reasons, including the desired sound of the ensembles, easier performance, but also the existence of longer internodes for bass registers. Nowadays, these *jach'a lakita* panpipes are usually made from thicker-walled *chhalla* types, since community members cannot afford the elevated prices for thinner-walled types.[98]

Figure 21: Panpipe Bindings (Source: Own Photo)

Left: Traditional, Right: Modern

However, preferences in the autochthonous flute-making context have also shifted simultaneously. Julio's brother Antonio explained to me that Sebastián was one of the first Walateño flute makers to travel to Bermejo in the 1970s in order to search for a new *chhalla* bamboo type, which he had heard grew in the Tucumán forests of the southern Andean *yungas*. He

[98] I have observed the same phenomenon in the Kallawaya region among *qantu* panpipe players, who have started to buy consorts from Walateño panpipe makers in the city. They also used a locally sourced thin-walled *chhalla* bamboo in former times (see Chapter One).

encountered this particularly thick-walled *chhalla* type and many Walateño panpipe makers and autochthonous panpipe players in rural Aymara communities began to appreciate this thicker variant. These tubes are more robust and usually do not break during performances and communitarian feasts, where the alcohol level increases significantly with the later hours of night (see also Martínez, 2002).

Moreover, some sons of elderly panpipe makers, in line with the views of *mestizo* panpipe players from the city with whom I conversed, argued that different autochthonous panpipe genres would require specific types of *chhalla* bamboos. For example, I heard that *suri siku* raft panpipes must necessarily be made with thicker-walled *chhalla* bamboos (an opaquer sound), while *jach'a siku* panpipes must ideally be made from thinner-walled *chhalla* types such as 'Quime' (a clearer sound and easier to overblow).

Such a focus on the sound of these different *chhalla* types seems to be of urban influence, since former rural flute makers, both in Walata Grande and Condo, instead focussed much more on morphological differences rather than sound, as shown by previous ethnomusicological studies of highland flute makers (Gutiérrez, 1991a, 1995, 2002; Gutiérrez et al., 1998, 2000; Gutiérrez & Gutiérrez, 2009).[99] Furthermore, often during my visits to the *qhatu* of the

[99] My wife Jesika purchased a *tropa* ('consort') of *suri siku* years ago, for which the Walateño panpipe maker employed available thinner-walled 'Quime' *chhalla* bamboo. This does not mean that different *chhalla* types do not have particular acoustic implications. In fact, many of the autochthonous *siku* genres on the Altiplano are based on pairs of panpipes constructed with double rows (not to be confused with professional urban *zampoñas*). Autochthonous panpipe players blow against the rear edge of a tube of the first row, whereas the upper half of the split air stream then passes into the opposite tube of the second row, making it sound at a lower intensity. These second rows have open or closed (stopped) tubes at their distal end and are crafted at different interval ratios (third, fifth, or octave). These are commonly referred to as *resonadores* or 'resonators'. However, Gérard (2018, p. 299) has recently

elderly and renowned rural *sikuluriri* Vicente in Juan Granier street, I would observe him using different *chhalla* types in the same pairs of *siku* panpipes he was crafting. In fact, this actually would not happen in the professional flute-making sphere or under these new urban musical values presented above. While asking him once about the sounds of different *chhalla* types, Vicente simply responded that "they all sound the same"[100].

His statement reminded me of formerly widespread "*sirinu*/*sirina*" traditions on the Altiplano (Ritter, 2002; Stobart, 2006b; Turino, 1983). For many Aymara (and in some cases also urban *mestizo*) musicians, a "good", "beautiful", and "seductive" sound (concerning tuning and timbre) of musical instruments, or entire flute ensembles, did not entirely depend on inherent acoustic properties of bamboo materials used for making these wind instruments, but was further related to very careful, (semi)social, and spiritual relationships with the *sirinu*/*sirena*, or as this being is called in Aymara, *añchañchu*, a powerful, ambiguous, creative, but also very dangerous and potentially corruptive being from within *manqha pacha* or the 'inner world'.

In Walata Grande, in the past, wind instruments were placed with offerings and libations at specific aquatic places like water sources (ay. *uma nayra*), lakes (ay. *quta*), or rivers (ay. *jawira*) in order to let the *añchañchu* "perfectly tune" and enchant these musical instruments. In Stobart (2006b, p. 117) we read that

---

argued that they are more precisely "modifiers of timbre", as they add additional partials to the overall sound. Having played autochthonous double-rowed *siku* made from different *chhalla* types myself, my impression was that these timbre modifications are much clearer and sharper with double-rowed autochthonous *siku* made from thinner-walled *chhalla* tubes. My explanation would be that the edges of the tubes of the first and second row are much closer together, allowing more air to pass into the second tube.

[100] "Todos suenan igual."

> in the instrument making village of Walata Grande (Department La Paz), I was told that consorts of wind instruments are placed beside the sirena's spring together with offerings. The players withdraw to a safe distance and listen out for the tuning note that initiates each piece. The moment the sirenas sound this note, a man from the group hurls a tin can in order to startle and frighten them back into the earth, whereupon the players retrieve their instruments which are then claimed to be 'perfectly in tune' and to outshine all other consorts played in the feast.

As expressed by this testimony, Walateño flute makers were very wary of these creatures, maintained very respectful distance, and undertook reciprocal exchanges in order to appropriate their power and render them more beneficial for them (see Gose, 2018). Indeed, they very frequently made offerings to the *añchañchu*, for example sacrificing red cockerels and guinea pigs and spilling their blood on new sets of flutes (Stobart, 2006b).[101] I once observed Ignacio's *musiñu* ensemble making a *ch'alla* libation to the *añchañchu* on their set of flutes and percussion instruments before starting to play.

Since many Walateño flute makers before Vicente told me stories about their personal relationships with the *añchañchu*, I was expecting something similar. But Vicente went on to explain that the sound of autochthonous *siku* panpipes would much depend on how panpipe players blow into the tubes (rural musicians often overblow notes which is a fundamental blowing technique in some *siku* genres), but especially on how makers craft them.

In this moment, he began talking about electronic pitch meters which professional urban panpipe makers nowadays use for tuning panpipes (in

[101] They apparently had made these offerings and sacrifices so frequently that the *añchañchu* lost appetite and simply has not consumed them, which in turn meant that musicians were not provided musical assistance (Stobart, 2006b). In addition to these aquatic places, Walateños have claimed that some *sirenas* also reside in dry hollows and rocks.

standard equal temperament), and argued: "Perhaps you can use the electronic pitch meter for making these urban *zampoñas*, but it does not work for making autochthonous *siku* and consorts."[102]

Much has been written about how traditionally crafting panpipes with *tupu* measuring sticks resulted in slight variations in frequency of each note, whereas the whole autochthonous ensemble, usually comprised of different registers of parallel fifths and octaves produces an overall turbid and dense unison sound structure with notable pulsations or acoustic beats (Borras, 1995, 1998, 2002; Gérard, 1999, 2002, 2015; Hachmeyer, 2019; Stobart, 2006a; Turino, 1989, 1993).[103]

Gérard's (1997, 1999, 2002, 2009, 2010, 2013, 2015) musical acoustic work suggests that pulsating and multiphonic sound aesthetics on the Bolivian Altiplano and beyond have pre-Hispanic origins and must therefore be seen as a "reiterative ancestral aesthetic" (Gérard, 2009, p. 125) concerning rural Andean Indigenous sounds.[104] Borras (1995) has further shown how Walateño flute makers have developed crafting techniques referred to as *altu*/*baju* in Aymara, by which makers craft half of the *qina*, *phala*, or *pinkillu*

---

[102] "Tal vez puedes usar un afinador para hacer estos sikus urbanos, pero no sale para hacer sikus autóctonos y tropas."

[103] These autochthonous *siku* ensembles – and also many *pinkillu*, *qina*, and *phala* consorts based on the same dense sound structure and local aesthetical principles – might be perceived as 'untuned' or 'dissonant' for a Western ear accustomed to standard equal temperament. When I bought autochthonous, rural-style flutes with these slight 'discrepancies' for our urban autochthonous musical group, many members complained about the 'unequal' sound of the flutes and asked me to return them to the maker, who must have done something wrong.

[104] It is noteworthy that Stobart (2019b) recently critiqued these views of musical archaeologists as broad generalisations over diverse semantic meanings in contemporary ethnographic contexts having certain ideological effects (heritage making) and closing up the attention to other important sounds in rural Andean music.

flute consorts with slightly displaced fingerholes (often only a few millimetres).

However, nobody (except Gérard, 1998, for *suqusa*) has yet mentioned the role of irregularly growing bamboo tubes, which add a natural layer to these culturally developed crafting techniques. For example, makers would often use bamboo tubes and canes with different diameters in order to make flute consorts. However, irregularly growing bamboo is particularly important for autochthonous *siku* making, where flutes do not have fingerholes to displace.

These slight variations and discrepancies in autochthonous *siku* appear in the first place due to the irregularities of bamboo nodes on the bottom of each *chhalla* tube (Figure 22). As elderly autochthonous panpipe makers usually measure the tube lengths with their *tupu* on the outside of the tube, from the node upwards, each tube finally turns out to be slightly different because its inner node structure grows irregularly and is not visible to the panpipe maker from the outside.

Figure 22: Irregular Nodes in *Chhalla* Bamboo (Source: Own Photos)

lluq'a Alto Beni

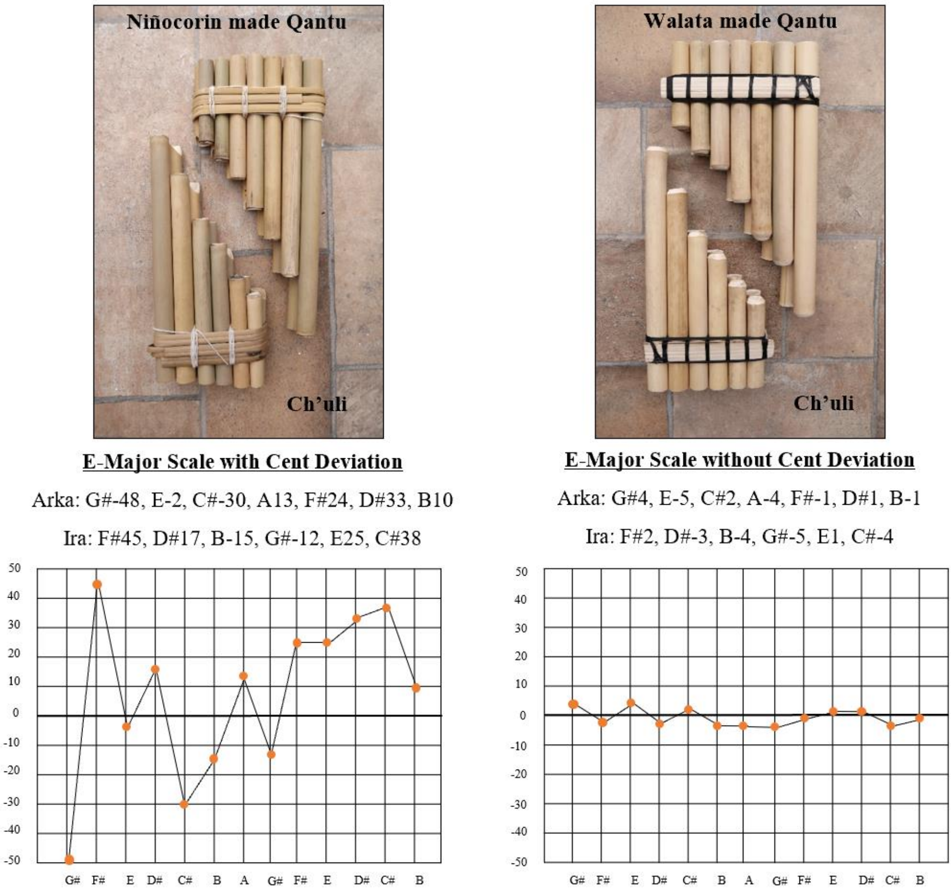
Despite the use of chromatic pitch meters in more professional panpipe-making contexts, the use of *tupu* measuring sticks has not been completely abandoned. Nowadays, makers of modern urban *zampoñas* make use of one single *tupu* indicating the approximate tube lengths for every pitch in the twelve-tone equal temperament system. In contrast to autochthonous *sikuluriri*, professional *zampoña* makers, however, let the chromatic *tupu* sink into the *chhalla* tube and calculate the tube length from the inside of the tube, thus eradicating the effect of the irregularly grown bamboo nodes.

They mark the approximate length of each tube with a cutter knife at a slightly lower frequency than the required pitch. Rotating the tube against the blade of the cutter knife, a few millimetres are sliced from the tube edge (sp. *bajar*) to fine-tune the tube to the required note with the help of the electronic pitch meter. Once the maker has cut a slice of the tube edge, he usually blows into the tube in order to test the frequency. If the pitch is still too low, he cuts another slice and tests again until the required pitch is finally reached.

If you walk around the block of Linares street, from some distance away, you can often hear professional *zampoña* makers testing and fine-tuning *chhalla* tubes. Accustomed makers like Andrés and Antonio have learnt by everyday practice how to translate cents (measure of musical intervals, 100 for each semitone if tuned in standard equal temperament) into millimetres of the tube edge and therefore often require only one exact cut in order to fine-tune each tube.

If autochthonous *siku* panpipes are crafted with chromatic pitch meters – something that happens if you ask a Walateño maker for professional urban *zampoñas* – these variations from equal temperament and intentional discrepancies in frequency are removed. This difference in panpipe tuning exemplifies the juxtaposition of *qantu* panpipes (*ch'uli* size) that I purchased, respectively from a local *qantu* panpipe maker in Niñocorin (Charazani), who used a *tupu* measuring stick, and a Walateño maker, who employed an electronic pitch meter (Figure 23).

Figure 23: Difference in Panpipe Tuning (Source: Own Elaboration)



Another striking example is the *suri siku* panpipes that I purchased for our musical collective in the city of La Paz. Here again, the Walateño panpipe maker used a chromatic pitch meter to tune these instruments, thus removing the intentional deviations from standard equal temperament. This effect is even more far-reaching in *suri siku* panpipe consorts, whose repeated heptatonic scales rather tend to organise notes in almost equally distributed intervals (nearly "equi-tonal") (Borras, 2000).[105] Thus, the Walateño panpipe

[105] In practice, the intervals are only approximately equal, and a great discrepancies exist between consorts of flutes (see Borras, 2000).

maker further adapted the (nearly) equi-tonal heptatonic scale to a Western major/minor scale based on whole and semitones (diatonic) (Table 5).

Table 5: Difference in *Suri Siku* Tuning (Source: Own Elaboration)

	Suri Siku (F# Major)[a]																
F# Major Scale (E.T.)	E#	D#	C#	B	A#	G#	F#	E#	D#	C#	B	A#	G#	F#	E#	D#	C#
Deviation (Cents)	+4	0	-3	+2	+6	+5	+7	-3	3	-5	-5	-2	-6	-8	-7	+1	-1
Intervals (Cents)	204	203	195	104	201	198	110	194	208	200	97	204	202	99	196	202	0
	Suri Siku (Medida 29)[b]																
F# Major Scale (E.T.)	E#	D#	C#	B	A#	G#	F#	E#	D#	C#	B	A#	G#	F#	E#	D#	C#
Deviation (Cents)	-68	-53	+13	+17	-11	+64	+58	-43	-45	+45	+55	+3	+68	+76	-26	+7	+30
Intervals (Cents)	185	134	196	128	125	206	201	202	110	190	152	135	192	202	177	177	0
	Suri Siku (Medida 31)[c]																
F# Major Scale (E.T.)	E#	D#	C#	B	A#	G#	F#	E#	D#	C#	B	A#	G#	F#	E#	D#	C#
Deviation (Cents)	-17	-38	-17	+27	-49	-19	+13	-52	-20	-20	+27	-33	-42	+6	-84	-18	-34
Intervals (Cents)	221	179	156	176	170	168	165	168	200	153	160	209	152	190	134	216	0

[a] *Malta* sample of consort made by an urban-based Walateño maker of urban style *zampoñas* in 2018.
[b] *Malta* sample bought by my wife from an urban-based Walateño specialist for rural-style *siku* in 2010.
[c] Means of an ensemble made by Marcelino Canaviri Silva from Condo (Oruro), measured by Arnaud Gérard (2000).

According to Gérard (2000), crafting *suri siku* panpipes in a (nearly) equi-heptatonic system allows for using multiple (five to seven) minor pentatonic scales based on a single generating block of notes. This possibility is significantly reduced (only two) when these instruments are crafted according to a Western diatonic scale. Although most contemporary panpipe styles are already based on Western diatonic scales (see Appendix Two) – with many songs played using pentatonic scales (Baumann, 1985) – some rural *siku* panpipe styles (*chiriwano*, *mimula*, *ärachi*, *jula-jula*, *ayarachi*, or the above-mentioned *suri*) are based on local scales with different tonal organisations.[106] However, the example of the *suri siku* panpipes above suggests an ongoing adaptation of more local scales to the Western tonal system.

---

[106] For example, the reed-made *ayarachi* from Tarabuco and Potosí are based on five and six respectively (nearly) equally distributed intervals (Borras, 1998).

In sum, it does make a great deal of difference nowadays which Walateño panpipe maker you engage to have him craft a consort of autochthonous *siku* panpipes for you. Unfortunately, flute makers with a particular knowledge of rural-style flutes including their sound aesthetics and scales (tonal organisations) are extremely scarce today, while the elderly who usually possess such a knowledge are dying without transmitting it to subsequent generations.

From a postcolonial perspective in ethnomusicology (e.g., Solomon, 2012), one might argue that the diffusion of the Western tonal system in autochthonous flute making, especially the use of standard equal temperament, might be seen as a question of "cultural dominance" (Wallis & Malm, 1984) which eradicates local Andean Indigenous sound aesthetics of flutes and collective consorts. In some contexts, autochthonous flute consorts tuned in standard equal temperament are still rejected by autochthonous panpipe players as lacking in "flavour" (Gérard, 1999, p. 159; see also Stobart, 2006a, p. 193). In other more professionalised and presentational contexts, these "finely tuned" (sp. *bien afinado*) *siku* panpipes, as often argued, are explicitly appreciated by some autochthonous panpipe musicians as an indicator of supposed musical professionality (Hachmeyer, 2019).

Tuquru Bamboos

Walateño flute makers nowadays distinguish between three main types of *tuquru* bamboo: *lluq'a paceño, lluq'a cochabamba,* and *kjirki*. The first two types have 'smooth' (ay. *lluq'a*) surface textures and furthermore are geographical categories (see Chapter Five), while the third type has a 'rough' (ay. *kjirki*) surface texture. According to the local *tuquru* typology of Walateño flute makers, if adequately dried, these different *tuquru* types have tubes with particular characteristics that vary according to inner wall texture, wall thickness, outer layer quality, and surface texture (Table 6).

In contrast with *chhalla* bamboos, the tubes of all these *tuquru* types have various lengths and diameters. *Lluq'a cochabamba* and *kjirki* tubes have grooved inner wall textures (facilitating air flow), *lluq'a paceño* tubes are often spongy and require meticulous cleaning. By comparison, *lluq'a paceño* tends to have thick walls, *lluq'a cochabamba* is usually thinner. Some makers further subdivided the *lluq'a paceño* type into three subvariants depending on where these are sourced (northern, central, or southern La Paz provinces, see Chapter Five).

Table 6: *Tuquru* Types and Characteristics (Source: Own Elaboration)

Type	**Subtype**	***Wall***		***Surface***	
		Texture	***Depth***	***Outer Layer***	***Texture***
lluq'a paceño	Northern	rather spongy	thin to thick	scrapable	smooth
	Central	very spongy	rather thick	scrapable	smooth
	Southern	rather grooved	regular	scrapable	smooth
lluq'a cochabamba		grooved	thin	not scrapable	smooth
kjirki		grooved	(rather) thin	---	rough

The main difference between La Paz and Cochabamba-derived *lluq'a* types, however, is that the outside layer of the former can be scraped while the latter cannot. When working with *lluq'a paceño* tubes, flute makers usually employ a knife to scrape a longitudinal line along the flute body, from the head to the foot, in order to align the fingerholes with the notch or fipple. As the outside layer of the *lluq'a cochabamba* tube does not allow scraping, flute makers often use a pencil instead. This difference does not apply to *kjirki tuquru* as it has a rough surface texture (the derivation of the Aymara name), whereas the other *tuquru* types with a 'smooth' surface texture are termed *lluq'a* in Aymara.

In sum, Walateño panpipe makers employ three different *tuquru* bamboo types (or five including subtypes) (Figure 24). As with different *chhalla* bamboo types, material preferences of these *tuquru* types vary as well. In general, *tuquru* tubes are used more for making autochthonous and tourist flutes than for professional ones. Since the 1980s modern urban *quenas*, for example, have predominantly been made from hardwoods, which come in an impressive range of varieties (Figure 25).

Figure 24: *Tuquru* Bamboo Varieties (Source: Own Photo)

From Left to Right: *lluq'a* (*paceño*) (northern, central, southern); *kjirki*; *lluq'a* (*cochabamba*)

Some Walateño specialists in urban *quena* making, like Favío, must compete with renowned non-Walateño urban *quena* makers, who in many cases have professional experience as *quena* players in famous Bolivian folklore ensembles. For example, I often visited Agustín Portillo in his shop in the Melchor Jiménez street, parallel to the touristic Linares street. Agustín, as well as Favío, or any other urban *quena* maker, usually buys mill-cut and bored hardwood tubes for about 30-35 BOL each (~3.0-3.5 GBP), while selling the final professional urban *quena* or lower key variants of *quenacho* or *mama quena* for 100-200 BOL (~10-20 GBP).[107]

[107] During one of my visits, Agustín was also making professional urban *quena* from black ebony wood, imported from Tanzania, Africa, as he told me. He sold these ebony *quena* for US$200.

Figure 25: Hardwood Varieties[108] (Source: Own Photo)

Urban *Quena*/*Quenacho* Tubes

Modern urban *quenas* are also made from selected well-treated, straight, and thick-walled *tuquru* internodes, which is sometimes the more cost-efficient variant. Naturally hollow *tuquru* bamboo has internodes with similar properties to hardwoods, which have to be mill-cut and bored first with heavy machinery. For this reason, *tuquru* retailers often argue that selected *tuquru* internodes for professional urban *quena* making should cost the same as mill-cut and bored hardwood tubes.

[108] From left to right: Bolivian Rosewood (*Jacarandá*/*Moradillo*) (*Machaerium scleroxylon*), Verawood (*Guayacán*) (*Bulnesia sarmientoi*), Verawood (*Guayacán*) (*Bulnesia sarmientoi*), (*Quebracho*) (*Schinopsis lorentzii*/*marginata*), Snakewood (*Piel de Víbora*) (*Brosimum guianense*), Ebony (*Diospyros* sp.), Purpleheart (*Morado*) (*Peltogyne heterophylla*). Identified by: Dr. Alfredo F. Fuentes (National Herbarium of La Paz).

While rural *qina* flutes are blown strongly stressing upper harmonics and strident sonorities (while often further emphasising wind flow sounds through blowing more air over the notch)[109], their urban counterparts are blown smoothly to produce sweet, mellow, and clear sounds, often stressing a meditative or sentimental style (Stobart, 2016, 2019a). Concerning the difference in sonority between wooden and bamboo (*tuquru*) urban *quena*, Agustín once emphasised that those made from wood sound more "direct" and "smooth", whereas those from bamboo were "hoarser, like the wind of the Altiplano."[110] Additionally, he argued that smaller *quena* sizes (e.g., *quenillas*) are more associated with higher, more delicate, and rapidly played tunes, while larger *quena* sizes such as the *mama quena* tend to be linked with deeper and more ponderous tunes "from within"[111]. These explanations are very similar to Matsunobu's (2013, p. 195) description of the sonorities of Japanese *shakuhachi* flutes.

Favío only employs very straight and thick-walled *lluq'a paceño* tubes to make professional urban *quenas*. If asked to make autochthonous *qina*, which is rare, he instead employs thinner-walled types. By contrast, my friend Basilio, who specialised in making autochthonous *qina* and *pinkillu* flutes (recently adding *tuquru*-made native American flutes to his repertoire), prefers to use *lluq'a paceño* types. This preference was also shared by most of the flute makers who use *tuquru* bamboos that I interviewed.

---

[109] This acoustic phenomenon is referred to as 'flow noise' in physical acoustic terms. However, for many rural Andeans on the Altiplano such a sound indicative of strong wind is not perceived as 'noise' but rather as a central component of the desired sound of these instruments.

[110] "El sonido de las quenas de madera es más directo y suave. Quenas de tuquru suenan más ronco como el viento del altiplano."

[111] "Esa profundidad es de adentro."

However, these *lluq'a paceño* variants were not available during the time of my research, which meant that most *tuquru* bamboo was brought to La Paz city from Cochabamba department. While *tuyu* panpipe makers very much appreciate these *lluq'a tuquru* tubes from Cochabamba department for their extremely long internodes (of up to two meters), *musiñu* makers perceive them to be of lower quality than the *lluq'a paceño* types ('too fragile', 'often breaks', 'too light').

Many skilled *musiñu* makers like Ignacio expressed a preference for the more robust and heavier *lluq'a paceño* types, despite requiring more cleaning and pre-crafting preparations. Additionally, they do not produce such long internodes as the *lluq'a* type from Cochabamba department, so that they must be joined together in order to craft bass register sizes (ay. *saliwa*) of *musiñu* flutes. Ignacio also uses selected *kjirki tuquru* tubes, which are very much appreciated in the autochthonous flute-making sphere due to their thinner-walled tubes.

Conclusions

The last section has shown the great diversity in material selection and musical bamboo preferences, which I would associate with different spheres of flute making and by extension varying musical performance contexts. In that sense, both musicians and makers enter into mutually influencing relationships. In some cases, Walateño flute makers have followed their clients' musical bamboo preferences (i.e., in the case of professional urban *zampoña* and thin-walled 'Zongo' *chhalla*), while in others, makers seem to have created and imposed material preferences onto performance contexts (i.e., in the case of *musiñu* duct flutes and the more robust and thicker-walled *lluq'a paceño* tubes).

Another, possibly scientific explanation for the diverse and often contradictory attitudes to musical bamboo selection might be attributed to acoustics. The sound of these various flutes is primarily produced through splitting a stream of air, while according to Gérard (2017) the resonance in the bamboo tube is secondary. This might contrast with certain string instrument crafting traditions, where resonance is key to sound production and specific tone woods are selected due to their acoustical properties (although aesthetic aspects of material selection should not be underestimated) (Allen, 2012; Brémaud, 2012; Dawe, 2013, 2016; Post, 2019).

However, what people perceive is subjective and culturally shaped at some level (see, e.g., Stobart, 2013b). Thus, the social interactions and cultural representations that produce different perceptions about musical bamboos and their sound might be regarded as independent from these physicalist explanations. Moreover, as Stoichita & Brabec de Mori (2017) argue, in some cases, human auditory experiences also target the way the world is perceived, which is exemplified in the *sirinu*/*sirena* tradition mentioned above.[112] Moreover, musical bamboo preferences and material selection do not solely evolve around acoustic properties or sound. Other characteristics are important, for example aesthetical aspects, the texture of bamboos, their morphologies, and finally the opinions about their performance quality (i.e., thinner-walled *chhalla* tubes are easier to blow than thicker-walled types).

[112] See Rivera A. (Forthcoming) for more examples and a good summary of how sound and music making/production in the Andes is not merely a human endeavour.

I have shown in this chapter why musical bamboos are important in renegotiating musical values and meanings surrounding different Andean music-making practices, where bamboo-made flutes are involved. However, I am inclined to argue that many of the current values attributed to the sound of bamboos have rather recent urban origins. These dynamics have contributed to material preferences in some cases (e.g., the thin-walled 'Zongo' *chhalla* tubes in the context of professional *zampoña* making) and introduced new bamboo selection habits in others (e.g., different thin- or thick-walled *chhalla* tubes for particular *siku* styles).

Furthermore, I have shown that material demands shifted significantly between the spheres of flute making. While bamboo demand has decreased in the autochthonous flute-making sphere, it has increased in professional (more urban *zampoña* than *quena*) and particularly in tourist-destined contexts. Consequentially, perceptions of musical bamboo shortages were very unevenly distributed among Walateño flute makers in the city. In addition, some makers even downplayed the idea of bamboo scarcity as a recent phenomenon or problem. Instead, they related periodic shortages to the recurrent natural scarcity periods of the ecological life cycle of particular musical bamboo species.

In this chapter, I have suggested that the idea of "sustaining" flute-making practices, in the sense of maintaining a historical *status quo*, is empirically flawed considering the multiple cultural and economic transformations of highland flute making, especially those having occurred over the second half the twentieth century and since the turn of the millennium. Referring back to my theoretical framework of sustainability in Chapter One, a simple "keep going" perspective is deficient regarding the negative environmental consequences that were triggered by adapting flute-making practices to new economic contexts. I therefore argue for a more critical view towards cultural reproduction or resilience which takes into consideration possible negative environmental impacts.

Generally speaking, I have heard very few self-critical reflections from makers about their own economic actions and potential environmental consequences. For example, souvenir flute makers, who are more oriented towards making profit, often use immature bamboos, which are sometimes cheaper than mature ones, a profitable situation from an economic point of view, but a problem from an ecological and environmental perspective. These makers furthermore had little or nothing to say about bamboo preferences since the flutes they produce are not destined for musical purposes and the musical bamboos they use do not have to fulfil certain acoustic criteria. I would interpret this increased demand and the indifferent bamboo use in terms of a potential bamboo rift, which especially occurs in the touristic flute-making sphere. In practical terms, this means that the increased, growth- and quantity-oriented petty commodity production of flute souvenirs increased bamboo demand, thereby triggering unsustainable sourcing practices that have disrupted the bamboos' natural cycles of growth, maturation, and reproduction.

Before turning to issues of bamboo ecology and the economics of bamboo gathering in Chapter Six, it is necessary to assess flute makers' claims that musical bamboo habitats are destroyed by other non-musical activities such as the deforestation of tropical forests and land-use changes in recognised regions of musical bamboo sourcing. I will analyse these claims in the next chapter, exploring Walateño flute makers' local musical bamboo typologies and geographic distributions of native woody bamboos. I will contrast the potential distributional areas of musical bamboo types and their different variants with preferred musical bamboo-sourcing regions/sites and calculate potential musical bamboo niche loss and habitat destruction resulting from deforestation.

Chapter 5

The Geography of Musical Bamboos

Local Typologies, Distributions, and Habitat Destruction

Linking to the framework of sustainability presented in the introduction, this chapter is situated within the broader sense of environmental sustainability as it relates to the environmental protection of tropical forests, ecosystems, and musical bamboo habitats, as well as to the conservation of native woody bamboo biodiversity more generally. From the ecological and phytogeographical perspective developed in this chapter, the distribution of sourcing regions is fundamentally determined by the range of different musical bamboo species. Thus, a principal environmental precondition for musical bamboo sourcing practices of any kind is the existence of musical bamboos in their natural habitat.

This chapter explores the local bamboo typologies used by Walateño flute makers and juxtaposes the ethnographic data against a botanical analysis of different musical bamboo types/variants employed in flute making. I then explore the geographic distributions of these various bamboo types/variants according to recognised sourcing regions. I move on to analyse the impact of deforestation on their geographic distribution, quantify musical bamboo habitat destruction, and discuss the consequences of such factors for highland flute making and musical bamboo sourcing, as well as for musical bamboo conservation as linked to the protection of the broader *yungas* cloud forest ecoregion.

A Country of Forests, and Deforestation

Almost 50% of Bolivia's territory is covered by old-growth forests (Cuéllar et al., 2012, 2015). It is among the 15 countries in the world with the largest area of tropical forests (FAO, 2010). The great majority (80%), among them Amazon rainforests, Chiquitano semi-deciduous forests, and Chaco dry forests, are located in the lowlands at altitudes below 500 metres above sea level. The rest corresponds to *yungas* cloud forests on the eastern slopes of the tropical Andes (1,000-3,500 m a.s.l.), Tucumán forests in the southern Andean *yungas* (1,000-3,500 m a.s.l.), and dry forests in Inter-Andean valleys (1,000-3,500 m a.s.l.). Deforestation in Bolivia, of which almost two-thirds is illegal (ABT, 2018), has continuously increased since the 1970s and reached a worrisome high annual rate of more than 3,000 km² after new agriculture-related laws were passed favouring deforestation in recent years. It is among the ten countries with the highest average annual net loss of forest area (FAO, 2020). The main threat to Bolivia's old-growth forests are land-use changes and the conversion of natural lands to agriculture and cattle rearing, involving diverse actors such as Yungueño farmers, Andean colonists, lowland communities, cattle ranchers, local farmers from Santa Cruz department (Cruceño farmers), and agro-industrial corporations (soybean production for export) (Andersen, 2013; Killeen et al., 2008; Müller et al., 2012, 2014a, 2014b).

Besides the fact that deforestation liberates carbon dioxide (CO_2) and thus contributes to global warming and climate change[113], it is a cause of

[113] Land-use change and forestry (LUCF) causes more than 60% of Bolivia's total greenhouse gas emissions and 80% of the country's total CO_2 emissions (Andersen et al., 2016; see also

biodiversity loss in one of the most biodiverse countries in the world (Andersen, 2014; Andersen & Jemio, 2015; Andersen & Ledezma, 2019; Andersen et al., 2016; Cuéllar & Larrea, 2016; Ibisch & Mérida, 2003; UNDP, 2013; Urioste, 2010). Biodiversity loss in Bolivia, but also on the global scale, is mostly the result of habitat destruction, where natural areas, such as tropical forests, are converted to agricultural land (Andersen & Ledezma, 2019; Barraclough & Ghimire, 2000; Dirzo & Raven, 2003; Dudley & Alexander, 2017; Foley et al., 2005; Gibbs et al., 2010; Gibson et al., 2011; Laurance et al., 2014; Newbold et al., 2015; Taylor et al., 2015; Wassenaar et al., 2007).

Many of the Walateño flute makers and highland bamboo traders I interviewed told me about the destruction of tropical forests in the Andean-Amazonian foothills of Alto Beni and the *yungas* ecoregion, where the principal musical bamboo sourcing sites are located. For example, one Walata Chico bamboo trader I interviewed once returned from a *chhalla* bamboo collection trip to Taypi Playa (Caranavi Province) to discover that this recognised site for sourcing *chhalla* bamboos had been converted into coca plots. Similarly, Nicasio once recounted how the already substantially degraded old-growth forests with *chhalla* bamboo presence in Alto Beni are being chopped down and replaced by rice, sugar cane, or monocultural fruit plantations (see Chapter One). Hearing statements like these is nowadays extremely common. Against this background, it is important to know in which tropical forests musical bamboos grow and where they are sourced in order to analyse the impact of deforestation on their distribution and to quantify

CAIT, 2019). Although Bolivia's total GHG emissions only constitute 0,10% of the total global emissions, per capita emissions are high (13 tons).

habitat destruction. In this context, it is noteworthy that the woody bamboos that provide materials for making highland flutes in the Bolivian Andes are uncultivated and native[114] Andean woody bamboos growing in their natural habitats in evergreen forests in the *yungas* and Andean-Amazonian foothills. This has specific implications on the organisation of bamboo sourcing and, from the perspective of my research, is significant to the phytogeographic[115] analysis of environmental niches and related geographic distributions of different musical bamboo types and varieties. Besides other factors – such as topographical sourcing limitations, bamboo collection and trade networks, or road infrastructure developments – the selection of sourcing sites is fundamentally determined by the geographic distributions and current presence of musical bamboo populations in their natural habitats.

As explained in Chapter Three (Methodology), for the phytogeographic analysis presented in this chapter, I have drawn on both flute makers' local musical bamboo typologies and botanical specimens of tropical woody bamboos archived in the National Herbarium of La Paz (LPB). Species distribution models are usually based on botanical knowledge and species occurrence data gathered in herbariums. However, botanical information about musical bamboo occurrences is extremely scarce. Therefore, I want to put the existent botanical knowledge into dialogue with flute makers' local

[114] I define 'native' as the ecological state of occurring naturally (without human intervention) in a given region, ecosystem, or habitat due only to natural processes. This is equivalent to indigenous, or autochthonous, and in counter-distinction to introduced or non-indigenous species.

[115] Phytogeography: Branch of biogeography that studies the geographic distribution of plants (also called botanical geography).

musical bamboo typologies, which are mainly based on geographic origins and musical bamboo allocations to recognised sourcing regions.

Local Typologies: Musical Bamboo Types and Sourcing Regions

In the previous chapter, I explored distinct flute-making contexts and described urban bamboo supply and distribution mechanisms within these. I presented different musical bamboo types, their morphological characteristics, and the musical values and meanings attributed to these. Since local musical bamboo typologies of Walateño flute makers are based on geographical origins of different musical bamboo types and variants, I continue now to explore their places of origin, mentioned by Walateño flute makers and highland bamboo traders during my conversations with them.

In general, Walateño flute makers, more than highland bamboo traders, were extremely careful to share concrete information about specific collection sites with me (see Chapter Two). Many only mentioned broader regions, places, or communities, from which musical bamboo collection is undertaken. Based on this information, I created tables of sourcing sites and their corresponding administrative divisions (see Appendix Four). I attributed to each of these mentioned *chhalla* and *tuquru* bamboo sourcing sites geographic coordinates and mapped them onto maps of Bolivia (Figure 26 and 27). Generally speaking, Walateño flute makers and musical bamboo traders have mentioned more sourcing sites in La Paz department (especially in the southern provinces) compared to the departments of Cochabamba or Santa Cruz. Additionally, *chhalla* sourcing sites were mentioned around Bermejo near the southern Bolivian border with Argentina. These recognised sourcing sites can be grouped according to regional clusters.

Figure 26: Map of *Chhalla* Sourcing Sites and Regions

(Source: Own Elaboration)

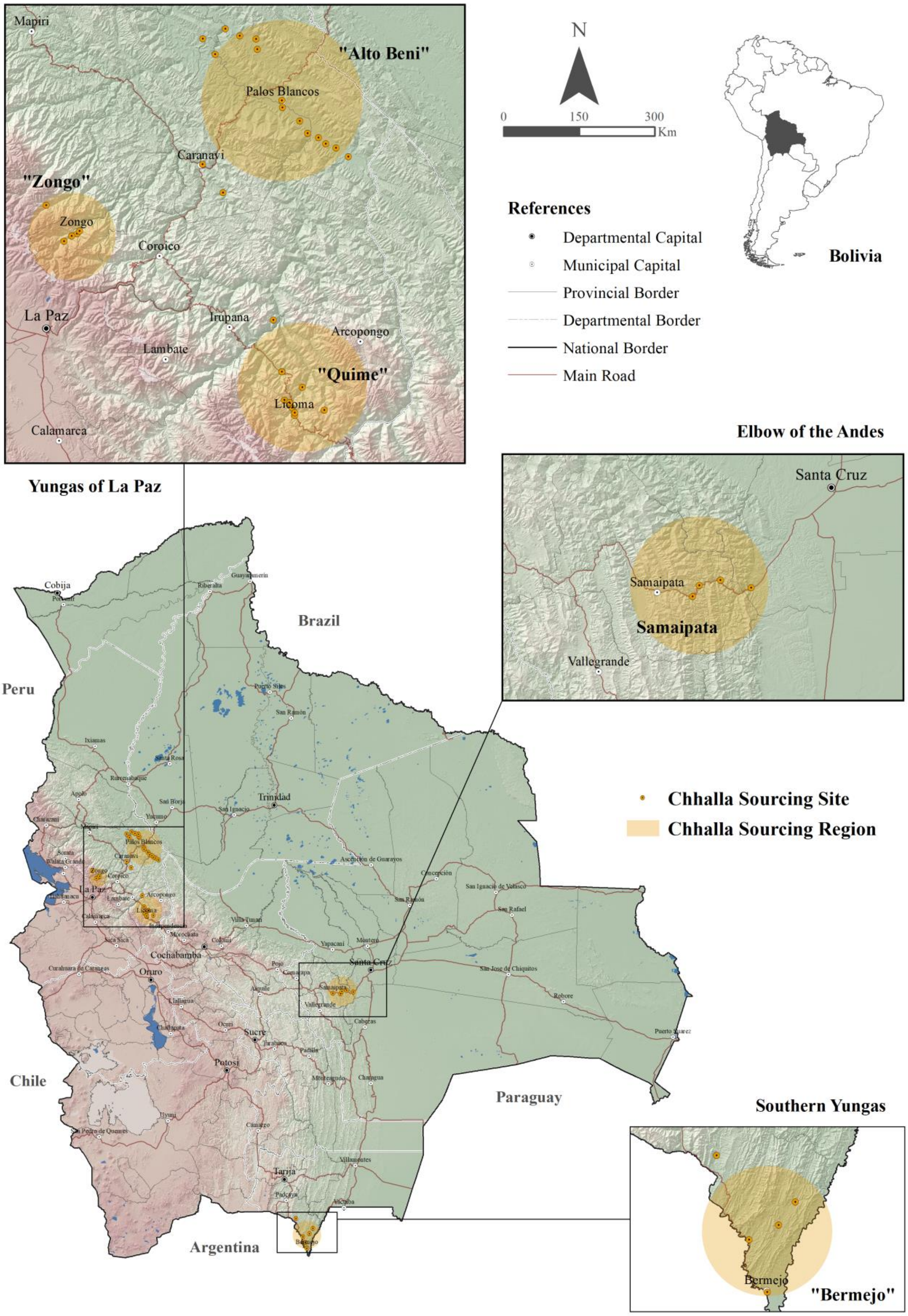
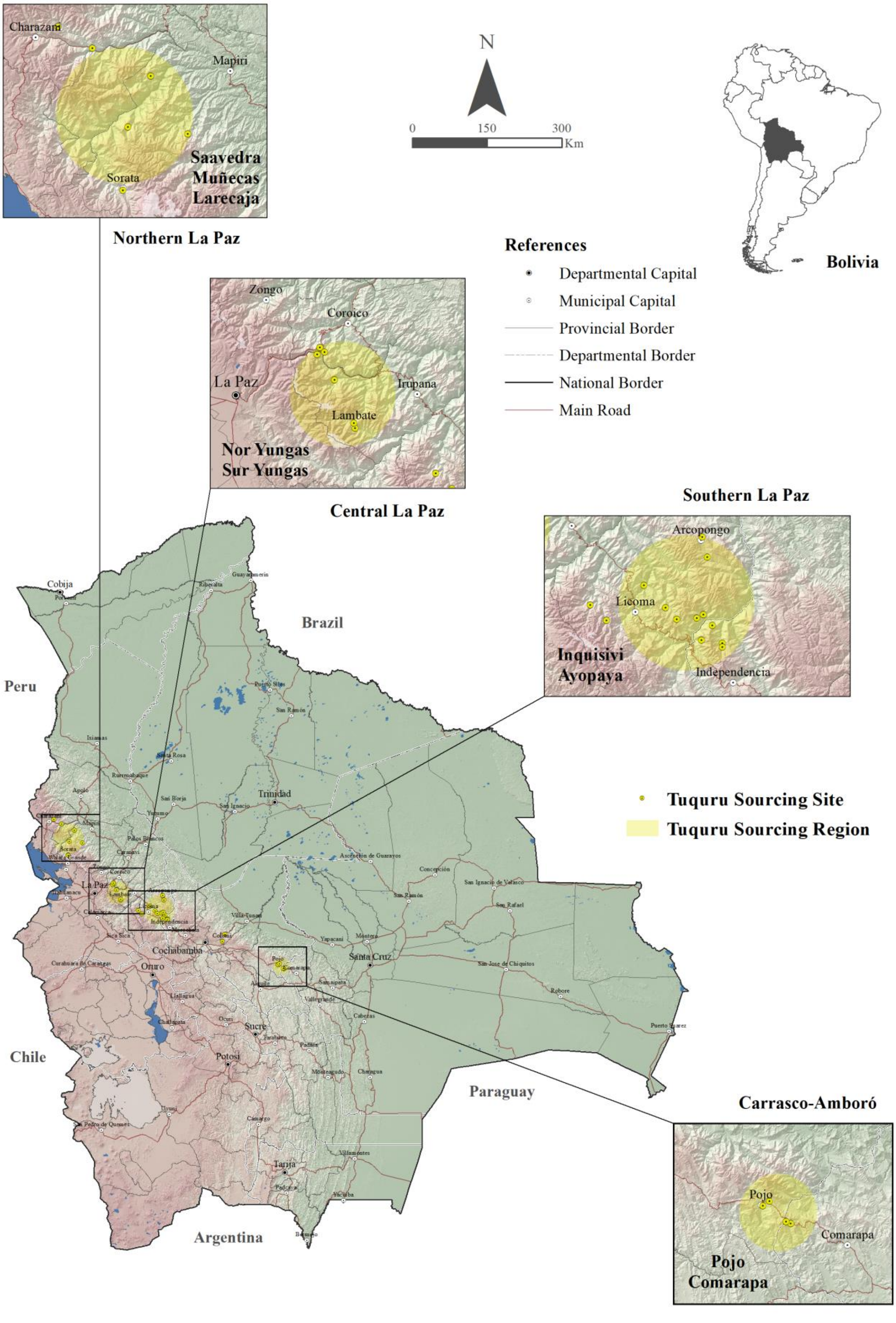


Figure 27: Map of *Tuquru* Sourcing Sites and Regions

(Source: Own Elaboration)



Chhalla Bamboos

In the case of *chhalla* panpipe bamboos, four principal *chhalla* sourcing regions can be identified (Figure 26): 'Zongo' (subtropical *yungas* valley close to the city of La Paz), 'Quime' (Inquisivi *yungas*), 'Alto Beni' (broader ecoregion) and 'Bermejo' (southern *yungas*).

The collection sites in the so-called 'elbow of the Andes' (sp. *el codo de los Andes*) around Samaipata (Santa Cruz department) were mentioned by a highland bamboo trader, who stopped trading musical bamboos following the death of his father-in-law in the year prior to my research (see Chapter Two). According to him and many Walateño flute makers, the *chhalla* panpipe bamboo sourced in the Samaipata region is of the same type as that from Bermejo. Therefore, Walateño flute makers do not consider it to be a distinct bamboo type and is instead subsumed under the 'Bermejo' label.

During my research travels to sourcing sites in different subtropical *yungas* regions, I furthermore encountered *chhalla* panpipe bamboos in places not mentioned by Walateño panpipe makers as *chhalla* sourcing regions. For example, in the Pojo municipality of Carrasco province (Cochabamba), which is primarily recognised as a *tuquru* sourcing region (see below), locals showed me *chhalla* bamboos, which were unknown to Walateño panpipe makers in La Paz city at that time. When I showed some panpipe makers these *chhalla* bamboos from Pojo, many directly stated after a short assessment of the wall thickness and inner wall texture that they are of the same 'Quime' *chhalla* type sourced in the Inquisivi *yungas*.

Similarly, I once brought some dried *chhalla* tubes collected in Carijana, in the Kallawaya *yungas* in the province of Bautista Saavedra (northern La Paz department), to La Paz city. Local panpipe makers in the Kallawaya region exclusively used these *chhalla* tubes for locally making *qantu* panpipes (see Chapter One). In La Paz, Andrés assessed them for me and stated that they were the same *chhalla* type found in the Zongo valley. Therefore, I do not consider these places as primary *chhalla* sourcing sites for Walateño flute makers, although (through my intervention) they might now know about them.

Distinct *chhalla* types sourced in these recognised regions in the *yungas* and Andean-Amazonian foothills form the typical local *chhalla* bamboo typology of Walateño flute makers (Table 7). In the valley of Zongo (La Paz municipality, Murillo province), an extremely thin-walled *chhalla* bamboo is sourced, which is known as ‘Zongo’. In the *yungas* of Inquisivi province, another *chhalla* bamboo type is sourced, which makers know by the name of ‘Quime’. In the Tucumán forests of the southern Andean *yungas* around Bermejo (as well as in the elbow of the Andes around Samaipata), a particularly thick-walled *chhalla* bamboo is sourced, which is referred to as ‘Bermejo’.

What is commonly known as ‘Alto Beni’ is actually two different variants (*lluq’a* and *qipu* type), growing in distinct areas in the Alto Beni region. Alto Beni is not only one of the municipalities of Caranavi province (La Paz department), but also defines a natural geographic area (broader ecoregion), partially integrated within the departments of La Paz, Cochabamba, and Beni. It is situated in the syncline valley of the mid-course of the Beni river in the Andean-Amazonian piedmont or foothills. The *lluq’a* variant is sourced on the left side of the Beni river around San Antonio and towards San José in the southeast part of the declared Mosetén Indigenous territory (sp. *Tierra Comunitaria de Origin* or simply TCO), while the *qipu* variant grows on the right side of the Beni river towards Inicua Bajo in the northwest part of the Mosetén TCO. Both have distinct ecological life cycles suggesting that they are two different bamboo species.

The very rarely used *kjirki chhalla* type is sourced in the Caranavi municipality (La Paz department) at the upper entrance to the Alto Beni region (La Cumbre). I was further shown the same species, known as *q'umer* ('green') in Quechua, in the Kallawaya *yungas* in northern La Paz department (Bautista Saavedra province). Since it is not frequently used by Walateño flute makers in the city, I will focus here on the four main *chhalla* types and sourcing regions: 'Zongo', 'Quime', 'Alto Beni', and 'Bermejo'.

Table 7: *Chhalla* Types and Central Sourcing Regions (Source: Own Elaboration)

From Left to Right: Zongo, Quime, Alto Beni (*lluq'a*), Alto Beni (*qipu*), Kjirki, Bermejo

Types:	'Zongo'	'Quime'	'Alto Beni' *lluq'a*	*qipu*	'Kjirki'	'Bermejo'
Sourcing Regions (Departments)	**Zongo Valley** (La Paz)	**Inquisivi Yungas** (La Paz)	**Alto Beni Region** (La Paz)			**Southern Yungas** (Tarija)

Tuquru Bamboos

The panorama concerning *tuquru* bamboo types looks similar. Four principal sourcing regions can be identified (Figure 27): 'Northern La Paz Department' (Bautista Saavedra, Muñecas, and Larecaja provinces including Sorata valley), ‘Central La Paz Department’ (Nor and Sur Yungas provinces), ‘Southern La Paz Department’ (Inquisivi province, La Paz, and the border area of Ayopaya province, Cochabamba) and ‘Carrasco-Amboró’ including the municipalities of Pojo (Cochabamba department) and Comarapa (Santa Cruz department). Different *tuquru* varieties sourced in these geographic regions form the typical *tuquru* bamboo typology of makers (Table 8).

Table 8: *Tuquru* Types and Central Sourcing Regions (Source: Own Elaboration)

Types:	***Sourcing Regions:***
lluq’a paceño	**Northern La Paz** Saavedra Muñecas Larecaja
	Central La Paz Nor Yungas Sur Yungas
	Southern La Paz Inquisivi Ayopaya
kjirki	**Southern La Paz** Arcopongo Inquisivi
lluq’a cochabamba	**Carrasco-Amboró** Pojo Comarapa

From Left to Right: ***lluq’a paceño*** (Northern, Central, Southern); ***kjirki***; ***lluq’a cochabamba***

The *lluq’a paceño* type is sourced in the northern, central, and southern provinces of La Paz department (I will simply call them further ‘Northern’, ‘Central’, and ‘Southern La Paz’). Many makers regard *tuquru* tubes coming from these three regions as one single *tuquru* type (*lluq’a paceño*) due to their morphological similarities. However, they are aware that *lluq’a paceño* tubes sourced in the southern La Paz department (Inquisivi-Ayopaya) are available at different times from those sourced in the central or northern La Paz provinces. This suggests different ecological life cycles of two distinct *tuquru* bamboo species.

The *lluq'a cochabamba* type is sourced in the Carrasco-Amboró region in the municipalities of Pojo (Cochabamba department) and Comarapa (Santa Cruz department). Due to the difference in surface texture (not scrapeable) and consistency of dried tubes (more fragile because of thinner tube walls), makers regard it as a distinct *lluq'a* type. The *kjirki tuquru* type is sourced in the southern La Paz province of Inquisivi, especially in the canton Arcopongo and the border area of Ayopaya province (Cochabamba department). For makers, it is a distinct *tuquru* type due to the scabrous or 'rough' (*kjirki*) surface texture (see Chapter Four).

As these different *chhalla* and *tuquru* types and variants have particular morphologies, geographic origins, and their own ecological life cycles, Walateño flute makers treat them as distinct species. In sum, in making a of Andean flutes such as panpipes as well as vertical and transverse flutes, Walateño flute makers today use up to ten different species of Andean woody bamboos (six *chhalla* and four *tuquru* varieties). In the following sections, I will explore how these *chhalla* and *tuquru* bamboo types and varieties are scientifically classified as different Andean woody bamboo species and how they are distributed.

Tropical Bamboos and Highland Flutes: Bio-Musical Diversity

According to modern botanical taxonomy, bamboos (*Bambusoideae*) are evergreen (non-deciduous) perennial[116] flowering plants (*Angiospermae*) and one of the twelve subfamilies of grasses (*Poaceae*). The bamboo subfamily

[116] Perennials are plants with a life cycle more than two years, in contrast to shorter-lived annuals (one year) and biennials (two years).

contains worldwide about 1,200 species belonging to approximately 90 different genera (Bystriakova & Kapos 2006; Judziewicz et al. 1999). Bamboos grow in diverse ecoregions, from tropical rainforests to mountain ranges and biodiverse cloud forests. Their global geographic distribution includes Asia-Pacific, Central and Southeast Africa including Madagascar, as well as Central and South America (Bystriakova et al., 2003a, 2003b, 2004).

The Americas, with more than 500 known species arranged in about 45 recognised genera, are collectively richer in bamboo species variety than the African mainland and Madagascar, but less diverse than the Asia-Pacific region (Bystriakova & Kapos, 2006). According to Soderstrom et al. (1988), Clark (1990, 1995, 2001) and Judziewicz et al. (1999), Mexico, the tropical Andes, and Brazil have the highest species richness and greatest level of bamboo endemism[117] on the American continent. In the tropical Andes, approximately 130 known species are reported to date, 90% of which are endemic, i.e. they uniquely exist in the tropical Andes (Clark, 1990, 1995, 2001). For Bolivia, 73 bamboo species have been reported to date, belonging to 15 different bamboo genera (Villavicencio et al., 2014).

Bamboos are botanically divided into three tribes (taxonomic rank above genus but below family and subfamily): woody bamboos of tropical climate (*Bambuseae*), woody bamboos of temperate climate (*Arundinarieae*), and herbaceous bamboos (*Olyreae*). The introduced and cultivated temperate-climate woody bamboos in Bolivia (e.g., species in the *Phyllostachys* genus such as the golden or yellow groove bamboo) are not used in highland flute

[117] Ecological state of being unique to a defined geographic location, such as country, vegetation zone or habitat. Species that are native (or indigenous or autochthonous) to a place are not endemic when they are found elsewhere.

making. Herbaceous bamboos do not have hollow wooden culms (joint stems) that serve as resonator tubes. Thus, the bamboos used in highland flute making in the Bolivian Andes belong to the subtribe of tropical woody bamboos (*Bambuseae*).

Of the more than 500 known bamboo species in the Americas, up to 430 species are tropical woody bamboos, taxonomically grouped in about 20 recognised genera (Judziewicz et al., 1999). On Bolivian territory, 50 tropical woody bamboo species have been described to date, belonging to eight different woody bamboo genera (Villavicencio et al., 2014; see also Jiménez, 2016) (Table 9).[118]

Table 9: Tropical Woody Bamboos (*Bambuseae*) in Bolivia

(Source: Own Elaboration based on Villavicencio et al. 2014)

Tribe	***Bambuseae***				***# Total***
Subtribe	*Arthrostylidiinae*	*Bambusinieae*	*Chusqueinae*	*Guaduinae*	
# Genera	5	1	1	1	**8**
	Actinocladum *Arthrostylidium* *Aulonemia* *Merostachys* *Rhipidocladum*	*Bambusa*	*Chusquea*	*Guadua*	
# Species	21	2	15	12	**50**
(Endemic)	(9)	(0)	(3)	(1)	**(13)**

In the context of highland flute making in the Bolivian Andes, it is tantalising to relate the musical (organological) diversity of bamboo-made flutes made on the Bolivian highlands (see Chapter Three and Four) with the biological diversity of native tropical woody bamboo species further down the eastern slopes of the Tropical Andes. However, Walateño flute makers, in

[118] Bamboos in the genus of *Bambusa* belong to the paleotropical realm (Judziewicz & Clark, 2007). Those species growing in Bolivia are introduced (‘not-native’) and therefore cultivated or naturalised. All other tropical woody bamboos belong to the neotropical realm, thus are native to Central and South America, so-called “New World bamboos” (Judziewicz & Clark, 2007; McClure, 1973; Villavicencio et al., 2014).

fact, do not use all woody bamboo species in flute making. Rather, makers use species whose internodes match particular selection criteria relating to morphological aspects according to flute type, such as consistency and geometry (straight, hollow), internode length and diameter, and wall thickness (or lumen size[119]). In fact, their selection criteria exclude many of the tropical woody bamboo genera mentioned in Table 9. For example, species in the genus of *Chusquea*, the most diverse among the Andean woody bamboos (Clark, 1995), generally have solid internodes, while those in the genera of *Actinocladum* and *Arthrostylidium* instead have short, delicate, or unequal culms and solid or small lumen sized internodes with a pithy centre (Clayton et al., 2006 onwards; Judziewicz & Clark, 1993; Judziewicz et al., 1999).

It has been argued in botanical literature that Andean flutes are principally made from species belonging to the Andean woody bamboo genera of *Aulonemia* (*tuquru*) and *Rhipidocladum* (*chhalla*), both short-necked, clumping bamboos with pachymorph[120] rhizomes and hollow, robust culms and internodes of different sizes and lengths (Judziewicz et al., 1999). To date, the genus of *Aulonemia* contains at least 31 described species, growing in Mexico and Central America, the Guyana highlands, the Andes (from Venezuela to Bolivia), and South-Eastern Brazil (Judziewicz et al., 1999). *Aulonemia* is a Latinised combination of the Greek words *αὐλός* (*aulós*), the name of the Greek double-reed wind instrument made of cane, woods, or shin bone, and *νέμος* (*némos*), meaning a forest with pasture for cattle, a wooded

[119] Lumen is the cavity in the internode. The lumen size varies according to the diameter of the internode and the thickness of the wall.

[120] Botanical term meaning ‘of a thick kind’, typical of clumping bamboos.

pasture, or glade (McClure, 1973). The name alludes to musical instrument making in the Andes and to the pendulous leafy culm tips grazed by cattle. The Andean woody bamboo genus of *Rhipidocladum* is comprised of 19 species, which grow from north-western Mexico over Trinidad and north-western Argentina to central Brazil (Judziewicz et al., 1999; Tyrrell & Clark, 2013). To date, nine different species are known in the Andes (Ruiz-Sanchez et al., 2019). The name of the botanical type-species, *Rhipidocladum harmonicum*, eludes to its use in Andean panpipe making.[121]

Geographic Distributions of Musical Bamboos

In order to get a first broad overview of the distributional patterns of all tropical woody bamboos in Bolivia, I modelled their distributions with Maxent software (Phillips et al., 2006), which produces occurrence probabilities of a species in a given environment. These species models are inductive models, as Maxent correlates the reported presence of a given species with the environmental conditions of the occurrence sites. I modelled the distribution of each tropical woody bamboo species, for which occurrence data was available (see Chapter Two and Appendix Three). With these species distribution models, I created a species richness map of tropical

[121] The Argentinian botanist Lorenzo Raimundo Parodi (1944) first described the plant as *Arthrostylidium harmonicum* and erroneously argued in his 1946 article *La planta usada por los indio del Perú para fabricar las quenas* that it is used for making Andean notched flutes (see Rodríguez & Rúgolo de Agrasar, 2015). Nowadays, the plant is called *Rhipidocladum harmonicum*, after bamboo specialist Floyd Alonso McClure re-allocated all woody bamboos having fan-like patterns formed by members of a mature midculm branch complement in the genus of *Rhipidocladum* (McClure, 1973). Thus, the name is derived from the Greek words, *ῥιπίς* (*rhipis*) meaning fan, and κλάδος (*klados*) meaning branch (see also Figure 3).

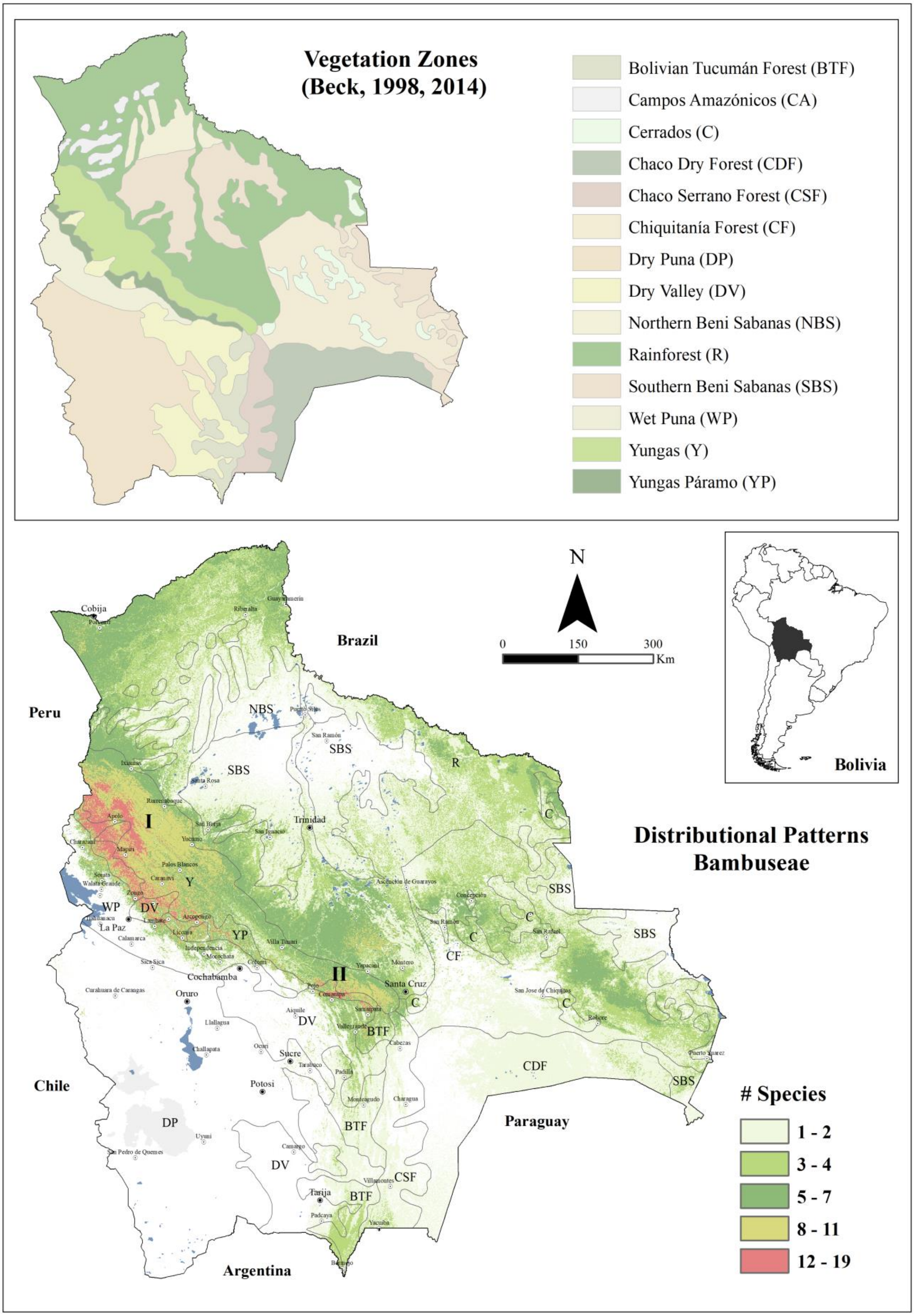
woody bamboos (*Bambuseae*) and contrasted this map with the general vegetation zones of Bolivia according to Beck (1998, 2014) (Figure 28).

The species richness map indicates abiotically suitable areas for most tropical woody bamboos within two principal vegetation zones: The *yungas páramo* region (abbreviation YP in the map) and *yungas* mountain cloud forests (abbreviation Y in the map). Thus, the majority of woody bamboo species belong to those scientific genera that make up so-called Andean woody bamboos (Clark, 1990, 1995). Results further show minor presences in the lowland tropical Amazon Rainforests (abbreviation R in the map) (especially *Guadua* lowland bamboo), in the subtropical moist broadleaf Bolivian Tucumán forests (abbreviation BTF in the map), and in the tropical semi-deciduous broadleaf Chiquitano forests (abbreviation CF in the map).

The *yungas páramo* region extends from 2,500 to 3,500 metres above sea level at the Peruvian border in the North of La Paz department towards the Carrasco and Amboró National Parks in Cochabamba and Santa Cruz departments, covering an area of approximately 11,000 km² (Beck, 2014). The evergreen subtropical mountain cloud forests of the Bolivian *yungas* extend from the Peruvian border in the North of La Paz department to the Samaipata region and the surroundings of Santa Cruz de la Sierra (city), crossing the departments of La Paz and Cochabamba. The total area of approximately 60,000 km² includes maximum elevations up to 3,000 m a.s.l. on the Andean slopes, descending towards the oriental limits in the Andean foothills to approximately 500 m a.s.l. (Beck, 2014).

Figure 28: Map of Distributional Patterns of *Bambuseae* in Bolivia

(Source: Own Elaboration)



The montane cloud forests of the *yungas* are the most diverse vegetation zone in Bolivia and have a considerable number of endemic plant species, which is attributable to its transitional position between contrasting habitats and extremely varying topography (Araujo et al., 2010; Beck, 2014; Cornejo-Mejía et al., 2011; Foster et al., 1994; Kessler & Beck, 2001).

Two principal centres of woody bamboo species richness can be identified within these vegetation zones: The first is situated in the *yungas* cloud forests of La Paz department, especially in the northern part including the provinces of Franz Tamayo, Bautista Saavedra, Muñecas, and Larecaja (I). This diversity hotspot extends towards the southern La Paz provinces of Murillo, Nor Yungas, Sur Yungas, and Inquisivi. The second centre of woody bamboo species richness is situated in the mountain cloud forest ridge of the departments of Cochabamba and Santa Cruz, including the provinces of Carrasco (Pojo municipality) and Manuel María Caballo (Comarapa municipality) (II).

In order to explore the specific distributions of *chhalla* and *tuquru* bamboos, I focussed on selected *Aulonemia* and *Rhipidocladum* species (scientific perspective) (Figure 29), as well as on generic distributions of *chhalla* and *tuquru* bamboos (local maker categories) (Figure 30 and 31). While the former is based on botanical knowledge and species occurrence data, the latter is largely based on local knowledge of flute makers about the ecology and distributions of *chhalla* and *tuquru* varieties.

Figure 29: Distributions of *Aulonemia* and *Rhipidocladum* Species

(Source: Own Elaboration)

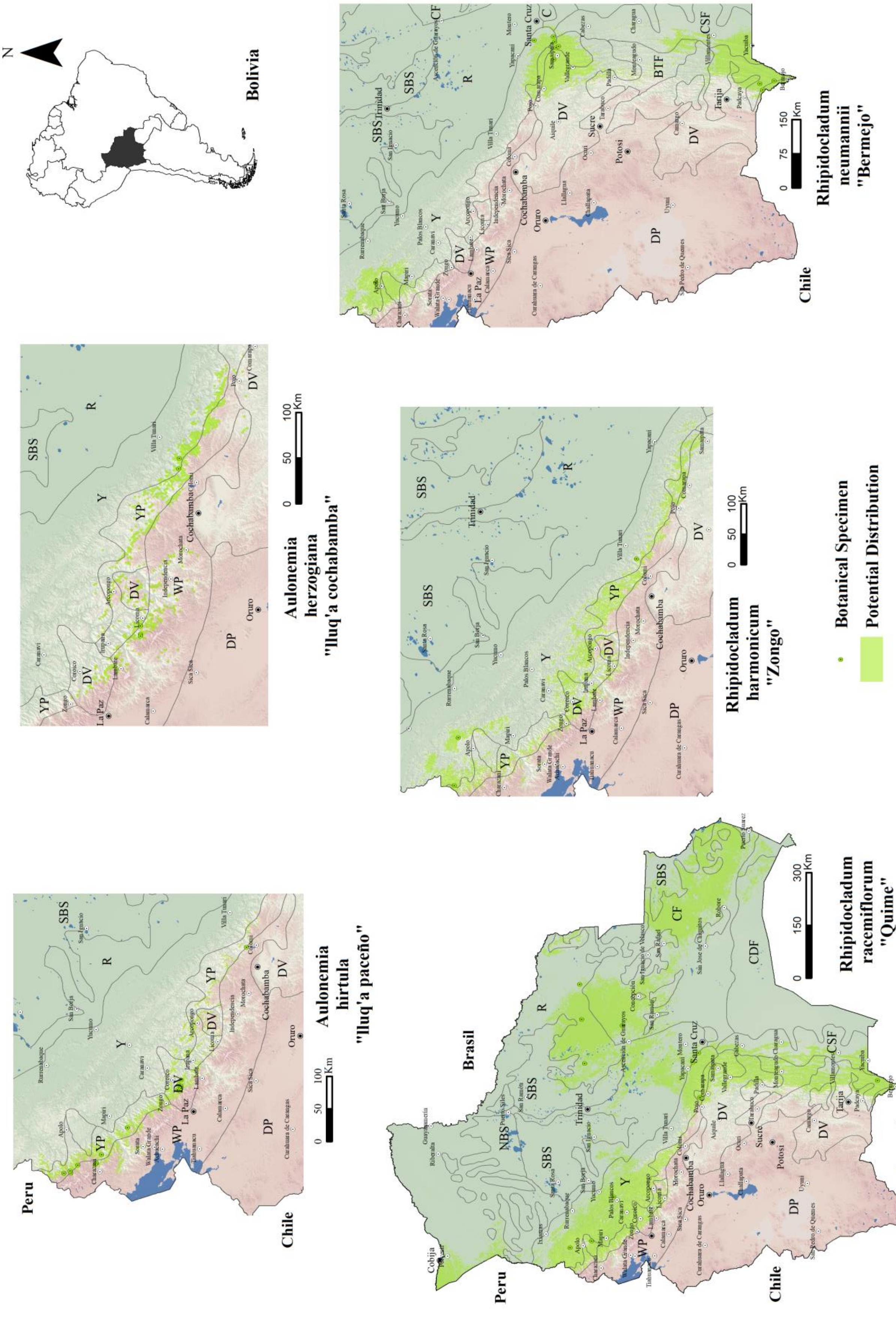


Figure 30: Distribution of *Chhalla* and Sourcing Sites/Regions

(Source: Own Elaboration)

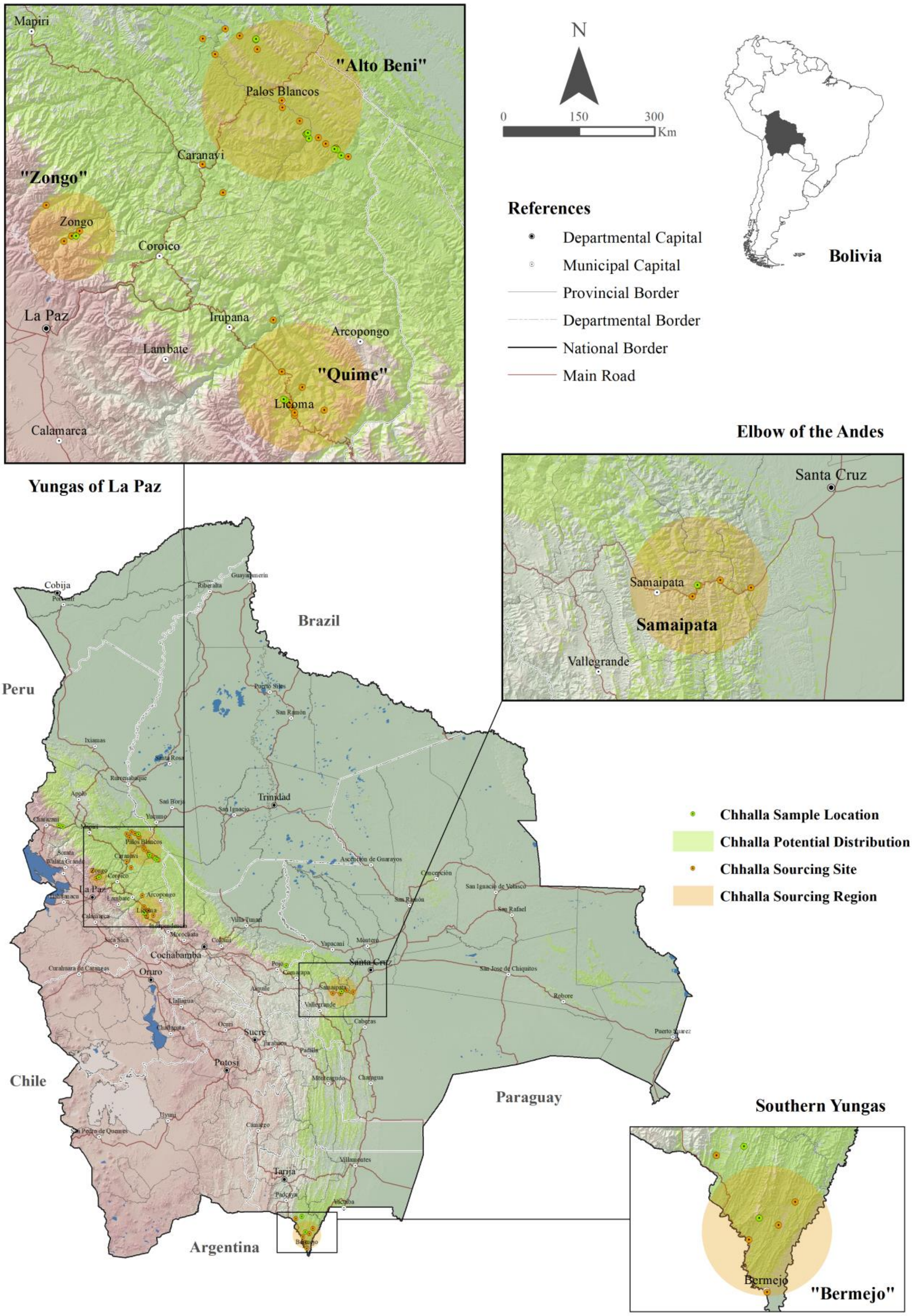
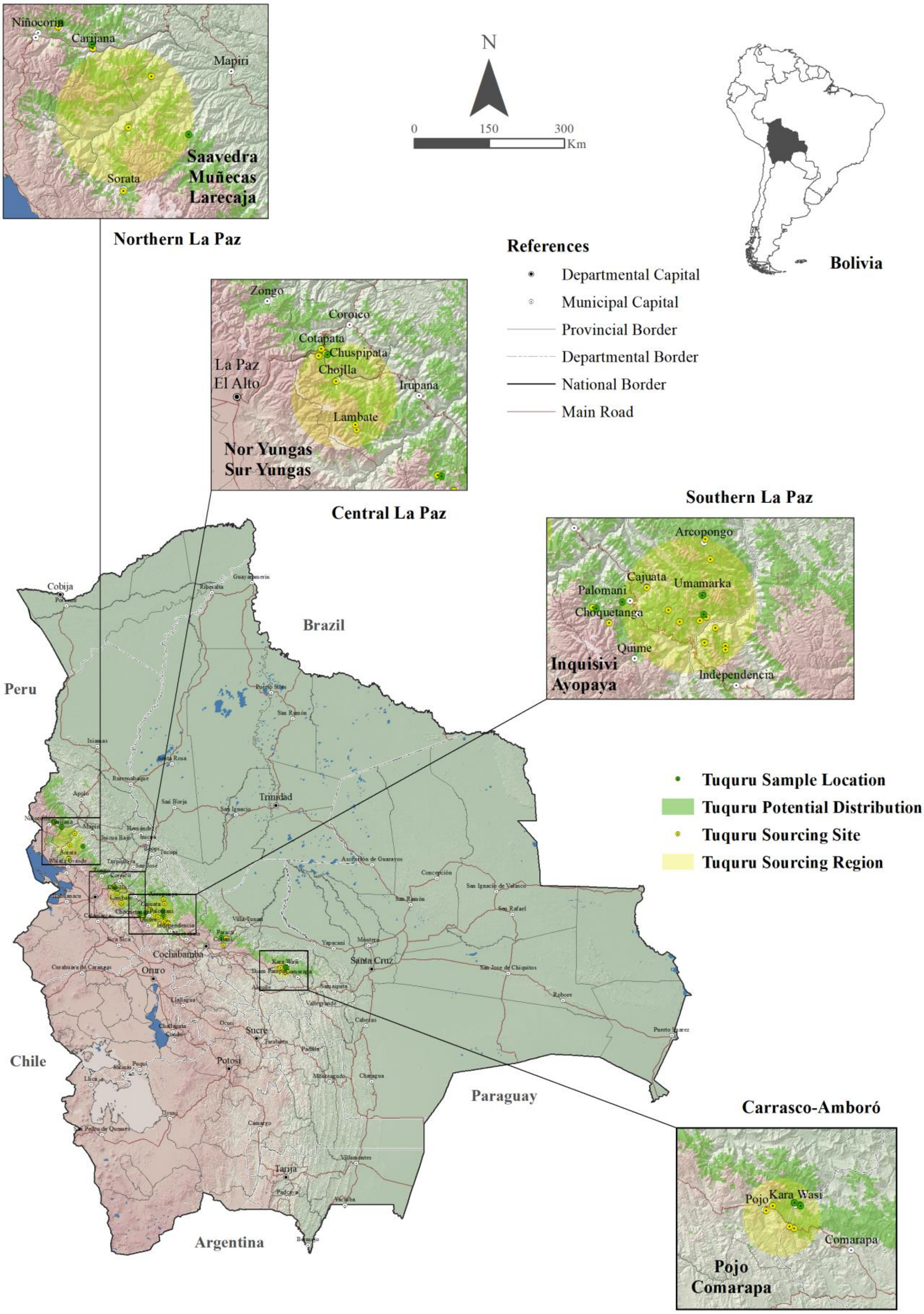


Figure 31: Distribution of *Tuquru* and Sourcing Sites/Regions

(Source: Own Elaboration)



Potential Distribution of Chhalla Bamboo

The different *chhalla* tubes presented in the local typology at the beginning of this chapter are collected from certain bamboo species belonging to the Andean woody bamboo genus of *Rhipidocladum* (Figure 29). The following allocation of scientific names for the principal *chhalla* types is based on the examination of herborised botanical specimens of the National Herbarium in La Paz, the distribution of species occurrence data, my modelling results, and botanical expert knowledge[122] about my own *chhalla* samples collected during my fieldwork.

The 'Zongo' *chhalla* tubes are collected from *Rhipidocladum harmonicum*. It grows in *yungas* cloud forests between 2,000 and 2,800 metres above sea level and its potential distributional area in Bolivia extends from the humid montane forests of the *yungas* of northern La Paz department over the entire *yungas páramo* region and upper cloud forest ridge towards Samaipata (Santa Cruz department).

The 'Quime' *chhalla* tubes are collected from *Rhipidocladum racemiflorum*. It has an extensive potential distribution in Bolivia and grows up to 2,500 m a.s.l. in montane cloud forests, lowland rainforests, and in the Tucumán forests in the southern Andean *yungas*.[123] The 'Bermejo' *chhalla*

[122] Thanks to Ximena Londoño (Colombia) and Christopher Tyrrell (United States) – both internationally recognised botanical specialists in South American bamboos – for assessing these *chhalla* samples, as well as the *tuquru* samples further below.

[123] The *chhalla* bamboo from Pojo, which makers subsumed under the 'Quime' label, was identified by Tyrrell as a *Rhipidocladum* species in the *racemiflorum* section. According to my species models, it can potentially be *Rhipidocladum parviflorum*, which has morphological similarities with *Rhipidocladum racemiflorum* (Tyrrell, 2008, p. 91). However, a botanical specimen identified as *Rhipidocladum racemiflorum* was gathered in Chontal not far from my own sample site in Diam Pampa (Carrasco-Amboró region).

tubes are collected from *Rhipidocladum neumannii*. This woody bamboo species potentially grows between 1,000 and 2,000 metres above sea level in the *yungas* cloud forests of northern La Paz and Santa Cruz departments (‘elbow of the Andes’), as well as in the Tucumán forests around Bermejo in the southern Andean *yungas*.[124]

Both *chhalla* species from Alto Beni are undescribed, whereas the samples collected during my fieldwork are the first ones of these species in the National Herbarium of La Paz. Therefore, I could not produce models for these species and statements about their potential distribution in Bolivia are limited. As described above, they are sourced in the Alto Beni region on the eastern and western sides of the Beni river.

In order to get a generic picture of the geographic distribution of these *chhalla* varieties, I modelled the potential distributional area of *chhalla* bamboo as a generic group. I used geographic coordinates collected during my fieldwork at central sourcing sites (Carijana, Zongo, Quime, Alto Beni, Pojo) and only added botanical information and species occurrence data for those collection sites (Samaipata, Bermejo) that I have not visited myself.

In sum, *chhalla* bamboos grow in *yungas* cloud forests of the departments of La Paz, Cochabamba, and Santa Cruz, as well as in the Tucumán forests in the southern Andean *yungas* around Bermejo (Figure 30). The Map of Figure 30 further indicates the corresponding *chhalla* sourcing sites and regions alongside the potential distribution of *chhalla* bamboos in Bolivia.

---

[124] The flute maker Nicasio Quispe once told me that a very similar ‘Bermejo’ *chhalla* bamboo with extremely thick tube walls were sourced in the Apolo valley of northern La Paz department.

Potential Distribution of Tuquru Bamboo

The different *tuquru* tubes presented in the local typology at the beginning of this chapter are collected from certain woody bamboo species belonging to the Andean woody bamboo genus of *Aulonemia* (Figure 29). Herborised botanical specimens in the LPB, the distribution of species occurrence data, my own modelling results, botanical expert revisions of my own *tuquru* samples as well as recent botanical literature (Jiménez, 2016) suggest the following allocation of scientific species for the four main *tuquru* varieties used by flute makers.

The *lluq'a tuquru* tubes from northern and central La Paz department are collected from *Aulonemia hirtula*, an Andean woody bamboo growing in montane forests between 2,500 and 3,500 metres above sea level (Jiménez, 2016). Its potential distributional area expands from northern La Paz department towards the southern provinces, with further occurrences in the *yungas* cloud forests of Ayopaya and Chapare (Cochabamba department).

The *lluq'a tuquru* tubes from the southern La Paz provinces are collected from *Aulonemia herzogiana*, a Bolivian endemic bamboo growing between 3,000 and 3,500 meters above sea level (Jiménez, 2016). It has a very restricted geographic distribution (endemism) expanding from the *yungas páramo* region of Inquisivi province (La Paz department) via Ayopaya province towards Tiraque province (Cochabamba department).

The *lluq'a* tubes from Cochabamba are collected from an undescribed *Aulonemia* species (a local variety with affinity to *Aulonemia herzogiana*). The sample I took during my fieldwork in the sourcing sites of Kara Wasi (Pojo, Cochabamba) is the first sample of this species in the LPB. It is endemic to the cloud forests of Carrasco and Amboró and grows at an altitude between 1,500 and 2,000 metres above sea level.

Similarly, the *kjirki* tubes are collected from an undescribed *Aulonemia* species growing in the Arcopongo canton of Inquisivi province (La Paz department) and the border area of Ayopaya province (Cochabamba department). My samples collected in the sourcing sites around Baja Minas and Umamarka (Arcopongo, La Paz department) are also the first ones of this undescribed *Aulonemia* species in the LPB. Therefore, I could not produce a specific distribution model for this *tuquru* type.

In order to get a generic picture of the distribution of these *tuquru* varieties, I also modelled the potential distributional area of *tuquru* bamboos as a generic group. This potential distribution is similarly based on geographic coordinates collected during my fieldwork at *tuquru* collection sites (Carijana, Chuspipata, Palomani, Umamarka, Kara Wasi) in addition to botanical information and species occurrence data for those *tuquru* sourcing sites (Pelechuco, Sorata, Cotapata, Choquetanga, Paracti), which I could not visit myself.

The *tuquru* bamboos are endemic to the *yungas páramo* region and distributed over a region stretching from northern La Paz department, via Cochabamba department, towards Samaipata in Santa Cruz department (Figure 31). Figure 31 further indicates corresponding *tuquru* sourcing sites and regions alongside the potential distributional area of *tuquru* bamboos.

Preliminary Conclusions

The musical bamboos of *chhalla* and *tuquru* are scientifically recognised as certain species within the Andean woody bamboo genera of *Aulonemia* and *Rhipidocladum*. While *tuquru* has a much more restricted geographic distribution towards the upper *páramo* region of the *yungas* cloud forest, some *chhalla* species, for example *Rhipidocladum racemiflorum*[125], also grow at lower altitudes towards the Andean-Amazonian foothills, for example in Alto Beni. The principal vegetation zones, where musical bamboos grow, are the *yungas* mountain cloud forests including the upper *páramo* region and the Tucumán forests in the southern *yungas* around Bermejo. Having assessed the broad potential distributions of *chhalla* and *tuquru* bamboos, I now turn to issues of deforestation and related musical bamboo habitat destruction with a particular focus on these two vegetation zones and forest types.

Deforestation and Musical Bamboo Habitat Destruction

Various authors provide deforestation data for distinct time periods using different methodologies such as remote sensing and aerial photography.[126] Analysing the magnitude over time based on selected periods and authors (Table 10), deforestation was low until the 1980s with tripling annual average rates towards the turn of the millennium. The period before 2000 is usually defined as historical deforestation as opposed to recent deforestation from 2000 onwards (see Cuéllar et al., 2012). Annual averages of recent deforestation steadily increased from 2,550 km² between 2000 and 2010 over 2,890 km² between 2010 and 2015 to 3,200 km² in 2016.[127] This was six times

---

[125] I suspect that the polymorphic species *Rhipidocladum racemiflorum* are in fact several distinct species, which are not botanically described yet (see also Tyrrell 2008).

[126] For example, Killeen et al. (2007), Cuéllar et al. (2012, 2015), FAO (2015), ABT (2011, 2016, 2018), SERNAP (2013), MMAyA-DGGDF (2017).

[127] Similar trends of tree cover loss (not necessarily equating to deforestation) for the years between 2000 and 2019 can be derived from the most recent version (1.7) of Hansen et al.'s (2013) Global Forest Change (see Appendix Five). The annual average tree cover loss (50% canopy) between 2000 and 2019 is approximately 2,800 km², while a considerably large area of about 12,000 km² has been lost only in the years between 2016 and 2018. Only in 2019,

the annual average of the 1970s. Since 2010, deforestation remains high with an annual rate of over 0.5% of the initial forest cover.

Table 10: Deforestation Rates in Bolivia over selected Periods (Source: Own Elaboration)

Period	Annual Averages (km^2)	Rates (%)[f]
1976-1986	540[a]	0.10
1987-1991	1,450[a]	0.25
1992-2000	1,800[a]	0.31
2001-2010	2,550[b]	0.43
2011-2015	2,890[c]	0.50
2016	3,000[d]	0.51
Accumulated until 2016	72,000[e]	

[a] Killeen et al. (2007) (data includes all forests: rainforest, cloud forest, semi-deciduous forest, and dry forest).
[b] SERNAP (2013). It is noteworthy that Cuéllar et al. (2012) calculate an annual average of 1,940 km² for the years between 2000 and 2005 and 2,050 km² for the years between 2005 and 2010.
[c] FAO (2015)
[d] MMAyA-DGGDF (2017)
[e] According to MMAyA-DGGDF (2017), total deforested area by 2016 was ~71,000 km².
[f] Calculated based on initial forest cover (588,000 km²) in MMAyA-DGGDF (2017).

According to official deforestation data provided by the Information and Forest Monitoring System (SIMB) of the General Direction of Forest Management and Development in the Bolivian Ministry of Environment and Water (MMAyA-DGGDF, 2017) (Table 11), historical deforestation until 2000 (baseline for the calculation of recent deforestation) was about 37,000 km², while recent deforestation between 2000 and 2016 was approximately 34,000 km². The total deforested area of about 71,000 km² by 2016 corresponds to 12% of the initial forest cover resulting in an extant forest cover in 2016 of approximately 517,000 km².

In terms of advances over time, deforestation until 1986 concentrated on areas around Santa Cruz city, the *yungas* of La Paz, Alto Beni-Yucumo, and

almost 8,000 km² tree cover was lost, mainly due to devastating wildfires, which have affected the entire Amazon biome. More than the half (52%) of the tree cover loss in Bolivia corresponds to humid primary forests.

Chapare (Killeen et al., 2007; Steininger et al., 2001). Until 2000, deforestation was mainly focussed on northern Santa Cruz and the Chapare region. Further deforestation during that period can be observed in Alto Beni (Palos Blancos) and Beni (Rurrenabaque), the Chiquitania and northern Amazon (Cobija, Riberalta, Guayaramerín) (Killeen et al. 2007).

Table 11: Deforestation Data (Source: Own Elaboration based on MMAyA-DGGDF, 2017)

Forest Cover (km^2)	Deforestation[a b c] (km^2)						Total (km^2)	Share %	Extant Forest (km^2)
	Before 2000[d]	2000-2010[e]	2010-2013	2013-2014	2014-2015	2015-2016			
588,000	37,000	20,100	6,300	2,600	2,100	2,800	70,900	12.0	517,100
		33,900							

[a] Divided into historical (before 2000) and recent (after 2000) deforestation.
[b] All data after 2000 calculated between September and August of the years in each time period.
[c] Rounded numbers.
[d] Cuéllar et al. (2015) estimate a historical deforestation of about 31,000 km^2.
[e] Similar numbers (20,550 km^2) provided for the same period by SERNAP (2013).

Between 2000 and 2010, massive clearings have been experienced in the Chiquitania, North of Santa Cruz, the northern Amazon, and additionally in the Chaco dry forest (Cuéllar et al., 2012; Müller et al., 2014a). Deforestation further expanded in the *yungas* of La Paz and Alto Beni, particularly in La Asunta, around Caranavi, in the Boopi valley, Palos Blancos and Covendo, between Yucumo and Rurrenabaque (Beni), and in the Arcopongo valley (Ferreira, 2019; SERNAP, 2013). Since 2010, deforestation has increased in these areas, especially in the Chiquitania and Chaco forests, but also in Chapare, northern Amazon, Alto Beni, and *yungas* of La Paz.

The majority of historical and recent deforestation took place in lowland forests (Amazon, Chiquitano, and Chaco) of Santa Cruz department accounting for almost 80% of the total deforested area (Cuéllar et al., 2012, 2015). According to Müller et al. (2014a, 2014b), mechanised/non-mechanised agriculture and cattle ranching caused the majority of deforestation in Bolivia. The main actors of deforestation in the lowland forests of Santa Cruz department are agro-industrial corporations (soybean production for export), Cruceño farmers, Andean Indigenous, Japanese and Mennonite colonists, and cattle ranchers (Killeen et al., 2008).

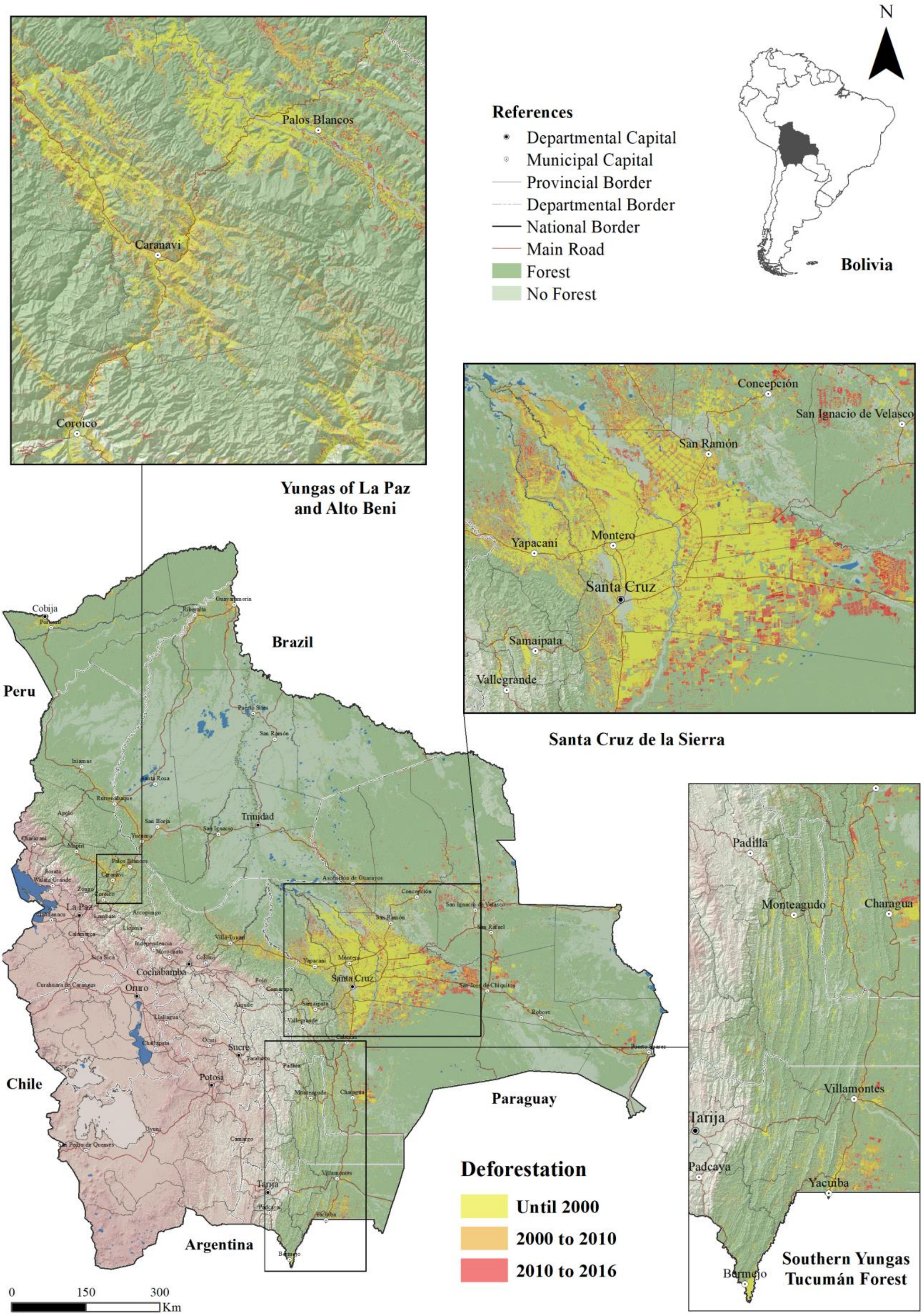
Deforestation in Yungas and Tucumán Forests

My particular focus here lies on the *yungas* cloud forests and the Tucumán forests in the southern Andean *yungas*, making up 20% of the forest cover in Bolivia (Figure 32). As indicated above, these forests host a high degree of woody bamboo species richness and give suitable habitat conditions for the musical bamboo types described above. Leguía et al. (2011) and Killeen et al. (2005) argued that the *yungas* and Tucumán forests have experienced minor deforestation rates compared to lowland forests due to their topographical characteristics and steep slopes impeding access to territory and land. This is also one of the major obstacles for musical bamboo sourcing (see below). Historical and recent deforestation in these forests make up 10% of the total deforested area in Bolivia (ca. 7,000 km² of 72,000 km²). Approximately 55% was deforested before the turn of the millennium.

Deforestation in the *yungas* of La Paz and the Andean-Amazonian foothills of Alto Beni is principally caused by non-mechanised small-scale agriculture of Yungueño farmers, Andean colonists, and lowland communities (Killeen et al., 2008). Until 2010 the Tucumán forest had been one of Bolivia’s least deforested vegetation zones, but recently it has been threatened by cattle ranching, the expansion of the agricultural frontier, uncontrolled fires, and (hydroelectric and hydrocarbon) development projects (Gallegos et al., 2019).

Figure 32: Map of Deforestation in Bolivia

(Source: Own Elaboration based on Official Deforestation Data, MMAyA-DGGDF, 2017)



Ledezma (2009) argues that agricultural activities have caused the most significant modifications of the *yungas* biodiversity during the 20th century. Especially since the 1980s, the coca crop (*Erythroxylum coca*) expanded in the central *yungas* ('original and ancestral area' of coca production) to the detriment of evergreen cloud forests and the natural vegetation (referred to as *ch'umi* by Yungueño farmers) (Figure 33).

Figure 33: Deforested Area for a Coca Plot (Source: Own Photo)

Near Irupana, Sur Yungas Province, La Paz Department

Yungas communities in central La Paz department are the main producers of legal coca leaves in Bolivia today. 55% of the region's cultivated lands are today used for cultivating coca, making up 80% of its gross product value (Álvarez, 2015; see also UNODC, 2020). Additionally, the Morales administration passed a new coca law in 2017, which has provoked debates about the expansion of coca production in the country and related deforestation (Hachmeyer, 2017c).

Following agrarian reform in 1953, a US-organised and Bolivian state-implemented lowland development plan ('March to the Orient') incentivised migration from the Andean highlands to the eastern lowlands resulting in the continuous expansion of the agricultural frontier in principal colonisation areas since the 1960s (Colque, 2014; Gill, 1987; Pacheco, 2006; Pacheco & Mertens, 2004; Urioste & Pacheco, 2001). Alongside other places (such as Chapare, Yapacaní, and San Julián), the Alto Beni region became an important destination for Andean settlers, who until the 1990s were responsible for most of the country's deforestation (Killeen et al., 2008).

Figure 34: Agricultural Frontier in Alto Beni (Source: Own Photo)

Banana Plantation near Inicua Bajo, Alto Beni, La Paz Department

The settlers initially exploited and exterminated forest resources which forced them to adopt intensive agricultural systems. Focussing on subsistence agriculture at the beginning, they successively accessed national markets over time, facilitated by cultural links to urban centres (Killeen et al., 2008). These Aymara and Quechua Andean settlers and their offspring referred to as 'interculturals' are alongside the Mosetén Indigenous people the dominant population group in Alto Beni today (von Stosch, 2014). Nowadays, Alto

Beni has a diversified agricultural economy based on slash-and-burn or fire-fallow cultivation including staples such as rice and corn, a monoculturally produced variety of fruits commercialised in La Paz city, and luxury goods such as coffee and cacao for export (Figure 34).

Remnant Distributions of Chhalla and Tuquru Bamboos

If *chhalla* and *tuquru* bamboos grow in native habitats in *yungas* and Tucumán forests, every conversion of these forests potentially destroys musical bamboo habitat. In order to calculate remnant distributions of musical bamboos, I erased all deforested areas and converted lands from the potential distributions of *chhalla* and *tuquru* bamboos presented above. The erased area defines the habitat destruction due to deforestation (Figure 35 and Table 12).

Approximately 3% (ca. 1,500 km²) of the modelled distribution of *chhalla* bamboos (of about 52,000 km²) correspond to areas which by 2000 had already been deforested, thus are places with confirmed *chhalla* bamboo absences. The remnant distributional area of *chhalla* bamboos in *yungas* cloud forests and Bolivian Tucumán forests corresponded to approximately 50,500 km² in 2000. Between 2000 and 2016, another 3% (ca. 1,600 km²) of potential *chhalla* habitat has been lost due to recent deforestation, principally in the *yungas* of La Paz and Andean-Amazonian foothills of Alto Beni. The remnant distributional area of *chhalla* bamboo was approximately 48,900 km² in 2016. Habitat destruction geographically concentrated on the Tipuani valley (Guanay, Teoponte, Tomachi), the *yungas* of La Paz (Coroico, La Asunta, Caranavi), Inquisivi province (Cajuata), and the Alto Beni region (especially on the eastern banks of the Beni river around Inicua and towards Inicua Bajo in recent years).

Figure 35: Map of *Chhalla* and *Tuquru* Habitat Destruction

(Source: Own Elaboration based on Official Deforestation Data of MMAyA-DGGDF, 2017)

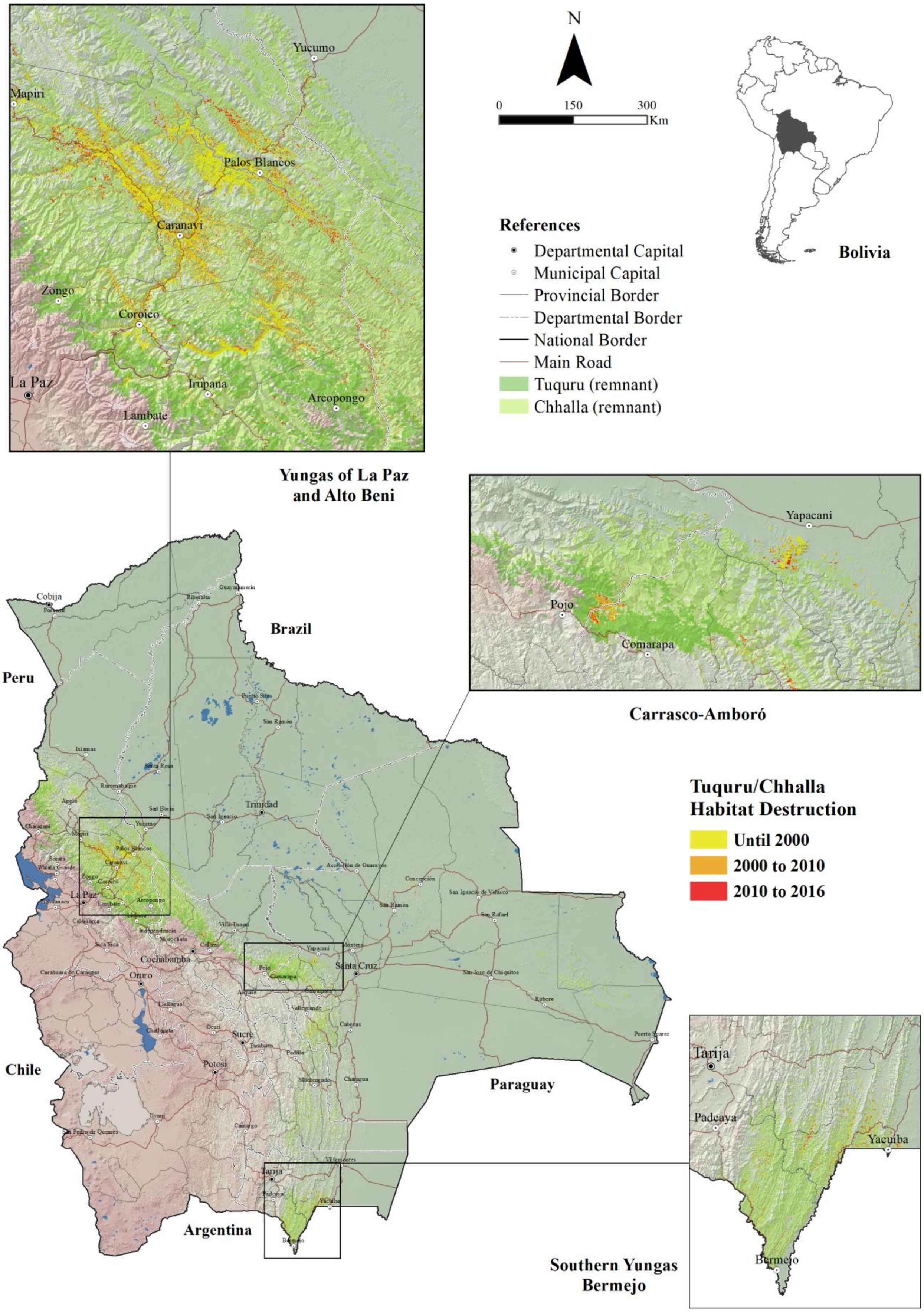


Table 12: *Chhalla* and *Tuquru* Habitat Destruction (Source: Own Elaboration)

	Modelled Distribution	Destruction by 2000		Remnant 2000	Destruction 2000-2016		Remnant 2016
	Km²	*Km²*	*%*	*Km²*	*Km²*	*%*	*Km²*
R. harmonicum	5,399	13	0.24	5,386	47	0.87	5,339
R. neumannii	37,504	1,270	3.39	36,234	893	2.46	35,341
R. racemiflorum	228,984	4,817	2.10	224,167	12,535	5.59	221,632
Chhalla	**51,906**	**1,508**	**2.90**	**50,398**	**1,568**	**3.11**	**48,830**
A. hirtula	4,292	21	0.49	4,271	28	0.66	4,243
A. herzogiana	1,005	1	0.10	1,004	3	0.30	1,001
Tuquru	**10,762**	**27**	**0.25**	**10,735**	**70**	**0.65**	**10,665**

Comparing these numbers with the selected *Rhipidocladum* species, one can say that *Rhipidocladum racemiflorum* (‘Quime’) and *Rhipidocladum neumannii* (‘Bermejo’) lost significantly more habitat than *Rhipidocladum harmonicum* (‘Zongo’). In fact, the latter grows in the upper parts of the *yungas* cloud forests (between 2,500 and 3,000 metres above sea level), where deforestation is low due to steep topographies and inaccessible areas.

Only 27 km² (0.25%) of *tuquru*’s potential distributional area of 10,762 km² corresponded to already deforested areas by 2000. Thus, the remnant distributional area of *tuquru* bamboo was 10,735 km² in 2000. Between 2000 and 2016, further 70 km² (0.5%) have been lost, resulting in a remnant distribution of *tuquru* bamboos of 10,665 km² in 2016. The habitat destruction that occurred can be observed in Aucapata around Pusillani (Muñecas), Sorata valley (Larecaja), Chuspipata and South of Coroico (Nor Yungas), Circuata and Arcopongo (Inquisivi), Villa Tunari around Paracti and Tablas (Chapare), and Pojo around Kara Wasi (Carrasco).

These significantly lower rates of habitat destruction are mainly due to the endemic distribution of *tuquru* within the *páramo* region of the *yungas* cloud forests on altitudes between 2,500 and 3,500 metres above sea level (Figure 36) with low levels of deforestation. Comparing these numbers with those of the selected *Aulonemia* species, the panorama looks very similar. Due to their endemic geographic distributions in the upper parts of the *yungas* cloud forests (*páramo* region), only minor degrees of habitat destruction can be identified.

Figure 36: *Yungas Páramo* Region (Source: Own Photo)

Between Choquetanga and Palomani, Inquisivi Province, La Paz Department

Discussion: Deforestation and Musical Bamboo Sourcing

Interpreting these results, one can say that *chhalla* bamboos have lost more habitat due to deforestation than *tuquru* bamboos. This is mostly due to the distribution of *tuquru* bamboos (*Aulonemia* spp.) being confined to the upper parts of the *yungas* forests (*páramo* region) with significantly lower deforestation rates, than at lower altitudes. Principal areas of *chhalla* habitat loss affecting bamboo sourcing are the less hilly landscapes of the *yungas* of La Paz and the Andean-Amazonian foothills of Alto Beni. While generally reducing the potential niche of *chhalla* bamboos, deforestation determines the selection of appropriate *chhalla* sourcing sites. For example, the agglomeration of sites in the southern La Paz province of Inquisivi (Licoma and Cajuata municipalities) is surely related to the fact that deforestation rates in Sur Yungas province are historically higher. Additionally, forests in the Nor Yungas province are much more difficult to access due to steep topographies.

Nowadays, species-poor grasslands resulting from deforestation are common in Sur Yungas province and coca crops more abundant. However, coca cultivation successively expanded in recent years also around Cajuata, Licoma, and other *yungas* communities in Inquisivi province (UNODC, 2017, 2019) (Figure 37). If these trends continue, deforestation in Inquisivi province will further destroy potential *chhalla* bamboo habitats in one of today's main *chhalla* sourcing regions ('Quime'). The same can be said about advances of deforestation in the southern Andean *yungas* around Bermejo, the pre-Andean rainforests in the Alto Beni region, and in the subtropical montane forests of the Zongo valley, where a particularly appreciated thin-walled *chhalla* bamboo grows (see Chapter Four).

Figure 37: Inquisivi *Yungas* (Source: Own Photo)

Charapaxi, Licoma Municipality, Inquisivi Province, La Paz Department

However, deforestation and land use change in the Zongo valley, especially related to the expansion of coca crops in recent years (UNODC, 2017), has tended to be concentrated on lower, less hilly parts of the valley. Therefore, the ‘Zongo’ *chhalla* bamboo (*Rhipidocladum harmonicum*), which grows in natural intact vegetation of the *yungas* cloud forests in the higher and sometimes inaccessible parts of the valley, is not (yet) threatened by deforestation-induced habitat destruction (see also Chapter Six).

During my fieldwork in Bolivia (2016-2019), Conservation International (CI) worked on implementing a municipal protected area in the Zongo valley. The project included rapid biodiversity assessments with botanists from the LPB and workshops with the local population. Juan Carlos Ledezma, the project director for CI Bolivia, assured me that during their workshops nobody had mentioned the use of *chhalla* bamboos as a forest resource.

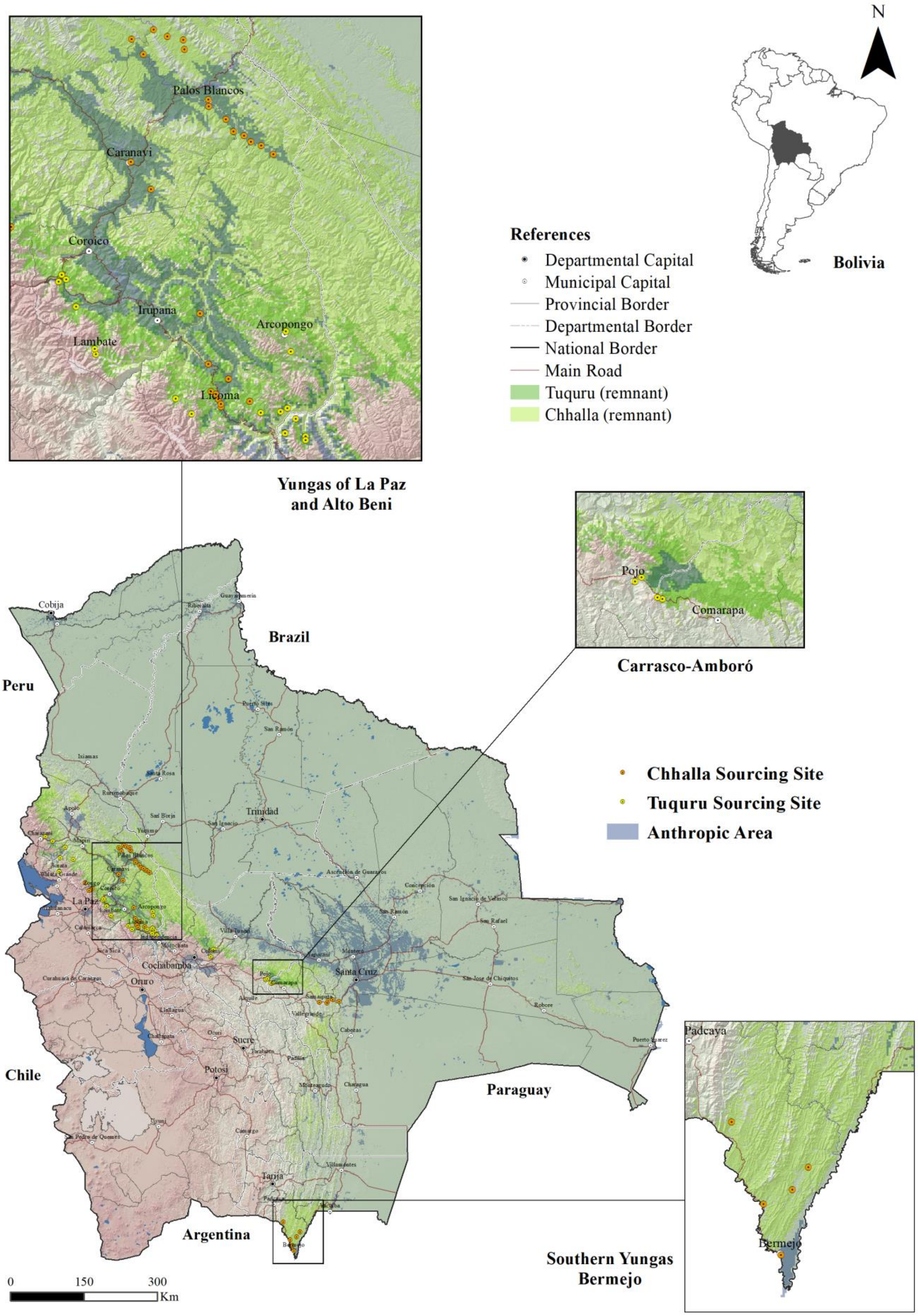
Beyond Deforestation: Sourcing Logics and other Obstacles

Despite these alarming trends regarding *chhalla* bamboo habitat destruction, it is notable that flute makers and bamboo traders did not mention many *chhalla* sourcing sites located in places that were distant from human settlements. If one analyses the distribution of *chhalla* sourcing sites in the *yungas* cloud forests and Andean-Amazonian foothills of Alto Beni mentioned by flute makers, it is clear that the majority are situated in regions with some form of human presence (anthropic area) (Figure 38).

For example, Walateño flute makers and musical bamboo traders did not mention places in the northern La Paz *yungas*, where land use is basically restricted to the pampas of Apolo and the tropical palm and cacao gardens of the Lecos Indigenous people. This can only be partially explained by the proximity to La Paz city. The Tucumán forests in the southern Andean *yungas*

Figure 38: Anthropic Area and Sourcing Sites

(Source: Own Elaboration; Anthropic Area: Navarro & Ferreira 2011)



around Bermejo are actually much further away (36 hours of public bus travel as compared to twelve hours to the Kallawaya *yungas*). Similarly, *tuquru* sourcing sites are also widely distributed in Bolivia, so that distance is not a principal factor determining the selection of sourcing sites.

Some makers have created musical bamboo collection and trade networks integrating distant places with the centre of highland flute making in metropolitan La Paz (see Chapter Six). In this regard, some places are perhaps better integrated into the road and highway system, which enormously facilitates networking, travels, and musical bamboo trade. For example, many Walateño flute makers and musical bamboo traders told me that they obviously want to avoid deadly traffic accidents during travels in *yungas* ecoregions, which would happen more frequently in the poorly integrated northern La Paz provinces.

In fact, old roads in the *yungas* of La Paz have been broadened and new ones with modern bridges and platforms built in recent decades. Thus, travels in the central *yungas* of La Paz department are much safer today than in former times. The old dirt road connecting La Paz city with the *yungas* of Coroico and Caranavi was replaced in 2006, following a 20-year construction period, with a new broader and paved highway with guardrails. Construction work on this highway continued during the time of my research to extend many parts of its route, for example between Caranavi and Alto Beni, leading further into the Beni lowlands and to the departmental capital Trinidad. The old *yungas* dirt road, which was built by the hands of Paraguayan prisoners of war during the Chaco war in the 1930s, was extremely dangerous because of its steep slopes, narrow single track, and lack of guardrails (Figure 39). The almost constant rain and fog in the higher parts of the cloud forests also made driving particularly hazardous. In 1995 it was declared the most dangerous road in the world by the Interamerican Development Bank, as so many people died in traffic accidents. The “Death Road”, as it was nicknamed, is nowadays a major tourist attraction for visitors to La Paz city and is only used today for downhill mountain biking between Chuspipata and Yolosa, close to Coroico. It is hard to imagine nowadays how huge trucks climbed this narrow, three-metre wide *yungas* road, bringing all kinds of lowland products, including *chhalla* bamboos, from the *yungas* and Alto Beni to the highland capitals of La Paz and El Alto.

Figure 39: Old *Yungas* Dirt Road 1950s (Source: ‘Los Yungas’ Facebook Group)

Despite these recent efforts to improve road infrastructure in the central *yungas* of La Paz, traffic accidents still regularly happen and sections of today's *yungas* dirt roads are frequently blocked by landslides, especially during the rainy season (Figure 40). Moreover, conditions similar to those of the famous "Death Road" still exist in other *yungas* regions, which are less economically integrated than the *yungas* of Alto Beni or central La Paz.

Figure 40: Landslide on *Yungas* Road (Source: Own Photos)

Nor Yungas Province, La Paz Department

Another reason for avoiding uninhabited areas in northern La Paz provinces, according to some flute makers and musical bamboo traders, was the higher probability of being surprised during musical bamboo collection in the cloud forests by *jukumari*, Andean spectacled bears (*Tremarctos ornatus*). *Jukumari* occasionally and opportunistically feed on young bamboo shoots and other tender vegetation in the higher parts of the *yungas* forests (Judziewicz et al., 1999, p. 78). Its natural habitat, referred to as *jukumari marka* in Aymara, coincides with *tuquru* bamboo habitat as well as other high mountain woody bamboos (*Chusquea* spp. or *Rhipidocladum harmonicum*). Although described as an extremely shy and timid animal, which is rarely observed in its natural habitat, female bears with cubs have been known to attack Walateño flute makers or bamboo collectors. However, bear encounters are not restricted to the northern La Paz *yungas*, as is evident from the many stories Walateño flute makers recounted to me (see Chapter Six).

As a general framing condition of musical bamboo sourcing, great areas of the *yungas* with potential musical bamboo presence are simply not accessible due to steep topographies and abysses often meaning natural dispersal limitations for Andean woody bamboos. Musical bamboo collectors sometimes walk for many hours in dense cloud forests to search for musical bamboo veins, and risk crossing steep ravines or climbing near-vertical cliffs and rock faces (see Chapter Six). In a more general way, access points to montane and pre-Andean rainforests (the majority of mentioned sourcing sites) are often local communities located within the natural habitats of the musical bamboos. This becomes especially evident with regard to *tuquru* bamboo sourcing, where most collection sites are situated close to communities located in the higher *páramo* region of the *yungas* forests.

In some cases, locals are further involved in musical bamboo collection (see Chapter Six). In fact, on the one hand, without Yungueño locals, musical bamboo collection would be much more difficult. However, on the other, they must also make their living in these rural areas, which often implies deforestation of mountain cloud forests and the destruction of potential musical bamboo habitats.

Aspects of Ecological Succession

Interestingly, second-growth forests have already regenerated over time in both the *yungas* of La Paz and Alto Beni (Killen et al., 2008; SERNAP, 2013). In 2010, almost 30% of the deforested area in the *yungas* (and 23% of the total deforested area in Bolivia) was defined as being in a state of regeneration. This indicates that many deforested areas are not used and left unexploited. Whether *chhalla* bamboos (*Rhipidocladum*) regrow in these second-growth forests is an open question.

Some Andean woody bamboos including some *Aulonemia* and *Rhipidocladum* species can be found in tropical forests with gap dynamics[128] and secondary ecological succession[129] due to natural disturbances (Judziewicz et al., 1999, p. 58). Other studies further indicate that fast-growing, effectively dispersing, and colonising woody bamboos act as pioneer species and gain dominance in ecological succession, significantly reducing tree regeneration in anthropogenically disturbed forests with shifting hierarchies of plant communities (Budke et al., 2010; Judziewicz et al., 1999; Kellermann & Lacerda, 2019; Lacerda & Kellermann, 2017, 2019; Larpkern et al., 2011; Montti et al., 2011a, 2011b).

For example, in the southwestern Amazon forests between Peru, Brazil, and Bolivia, semi-scandent lowland woody bamboos within the *Guadua* genus are said to benefit from human disturbances while contributing to the conversion of the Amazon biome into a savanna ecosystem in a near future with drier climates (Carvalho et al., 2013; Dalagnol et al., 2018; Ferreira et al., 2019; see also Judziewicz et al., 1999, pp. 64-66).

Judziewicz et al. (1999) have stated that *Aulonemia* and *Rhipidocladum* bamboos mainly grow in primary montane and humid forests. Where

---

[128] Patterns of plant growth following the creation of a forest gap, which is an area of disturbance in which the canopy of a forest has been opened.

[129] As opposed to primary succession, which begins in new habitat being uninfluenced by pre-existing plant communities, secondary succession follows disruption of an existing plant community.

deforestation is extreme, they are restricted to moist, steep, and still-vegetated ravines with running waters (Judziewicz et al., 1999, p. 58). In fact, I have not myself seen any *chhalla* bamboos in second-growth forests during my fieldwork in central *chhalla* sourcing regions. Additionally, Walateño flute makers and bamboo traders did not mention any issues related to possible regenerating *chhalla* populations in second-growth forests. As indicated above, they are very aware of the deforestation of old-growth forests and destruction of known *chhalla* populations.

In the light of my own fieldwork experiences, I would be inclined to say that makers and traders now tend to search for new sourcing sites in regions, where deforestation rates remain low and *yungas* old-growth forests with natural vegetation are abundant. The recent expansion towards the Carrasco-Amboró region is a striking example of this trend. The region is both integrated into the national highway system and covered by national parks where human settlements (e.g., Kara Wasi) are few, but gradually expanding. Although these settlements represent a threat to the integrity of forests and the biodiversity within these central *yungas* national parks (ca. 400 km^2 deforested area to date), they also facilitate access to musical bamboos.

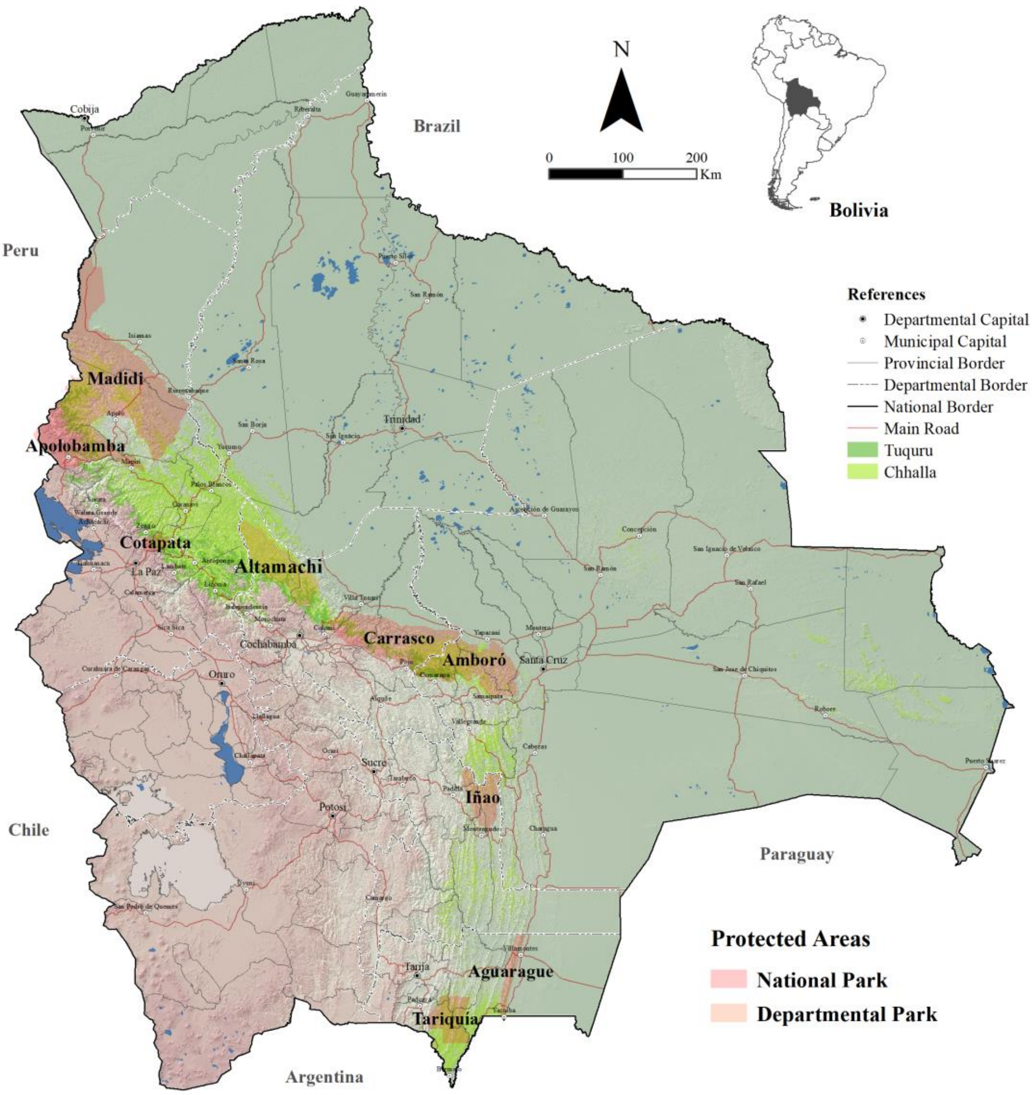
This opens up further questions about the collection of musical bamboos in protected areas, where human interventions are prohibited or strongly regulated. Furthermore, some national parks in Bolivia have been declared so-called “natural areas of integrated management”, which aimed at uniting biodiversity conservation with a sustainable resource use by the surrounding local population.

One example is the Cotapata National Park in La Paz department, were *tuquru* bamboos (*lluq’a paceño*) are sourced, for example on the pre-

Colombian Choro and Sillutinkara trails or around Chuspipata. However, due to its low and marginal scale, *tuquru* collection has not been considered in the management plan as a legal (and therefore regulated and possibly more sustainable) resource use activity (cf. SERNAP, 2005). The same can be basically said about any other of the protected areas covering potential musical bamboo habitats, such as Madidi, Apolobamba, Altamachi, Tunari, Carrasco, Amboró, and Tariquía, to mention just a few (Figure 41).

Figure 41: Musical Bamboo Distributions and Protected Areas

(Source: Own Elaboration)



Growing Typologies and the Appearance of Cultivated Bamboos

Although there is a trend to think of *chhalla* and *tuquru* as local bamboo categories belonging to native species within the Andean woody bamboo genera of *Aulonemia* and *Rhipidocladum*, these are not, however, rigid, or static categories. The recent incorporation of the *kjirki chhalla* type into the local panpipe bamboo typology is one striking example. The *kjirki chhalla* is taxonomically speaking not a *Rhipidocladum* species but belongs to the *Merostachys* genus (probably *Merostachys multiramea*, Londoño, 2018, pers. comm.).[130] Many makers reported that their bamboo search in the subtropical *yungas* forests included moments, in which they simply encountered new bamboo species falling into their selection criteria. They empirically tested the quality and properties of these newly discovered woody bamboos in their workshops and decided whether they were suitable for flute making or not. Due to their morphological resemblance to most *chhalla* types, the *kjirki* type turned out to be useful.

Another native woody bamboo called *chuqui* (*Guadua weberbaueri*), which is used in the Kallawaya region for making local *pifano* transverse flutes (Fuentes et al., 2017; Hachmeyer, 2015; Langevin, 1992), is, however, rejected by Walateño flute makers in La Paz city. They regarded it as too fragile for making their *phala* transverse flutes used in the *ch'unch'u* or *awki*-

---

[130] Interestingly, McClure (1973, p. 88) identifies a strong relationship and striking morphological resemblances between these two genera in some species (especially in the manner of development and the form of the branch complement at midculm nodes), while further describing characteristics of *Merostachys* defining a genus of its own (different culm leaf blades and spikelets). Lizarazu et al. (2011, p. 896) furthermore describe the robust, strong-walled, scabrous ('rough to the touch'), and mottled internodes as a differentiating characteristic of most *Merostachys* species. The same tube surface characteristics give the local name to this particular *chhalla* type in the local panpipe bamboo typology (*kjirki*).

awki flute genres (dances which respectively parody lowland Indigenous and elderly people). This and other species in the lowland woody bamboo genus of *Guadua*, which lowlanders commonly refer to as *tacuara*[131], are notorious for their long and well-developed thorns on culms and branches (Judziewicz et al., 1999, p. 65, pp. 239-247). Walateño flute makers denominate these bamboos usually as *ch'aphi tuquru* ('thorny' *tuquru*) in Aymara.

My urban-dwelling Walateño *quena*-making friend Favío uses two other non-*Aulonemia* bamboos, which he simply referred to as *tuquru* due to their morphological similarities (Figure 42). The first one is another *ch'aphi tuquru* bamboo, a more robust native *tacuara* type (*Guadua sarcocarpa*, Londoño, 2018, pers. comm.), which a local trader from Monteagudo (Chuquisaca) occasionally sells to him. The other one is sent to Desaguadero at the Bolivian border with Peru by a Peruvian bamboo trader, with whom the Mamani brothers maintain intimate trade relationships via the internet. In a personal communication, the Peruvian trader told me that the bamboo, which belongs to the introduced paleotropical genus of *Bambusa* (probably *Bambusa multiplex*, Londoño, 2018, pers. comm.), is cultivated in Pucallpa at the Ucayali river in the Peruvian Amazon. During my field research in Alto Beni, I was shown the same species in Santa Ana de Mosetén, cultivated in a private backyard. Locals confirmed to me that this *Bambusa* species had been brought to Bolivia from an artisan conference in Colombia.

[131] This is a Spanish denomination for species within the lowland woody bamboo genus of *Guadua*. Mosetén Indigenous people in the Alto Beni region have vernacular names for these species in their own language. Elderly consultants of Santa Ana de Mosetén showed me different *tacuara* species, all having local Mosetén names, for example, *bañe´* (*Guadua weberbaueri*), *wojpinaj* (*Guadua chacoensis*) or *tom´* (*Guadua sarcocarpa*). These different *tacuara* species are also used in lowland Bolivia for making different musical instruments such as violins (Ayoreo), rachets (Mosetén) and transverse flutes (Mojeño, Mosetén).

Figure 42: ‘Old’ and ‘New’ *Tuquru* Tubes (Source: Own Photo)

Left (old): *Aulonemia* spp.; Right (new): *Guadua* sp. and *Bambusa* sp.

These examples suggest that Walateño flute makers are beginning to expand their use of woody bamboos beyond native species of the Andean woody bamboo genera of *Aulonemia* and *Rhipidocladum*. Julio once explained to me that they contacted the Peruvian trader just because of a temporal scarcity of thick-walled *lluq’a paceño* tubes, which are favoured for urban *quena* making. This *tuquru* scarcity, however, is not related to deforestation and *tuquru* habitat destruction, as I have shown above. Favío never mentioned scarcity issues as a motivation for sourcing these new types of *tuquru*. He simply argued that they were heavier than native ones and extremely strong-walled (sp. *carnoso*) (appreciated by urban *quena* players accustomed to wood).

However, I can imagine that this trend to employ more imported or cultivated bamboos might expand in a context where deforestation accelerates, supply-induced scarcities worsen, and struggles over native bamboos increase. In fact, in other parts of South America (i.e. in Argentina or Peru), the use of cultivated Asian woody bamboos in Andean flute making (*Bambusa*, *Phyllostachys*, etc.) has already expanded to a significant degree. Moreover, back in the 1980s, a group of Walateño panpipe makers envisioned buying land in the pre-Andean tropical rainforest of Alto Beni in order to cultivate native *chhalla* bamboos on commercial plantations themselves. Consensus could not be found, and the project idea was soon abandoned.

Private *chhalla* plantations would certainly help guard against deforestation and the extension of the region's agricultural frontier. But given that different musical bamboo species have distinct environmental requirements, in the sense of Hutchinson (1957) (ecological niches), implementing musical bamboo plantations in different sourcing regions could prove logistically difficult (though not impossible). Against this background, an ecosystemic protection of old-growth forests with musical bamboo presence might be a better option (see Chapter Seven).

Conclusions

In this chapter, I have explored musical bamboo types and varieties, their geographic origins, and recognised sourcing regions. I presented general patterns and hotspots of tropical woody bamboo species richness and explored potential distributions of *chhalla* and *tuquru* bamboos, which could be used for further conservation action. Finally, I analysed the impact of deforestation on these potential distributions and calculated habitat destruction. From the perspective of my analytical framework of sustainability, the environmental protection of native musical bamboo habitats is a fundamental step towards securing bamboo sourcing practices in the future. This must necessarily involve measures to protect the entire ecosystems and vegetation zones in which these diverse musical bamboos naturally grow and in some cases are even endemic. Although often being identified as a general cause for musical bamboo scarcities, deforestation and habitat destruction, however, should be viewed in a more nuanced manner. While *chhalla* bamboos have certainly lost natural habitat due to historical and recent deforestation, especially in the mountain cloud forests of the *yungas* of La Paz and pre-Andean rainforests of Alto Beni, *tuquru* bamboos have not suffered significant deforestation-induced habitat destruction, mostly because of their restricted distribution or endemism to the higher parts of the mountain cloud forests (*páramo*).

Deforestation and *chhalla* habitat destruction must be seen as one additional aspect within this mosaic of factors limiting the availability of certain *chhalla* types (‘Quime’, ‘Alto Beni’) in highland flute-making workshops in the city. If deforestation advances in recognised *chhalla* sourcing regions, it certainly has the potential to create further tensions within *chhalla* bamboo collection and to worsen supply-induced scarcities. Despite the trends of deforestation in the yungas forest and the Andean-Amazonian foothills, it is not the only factor determining the selection of appropriate sourcing regions/sites. In general, there are topographical limitations as most musical bamboo populations in the *yungas* cloud forests are simply not accessible. Access points are often from *yungas* communities along central roads. Thus, developed road infrastructure (anthropic areas) plays a key role in this regard. Makers take advantage of human settlements in recognised musical bamboo-sourcing regions, and sometimes further involve locals in bamboo collections, as we will see in the next chapter. Factors like bamboo life cycles and unsustainable collection practices are also very important for understanding temporal scarcities in the city and the current dilemma concerning musical bamboo sustainability.

In the context of the diversity of bamboo species used in flute making in the Bolivian Andes, what is most impressive is the local, highly specialised knowledge that Walateño flute makers have developed surrounding the use of different *chhalla* and *tuquru* types. The musical estimation of these Andean woody bamboos has contributed to the development of local ecological and environmental knowledge, not only about their plant habits, environmental niches, and geographic distributions, but also about their ecology, growth patterns, and life cycles, as will be seen in the next chapter.

Chapter 6

The Ecology and Economics of Musical Bamboo Gathering

Local Environmental Knowledge and Drivers of Unsustainability

This chapter is about the ecology and economics of gathering musical bamboos. I take a closer look at the local environmental and ecological knowledge of flute makers and local collectors about musical bamboo ecology and ideal practices of musical bamboo gathering from an ecological perspective. Furthermore, the chapter examines the drivers of unsustainability in musical bamboo collection practices. I discuss how resource dilemmas and the shifting economic structures of highland flute making and the new musical bamboo trade have contributed to unsustainable collecting and bamboo resource management practices in recognised sourcing regions. Drawing on the sustainability framework, I analytically distinguish different social, economic, and cultural factors impacting how musical bamboos are sourced.

As an introduction to the topic of bamboo gathering, I initially describe the dangers of bamboo collection in order to then move forward to look closer at the reasons behind the current scarcity of the highly sought-after thin-walled ‘Zongo’ *chhalla* bamboo. My ethnographic experiences in the Zongo valley allows me to discuss how the ecology of musical bamboos frames flute making in a more general way. After describing in detail bamboo phenology and examples of best bamboo gathering practices, I turn to potential economic benefits for flute makers in times of material scarcities. Afterwards, I move on to assess the drivers of unsustainability in contemporary bamboo sourcing and to discuss resource dilemmas and overexploitation. I explore issues surrounding the loss of ecological gathering knowledge, commodification and the fate of extractivism, and middleman trading within a system of exploitation, before I conclude this chapter with a final discussion about ecological limits and economic decisions within bamboo sourcing.

The Dangers of Bamboo Collection

Many people during my fieldwork referred to the bamboo gathering activities in subtropical forests as 'harvest' (sp. *cosecha*), a term normally linked to agriculture and cultivated crops. Even Aymara Walateño flute makers used the word *cosechar* when they talked to me in Spanish, while using the verb *apthapiña* ('to gather/collect') when talking in Aymara.[132] Although *apthapiña* is sometimes used more generally to translate the Spanish verb *cosechar* (to gloss the way agricultural crops are collected from the fields), the abstraction within the Spanish noun *cosecha* does not reflect the linguistic plurality in Aymara regarding the practice of harvest (Rivera C., 2016).

For example, the harvest of potatoes is referred to as *llamayuña* in Aymara as potatoes are dug out, while the harvest of coca leaves is *k'ichiña* as every coca leaf is individually stripped off the bush. Different agricultural products have different ways of harvest and thus different linguistic categories. However, native woody bamboos grow in their natural habitats and are therefore not 'harvested' in any agricultural sense. Uncultivated musical bamboos are indeed gathered in the tropical forests, although *apthapiña* might

---

[132] "Nänakax chhallaw yunkan apthapxäna."

also refer to the collection of musical bamboos in *yungas* communities already ‘harvested’ by locals.

Notwithstanding, gathering or collecting native woody bamboos in tropical forests requires not only precise knowledge about the ecology of these bamboos, but also about the environment including flora and fauna in a broader sense (see Wilken, 1970). In the case of the musical bamboos in the Bolivian Andes, this includes a variety of potential dangers.

Today, urban-dwelling Walateño flute makers no longer gather musical bamboos themselves, having instead become totally reliant on musical bamboo trading networks and alliances. However, the majority can tell intriguing, and sometimes shocking, stories about their musical bamboo gathering experiences. For example, I was told about deadly traffic accidents on the very narrow dirt roads that meander down the eastern Andean slopes towards the lower subtropical *yungas* regions. High-spirited and sometimes intoxicated drivers in over-crowded public buses (or in the back of lorries until the 1990s) added to this potential danger.

Others explained to me in detail the many threats in the *yungas* forests, among them steep topographies and possible attacks of the *jukumari*, the Andean spectacled bear (*Tremarctos ornatus)*. As explained in the previous chapter, these bears sometimes feed on bamboo shoots and may surprise makers during bamboo collection, since some musical bamboos grow in *jukumari marka*, the ‘land of the jukumari’ (see Chapter Five).

In its natural habitat, the upper *páramo* parts of the cloud forests, the *jukumari* is a threatened species red listed by the IUCN (vulnerable status) and nowadays protected under Bolivian environmental law (Velez-Liendo & García-Rangel, 2017). This species is not excessively aggressive by nature and is unlikely to attack people, except in defensive mode in the face of danger or adult females protecting offspring. Makers tell vivid stories about bear encounters, sometimes with bad endings where makers lose their lives. I also heard stories about Walateño flute makers killing *jukumari* (apparently in self-defence), which resulted in investigation by the Forests and Environmental Preservation Police (sp. *Policía Forestal y Preservación del Medio Ambiente*, POFOMA).

In the pre-Andean Amazon forests of Alto Beni, the probability of being bitten by poisonous snakes is much higher than in the *yungas* mountain cloud forests. Antonio told me how, while in this region, he was infected by cutaneous leishmaniasis, an infectious disease of the skin transmitted by the bite of the sand fly (*Leishamania* sp.). The rapid spread of the infection, all over his body, is still evident today from the scars on his arms and face. He also told me about the dangers of developing myiasis from the parasitic human botfly (*Dermatobia hominis*) larva, known as *boro* in Aymara, and of contracting the widespread tropical viral diseases of dengue or yellow fever.

Considering all these dangers in the tropical forests of the eastern Andean slopes and Andean-Amazonian foothills, I could imagine why so little ethnographic research into musical bamboo gathering has been undertaken to date. After listening to these stories, I also better understood why Walateño flute makers must have decided to stop gathering musical bamboos themselves, besides other factors such as advanced age, outsourcing, and divisions of labour induced by craft specialisation (see Chapters Three and Four). In fact, many makers recommended that I should not risk my life travelling to the *yungas* in order to source bamboos myself. But my first queasy feelings turned into excitement. I depended on the local environmental knowledge of bamboo collecting locals, in whom I had to trust my life and that of my wife.

As shown in Chapter Four, the price of professional high-quality urban *zampoñas* made from 'Zongo' *chhalla* has significantly increased in recent years. Walateño panpipe makers ascribed this rise in price to current material shortages. However, to date, deforestation has not caused any significant habitat loss of this musical bamboo species (*Rhipidocladum harmonicum*), in the Zongo valley or in its other potential habitats (see Chapter Five). In order to understand the dynamics surrounding the current shortages of this valuable panpipe bamboo, I firstly travelled to the Zongo valley close the highland city of La Paz.

Precious *Chhalla* Bamboos in the Zongo Valley

As a consequence of continuous heavy rainfall during the rainy season, the valley was devastated in early 2018 by what locals call a *mazamorra*, a natural catastrophe, a flood of mud, stones, and water. It carved a path of destruction into the valley, sweeping away hills, animals, houses, and the people in its course. It was a horrific scenario, even half a year later. As roads had not been rebuilt by July, the bus Jesika and I took from the Chacaltaya Avenue in El Alto stopped in the upper *páramo* region, close to the hydroelectric plant of Sainani. We continued on foot and walked over stones laying everywhere, along destroyed paths, towards the ancient village of Zongo. After an approximately three-hour hike, we finally arrived.

We were accompanied by a local bamboo collector from Chirimoyani, Alejandro, who picked up several gas cylinders and brought these with his wheelbarrow back to his community. He explained to us in detail how he sources *chhalla* bamboos and sells them to interested Walateño flute makers. He mentioned makers' names which were familiar to me, a situation I also encountered in other sourcing regions. I quickly noticed that relationships between Walateño flute makers and musical bamboo collecting locals were not always entirely harmonious; a situation often linked to questions of economic exchange.

"They [Walateño flute makers] came here and collected *chhalla* themselves in former times"[133], Alejandro stated.

"And nowadays they are not coming anymore?"[134], I asked.

"Not so much, because we ourselves collect and sell [*chhalla* bamboos] nowadays. Many [communities in the Zongo valley] have forbidden them to collect [*chhalla* out of the forests]. Well, in former times, we did not know anything about its value, and they [Walateño flute makers] obviously did not tell us anything"[135].

In some cases, Walateño flute makers paid money for permission to collect musical bamboos in forests on communal or private lands. This is commonly referred to as 'forest rental' (sp. *alquiler de bosque*), where local landowners literally rent designated forest areas for musical bamboo gathering. As I found out later during subsequent trips, for example to Palomani, this is still happening in other sourcing sites in the Inquisivi *yungas*. In other cases, locals in sometimes very remote *yungas* communities have been given non-local, industrially produced, and manufactured goods such as soft drinks, noodles,

[133] "Vinieron aquí y ellos mismos sacaron chhalla antes."

[134] "Y ahora ya no vienen?"

[135] "No tanto, porque nosotros mismos ahora sacamos y vendemos. Muchos han prohibido que saquen. Es que, antes, no sabíamos nada de su valor, y ellos obviamente no nos decían nada."

sugar, or frying oil as a *quid pro quo* for collection permissions. While the former can be considered oral contractual agreements based on monetary compensation, the latter is more of a reciprocal open barter in the sense of Salomon (1985, based on Renfrew 1975, pp. 41-43), a direct (not delayed in time) exchange of goods without any social or ceremonial links (see also Gutiérrez, 1991a).

On some occasions, I heard Walateño flute makers stating that they tactically and interestedly convinced Yungueño locals with these goods, which apparently had much lower monetary value than that for the collected musical bamboos. This would imply a more Bordieuan understanding of unequal reciprocal exchange, or asymmetrical reciprocity in the sense of Alberti & Mayer (1976, p. 22) and Mayer (1976, p. 44), where musical bamboo collecting Walateño flute makers based their economic decisions on self-interested calculations while camouflaging them as symmetrical interchange or even generosity (Bourdieu, 1977; see also Appadurai, 1986, p. 12; Graeber, 2001, p. 28f; Sánchez, 1982, p. 160).

However, for rural people in remote *yungas* places, who are not making wind instruments themselves, musical bamboos actually have no direct use-value. They are additionally viewed as being part of the wild vegetation or tropical *yungas* ‘thicket’ (ay. *ch’umi*; sp. *monte*), an obstacle in many ways for local Yungueño farmers. On the contrary, urban goods and industrial products, which are sometimes difficult to obtain in remote rural *yungas* areas, usually have a much higher use-value for them.

When locals, however, became aware of the money that musical bamboos could produce when being traded as commodities, thus its monetary value on urban musical bamboo markets, they started to view the reciprocal barter efforts of Walateño flute makers as subtle forms of deception. Some locals in musical bamboo-sourcing regions started to collect and sell bamboos themselves and nowadays negotiate prices with more confidence.

This is the case in the Zongo valley.[136] Alejandro made no secret of his disagreement with such trade asymmetries and unequal exchanges. He defended the decision to increase control over the access to *chhalla* resources and justified the higher monetary payments with the tremendous effort of collecting *chhalla* bamboos in the densely vegetated cloud forests with steep ravines and other dangers.

He further told me about another bamboo collector, who we should search for in the community of Zongo. His name is Savino (Figure 43). After we encountered him, he offered us food and gave us shelter in one of the old colonial houses in front of the church. According to Zongueños, it was one of those houses, where Pedro Domingo Murillo had apparently resided after he escaped from royalist troops in La Paz city during the rebellion. This insurrection and first cry of liberty on 16 July 1809 has been identified by historians as the start of the liberation of South America from Spain.

Savino, who originally comes from the *páramo* village of Chhallana in Larecaja province, also told us about complicated relationships with Walateño flute makers. He mentioned that these difficult negotiations were a key reason why he had ceased involvement in the trade of *chhalla* bamboos many years ago. Walateño flute makers sometimes hired him as a local guide

[136] In the Zongo valley, this was apparently happening after a visit of a French folklore musician, who was taken by some Walateño flute makers to Zongo and instructed Zongueños on the value (in monetary terms) of these thin-walled *chhalla* bamboos on urban markets (see Chapter Two).

and/or collection worker, paying a daily wage. The big advantage of having a local guide is that locals almost always know their territory better. Without a local guide, Walateño flute makers would struggle through sometimes unknown *yungas* forests in order to search for musical bamboos (unless they returned to known sites which also frequently happened).

Figure 43: Savino Mallea (Source: Own Photo)

Looking at a Rock Wall (Zongo Valley)

At dawn, a few days later, Savino and I climbed up the hillsides out of the village, through extremely dense *yungas* vegetation. For some three hours or more, we clambered uphill, sometimes crawling on four legs, or crossing steep ravines, and finally we reached the exact altitude where the highly valued thin-walled *chhalla* panpipe bamboo grows. It was threaded like a vein through the dense vegetation of the mountain cloud forest. During our hike, Savino proved his precise local environmental knowledge about plants, wild animals, and territory. For example, we took care to avoid dangerous areas with steep topographies. He showed me indicator plants of different altitudes and read traces of wild animals like cougars (*Puma concolor*) and Andean spectacled bears (*Tremarctos ornatus*).

Being enclosed in the dense vegetation of the *yungas* cloud forest for the first time, everything in my surroundings – the *ch'umi* – looked similar to me; as a seemingly undifferentiated colour spectrum of bright and dark green (Figure 44). I quickly lost any sense of orientation and without Savino, I could have easily become lost. During my subsequent trips, though, I found out that this was a question of cultivating my senses. I began to familiarise myself more and more with the subtropical *yungas* forest environment and to a certain degree acquired the environmental knowledge that locals in sourcing regions like Savino taught me.

Figure 44: *Ch'umi* in the *Yungas* Cloud Forest (Source: Own Photo)

Zongo Valley, Murillo Province, La Paz Department

At those altitudes, where the *chhalla* bamboo was growing, there was no sign of deforestation or habitat destruction (see Chapter Five). Rather, we encountered natural intact vegetation common for the narrow parts of the upper Zongo valley in general (Figure 45). However, the *chhalla* bamboos were simply not mature, thus not ready for collection. Savino explained that the young adult plants of about two years would need to grow at least two years more in order to properly harden. I could only imagine how challenging it must be to collect extremely fragile *chhalla* bamboos in the dense vegetation of this *yungas* forest and then bring them down to the village intact.[137]

Figure 45: Upper Zongo Valley (Source: Own Photo)

Intact Natural Vegetation

[137] Later, Savino explained to me that one firstly opens a one-metre wide path into the forest with a sharp machete. Otherwise, collected *chhalla* culms could easily tangle up during descent in crossing branches and leaves. Because of the large distance to the village and exhausting ascent, collectors reside for several days in the *ch'umi*, surrounded by potentially infectious mosquitos, with prepared basic foodstuff, and sleeping in an improvised tent made from a plastic sheet.

If the *chhalla* bamboo in the Zongo valley had been mature during the time of my research, the destroyed road infrastructure would certainly have meant a considerable obstacle for sourcing. This is, however, not a normal condition, although floods and landslides frequently occur in the *yungas*. In sum, the contemporary shortages of the 'Zongo' *chhalla* bamboo in highland flute-making workshops in metropolitan La Paz must be linked in the first place to the growth habits and maturity cycles of the woody bamboo species. It is, in fact, only a seasonal shortage, which naturally recurs in repeating intervals. This is nothing new for Andean flute makers, who have always had to consider ecological and phenological aspects of musical bamboos.

Generally speaking, the phenology of Andean musical bamboos in distinct sourcing regions ecologically frames periods of material availability in a broader sense. Because of the economic and cultural importance for Andean flute making, it is worth looking closer at the impact of woody bamboo ecology and the phenological sequences of musical bamboos.

The Impact of Bamboo Ecology and Phenological Sequences

Woody bamboos such as *chhalla* (*Rhipidocladum*) and *tuquru* (*Aulonemia*) are somehow miracles of nature. Growth is extremely fast, making woody bamboos a useful renewable resource, not only for wind instrument making, but also for many other uses, including both local Indigenous and global industrial ones (FAO, 2007, 2010). For botanists, they pose a challenge, which is related to their long life cycles. The great majority are sterile (infertile) most of the time. This makes exact taxonomic identifications much more difficult (Ramanayake, 2006). They produce wind-pollinated flowers (anemophilous) and set seeds only once, following very prolonged lifespans, before rapidly senescing, declining, and dying within a comparatively short time of several months (monocarpism). The length of the vegetative growth process (also called intermast period or flowering interval) is species-specific and varies between less than ten and more than 120 years (Janzen, 1976).

When woody bamboos finally flower, the event is gregarious and synchronised over wide areas within the same cohort.[138] This is perhaps the most intriguing feature and, not without reason, recognised as an enigma by botanists (Ramanayake, 2006). The same cohort gregariously flowers in a continuous manner over a period of several-years (a timespan of twelve to 36 months) between flowering cycles, until every individual culm of distinct ages matures and finally senesces. Huge amounts of seeds are produced, which fall down on the forest floor and germinate with the first rains. New seedlings grow for the same time period as their parents and repeat the process.

In his frequently cited article “Why Bamboos Take So Long to Flower”, Janzen (1976) argues that gregarious flowering in monocarpic woody bamboos is not triggered by external impulses (i.e. weather cue) but by an internal physiological calendar, a genetically linked timetable. He hypothesises that mast seeding is an example of satiation of seed predators, while Pearson et al. (1994) argue that it is an escape from parasites. Another hypothesis is that periodic flowering followed by collective death (where the entire plant and rhizome die) evolved as a mechanism to create disturbance

[138] Herbaceous bamboos have mostly annual flowering cycles. Some woody bamboos might also additionally feature annual or sporadic/irregular flowering (Banik, 2015; Brandis, 1899; Das et al., 2008, p. 233).

in the environment and provide seedlings with a forest gap in which they can grow (Keeley & Bond, 1999).[139]

These recurring events of gregarious flowering have ecological implications and sometimes devastating consequences for human wellbeing, local livelihoods, and peasant economies dependent on woody bamboos. For example, in the north-eastern Indian state of Mizoram, a monocarpic woody bamboo known by Mizo people as *mau* (*Melocanna baccifera*) is responsible for the phenomenon called *mautam* in Mizo language, or the death of the *mau* bamboo (Adhikari, 2013; Chauhan & Saxena, 1985; Nag, 1999, Ramanayake & Weerawardene, 2003).

The *mau* bamboo gregariously flowers every 50 years, which is followed by a plague of black rats feeding on its seeds. When the *mau* seeds are exhausted, the rats turn to cultivated crops or stored grain, which causes famines (John & Nadgauda, 2002; Nag, 1999). Rodent outbreaks after bamboo mast seeding are a wide-spread phenomenon, which has also been recorded for other parts of the world, including South American countries like Argentina, Brazil, Chile, and Peru (Jaksic & Lima, 2003).

Although woody bamboos are the material basis for many musical instrument making cultures (Wegst, 2008), to my knowledge attention has not been drawn to the consequences of collective deaths of monocarpic woody bamboos. Interestingly, the giant timber bamboo or *madaké* (*Phyllostachys bambusoides*), from which *shakuhachi* flutes are made, has a vegetative

[139] This hypothesis links to the discussion about woody bamboo dominance in secondary ecological succession (see Chapter Four).

growth cycle of approximately 120 years (Janzen, 1976).[140] New shoots constantly grow from its running rhizome and develop into mature culms within the first four years. This provides *shakuhachi* makers with a continuous availability of materials over a considerable time period. If managed in a correct and sustainable way, makers can theoretically collect culms from the same clump until the bamboo finally dies.

As we will see in the next section, Andean musical bamboos have significantly shorter lifespans as compared to the *madaké* bamboo. Collective deaths of musical bamboos in the Bolivian Andes therefore mean recurring periods of seasonal scarcity of raw materials for highland flute makers within much shorter intervals.

Musical Bamboo Life Cycles in the Bolivian Andes

Knowing growth cycles of woody bamboos is not an easy task. A human lifespan is sometimes not enough to directly observe all vegetative stages over the long term. Although lifecycles of *chhalla* and *tuquru* are shorter than some other woody bamboos in the world, I did not directly observe flowering events of all musical bamboo types myself. Instead, I got a good overview of life cycle stages during my field trips in 2018, with some musical bamboos being in bloom, others in different vegetative stages. This lack of direct observations can be filled by herbarium specimens in order to reconstruct flowering dates and intervals (Guerreiro, 2013; Pohl, 1991).

---

[140] Modern urban *moseño* and other transverse flutes are made by Argentinian flute maker Angel Sampedro del Río, among others, with the very similar golden (*Phyllostachys aurea*) or black bamboo (*Phyllostachys nigra*). The former has a life cycle of about 30 years (Janzen, 1976), the latter approximately 60 years (Veller et al., 2015).

Beside the sparse botanical knowledge of taxonomic identification (see Chapter Five), even less is known about the phenology of Andean musical bamboos, or other neotropical woody bamboos in general (Guerreiro, 2013). Some species are reviewed by Janzen (1976). Pohl (1991) and Guerreiro (2013) are references for systematic phenological studies on neotropical woody bamboos, alongside many local studies focussing on species-specific periods.[141] One important local study with regard to my discussion of musical bamboo phenology is Jiménez's (2016) article about two *tuquru* species (*Aulonemia hirtula* and *Aulonemia herzogiana*) in Bolivia.

In order to reconstruct musical bamboo lifecycles, I will contrast these phenological studies with my own field observations and the local ecological knowledge of flute makers and bamboo collectors. My collaborators knew the seasons when musical bamboos would become available and for how long particular types 'disappear' (ay. *chhaqaña*, sp. *desaparecer*). Tables 13 and 14 show life cycle stages in 2018 and flowering intervals of musical bamboos.

Tuquru Phenology

The *tuquru* varieties showed the following life cycle stages in 2018 (Figure 46). The clumps of the southern La Paz *lluq'a* type (*Aulonemia herzogiana*), which I observed between Palomani and Choquetanga, were (pre)adult plants with individual culms of different ages and diameters. Some clumps seemed to be harvested, suggesting that a collection event occurred sometime earlier in the year. According to botanical specimens, flowering events happened in

[141] On the one hand, Pohl (1991) draws on 24 years of botanical field research and revises several neotropical woody bamboos in Costa Rica. On the other, Guerreiro (2013) surveys flowering records from botanical specimens and historical and recent literature for woody bamboo species native to southern South America.

the years 1911 (Herzog 2396)[142], 1966 (Steinbach 568), and 2010/2011 (reconstructed from Jiménez 6555) (see also Jiménez & Meneses, 2017). This suggest a life cycle of about eleven years (Jiménez, 2016).

Table 13: *Tuquru* Flowering Intervals and Life Cycle Stages (Source: Own Elaboration)

Type	**Locality**	**Species**	**Life Cycle Stage 2018**	**Interval (Years)**	
				Locals	**Botanists**
lluq'a paceño	Carijana La Paz	Aulonemia hirtula	(Pre)Mature Young Adult	10	10-11[ab]
	Chuspipata La Paz		Decomposition Seedlings		
	Palomani Licoma	Aulonemia herzogiana	(Pre)Mature Adult	10	11[ab]
lluq'a cochabamba	Kara Wasi Pojo	Aulonemia sp.	(Pre)Mature Adult	10	unknown
kjirki	Umamarka Arcopongo	Aulonemia sp.	(Pre)Mature Adult	10	unknown

[a] Jiménez (2016)
[b] Jiménez & Meneses (2017)

The population of the central La Paz *lluq'a* type (*Aulonemia hirtula*), which I encountered in Chuspipata, were seedlings that started to grow under decomposing culms of the parental plants. Based on botanical specimens, flowering events occurred in the years 1983 (Solomon 10694, 10709), 1994 (Wood 8484), and 2015 (Jiménez 6826) (see also Jiménez & Meneses, 2017). This similarly suggests a life cycle of ten or eleven years (Jiménez, 2016).

The population of the northern La Paz *lluq'a* type (*Aulonemia hirtula*), which I found in Carijana, were already young (pre)adult plants of about two or three years. Decomposing culms of the parental generation were laying around on the forest floor, suggesting that a flowering event occurred a few years earlier (2015/2016). During the end of my research in 2019, new mature *tuquru* bamboos from the northern La Paz provinces were already traded

[142] The name of the collector and the number of collection in brackets.

again in the cities of La Paz and El Alto after an absence period of several years. Furthermore, the flowering event in Chuspipata, La Paz (Bolivia) in 1983 coincides with a flowering event of the same species in Yanachaga, Oxapampa (Peru) in 1984 (Jiménez, 2016, p. 71). This would mean areas of gregarious flowering over a distance of more than 1,000 km.[143]

Figure 46: *Tuquru* Life Cycle Stages 2018 (Source: Own Photos)

Southern 'Paceño' (Palomani/Choquetanga)
Central 'Paceño' (Chuspipata)
Northern 'Paceño' (Carijana)
'Kjirki' (Umamarka)
'Cochabamba' (Kara Wasi)

My observations in Chuspipata (seedling) and Carijana (pre-adult) further suggest a time staggered initiation of the flowering process in individual culms over the same several-year gregarious flowering period. In other words, some mature culms flower first and set seeds that germinate and start to grow

[143] Actually, woody bamboos of the same cohort are even said to gregariously flower independently of geographic locations.

into new shoots. Pre-mature culms must mature first and then develop flowers and set seeds, initiating the new growth cycle temporarily staggered over the same several-year gregarious flowering period.[144]

Both *lluq'a cochabamba* and *kjirki tuquru* clumps (*Aulonemia* spp.), which I encountered in Kara Wasi and Umamarka, had adult plant populations with mature and premature individual culms of different diameters. No botanical specimens are available for these undescribed species. However, Walateño flute makers and locals in *tuquru* sourcing regions generally argue that the life cycle of all *tuquru* varieties is about ten years, which would be consistent with the cited botanical literature.

Chhalla Phenology

Concerning the *chhalla* varieties, I observed the following life cycle stages in 2018 (Figure 47): The 'Zongo' *chhalla* (*Rhipidocladum harmonicum*), which I was shown in the community of Zongo, had premature young adult plants of approximately two years with still soft culms. According to botanical specimens, the species flowered in Bolivia in 1985 (Solomon 13739), 2002 (Araujo 259), and 2015/2016 (reconstructed from own observations).[145] This suggests a flowering interval and species life cycle of approximately seven or

---

[144] In contrast to these gregarious flowering patterns, some individual culms and clumps collected in northern La Paz (Araujo 4179, 4168; Arellano 2344, 2825; Fuentes 16535) have been observed to bloom between 2008 and 2010. This does not coincide with the populations in the central La Paz *yungas* around Cotapata and Chuspipata. However, as many other botanical specimens from the same period (2008-2010) were found in vegetative growth phase, this might only be sporadic flowering of certain individual culms, or delayed flowering individuals from the former gregarious flowering period.

[145] Tyrrell (2008) noticed flowering events in 1929, 1943, 1945, 1985, 1992, and 1999 at separate populations along its South American distribution. According to this flowering data, the interval is uncertain (see Table 14).

eight years. This is exactly the same time period that urban-dwelling Walateño panpipe makers mention for this *chhalla* type.

Table 14: *Chhalla* Flowering Intervals and Life Cycle Stages (Source: Own Elaboration)

Type	Locality	Species	Life Cycle Stage 2018	Interval (Years) Locals	Interval (Years) Botanists
Zongo (Qantu)	Zongo La Paz	Rhipidocladum harmonicum	Juvenile Young Adult	7-8	uncertain[a] 7-8[b]
	Carijana Charazani		Juvenile Young Adult		
Quime	Palomani Licoma	Rhipidocladum racemiflorum	Germination Seedling	7	6-7[b] 16[c] 7-8[d]
	Diam Pampa Pojo		Flowering Decline	10	
lluq'a Alto Beni *qipu*	Boopi Alto Beni	Rhipidocladum sp.	Flowering Decline	4-5	unknown
	Fernández Alto Beni	Rhipidocladum sp.	Mature Adult	4-5	unknown
Bermejo (Samaipata)	---	Rhipidocladum neumannii	Mature Adult	6	5-6[ab] 21[e]
kjirki	Carijana Charazani	Merostachys (multiramea?)	Mature Adult	unknown	32[e]

[a] Tyrrell (2008)
[b] Own calculation based on botanical specimens for Bolivia.
[c] Pohl (1991)
[d] Londoño (2020, pers. comm.)
[e] Guerreiro (2013)

The 'Quime' *chhalla* (*Rhipidocladum racemiflorum*), which I saw in Palomani, were seedlings not older than half a year, growing under rotten culms of its parental generation. This suggests a flowering event in late 2017 or early 2018. The clumps of the same species, which I was shown in Diam Pampa, Pojo, were flowering. Between these two populations at these distinct sourcing sites lies a time difference of approximately six months.[146] Pohl (1991) argues that the populations in Costa Rica have a flowering interval of 16 years. This, however, neither coincides with Walateño flute makers nor

[146] Interestingly, populations of the same species flowered in Colombia almost simultaneously in early 2019 (Londoño 2020, pers. comm.).

with bamboo collecting locals in Palomani. Many panpipe makers argue for a seven-year life cycle (similar to the 'Zongo' *chhalla*), while I was told in Palomani that it has a life cycle of approximately ten years (similar to the *tuquru* bamboo in the region).[147] According to botanical specimens, the species flowered in Bolivia in 1983 (Solomon 11200)[148], 1992-1994 (Vargas 1695, Nee 44915), 2000 (Vargas 5405)[149], 2005 (Beck 31253), and 2017/2018 (own observations). This would suggest a life cycle of approximately six or seven years.[150]

The *chhalla* bamboo from Bermejo (*Rhipidocladum neumannii*), from which mature culms were collected during the time of my research, is said to have a flowering interval of 21 years (Guerreiro, 2013). However, according to botanical specimens from Bolivia, the species was in bloom in 1993 (Mostacedo 737), 1998-1999 (Nee 48768, 50453), and 2004-2005 (Jiménez 2474, Lluilly 196). This would suggest a shorter life cycle of approximately six years.[151]

---

[147] I was told that when *chhalla* dies, *tuquru* is mature, and vice versa.

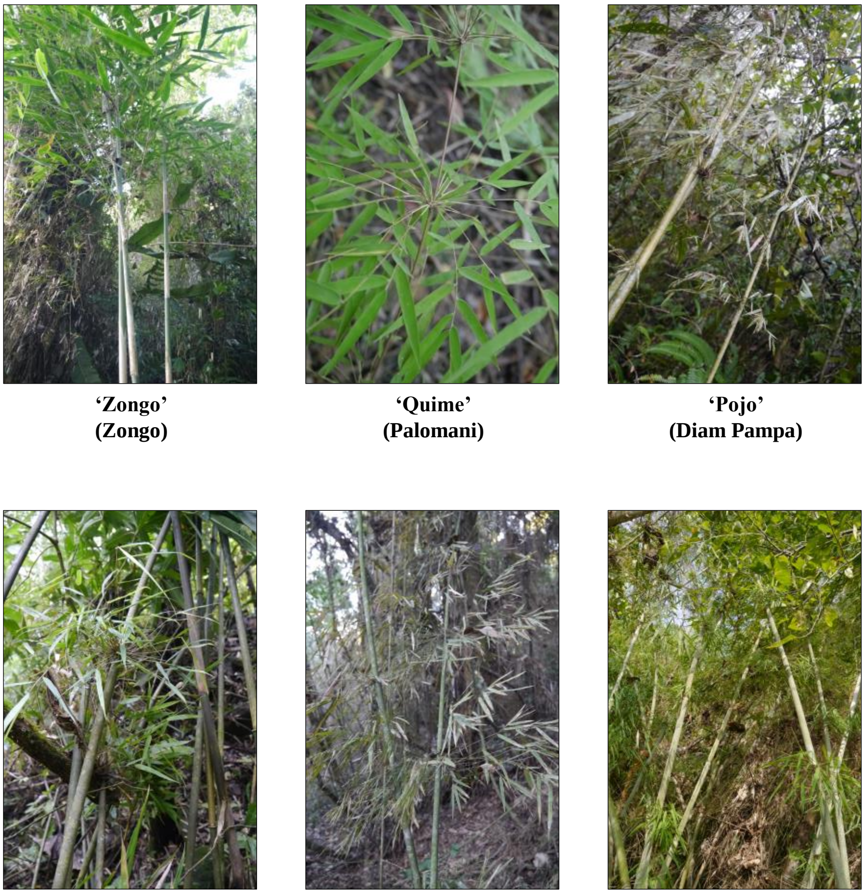
[148] In 1999, this specimen has been identified by L. Rúgolo as *Rhipidocladum neumannii* (see Tropicos data base: http://legacy.tropicos.org/Specimen/215463). However, in the LPB database this specimen appears nowadays as *Rhipidocladum racemiflorum*, as Jiménez re-examined this specimen in 2009.

[149] Also flowered in 2001 in Lipeo, Salta, Argentina (Sulekic 3199), close to the border to Bermejo.

[150] Based on observations of populations in Colombia, Londoño (2020, pers. comm.) argues for a life cycle of seven to eight years (see Table 13).

[151] Based on flowering events in 1944-1946, 1992-1994, 1999-2000 and 2005, Tyrrell (2008) argues for a flowering cycle of five or six years. It is always possible that flowering events can be infrequently observed or simply left out, which sometimes makes intervals appear larger than they really are (Pohl, 1991, p. 111). In fact, five to six years can easily be a common factor for the 21 years of Guerreiro (2013).

Figure 47: *Chhalla* Life Cycle Stages 2018 (Source: Own Photos)



'Zongo' (Zongo) | **'Quime' (Palomani)** | **'Pojo' (Diam Pampa)**

'Kjirki' (Carijana) | **'*Lluq'a* Alto Beni' (San José)** | **'*Qipu* Alto Beni' (Hernández)**

As the *kjirki chhalla* type (*Merostachys* sp., possibly *multiramea*) is a recent incorporation in the *chhalla* typology, Walateño flute makers I conversed with did not yet know its life cycle. The clumps I was shown in Carijana were mature adult plants. Guerreiro (2013) suggests that *Merostachys multiramea* (if the *kjirki chhalla* type is this bamboo species) has a life cycle of 32 years, with the last flowering event in 2003-2007.

Concerning the two *chhalla* varieties (*lluq'a* and *qipu*) from Alto Beni, the *lluq'a* type was flowering and declining, while the *qipu* type had adult plants with premature and mature individual culms. Interestingly, a maker friend once received a delivery of both Alto Beni types at the same time. He pointed to the already strongly deteriorated *lluq'a* type and explained to me that this must be one of the last collections, while the *qipu chhalla* bamboos were perfectly mature. Both are probably undescribed *Rhipidocladum* species, so that flowering intervals are unknown from a botanical perspective. The *chhallero* ('*chhalla* bamboo collector/trader'), with whom I collected *qipu chhalla* bamboos in Hernández (Alto Beni), said that both would have rather short life cycles of about four or five years.

Implications for Flute Making: Species Diversification versus Material Preferences

During my fieldwork with flute makers, I was always very intrigued by the fact that Walateño flute makers diversified the use of musical bamboo species to such an impressive extent (see Chapter Four and Five). In response to my question of why there are so many different musical bamboo types, Antonio once responded: "They [bamboos] are like us, we are also different depending on the region. People from the highlands are different to people from the lowlands." [152] According to Antonio, the diversity of musical bamboo types would therefore depend on the heterogeneity of geographic regions in Bolivia, just like the cultural diversity and identities of people. But why do they use so many different musical bamboo types?

On the one hand, there are musical, sonorous, and acoustic reasons, as I have shown in Chapter Four. However, many musical values attributed to distinct woody bamboo types are rather recent developments, influenced by urban musicians of both the autochthonous and (neo)folklore realm. In the

[152] "Son como nosotros, también somos diferentes dependiendo de la región. La gente del altiplano es diferente que la gente de las tierras bajas."

context of long life cycles and recurring scarcity periods due to collective deaths of monocarpic woody bamboos, another reason comes to my mind.

As shown in the previous section, different *chhalla* and *tuquru* varieties in recognised sourcing regions had different life cycle stages in 2018. During my fieldwork, flute makers witnessed a scarcity period of certain La Paz *lluq'a* types, while the *lluq'a* type from Cochabamba and the *kjirki* type were mature. Likewise, certain *chhalla* types such as 'Zongo', 'Quime', and later 'Alto Beni' (*lluq'a*) were unavailable, while 'Bermejo' and 'Alto Beni' (*qipu*) were traded in large numbers. Makers usually know the sequence in which musical bamboo species in different regions chronologically mature. Instead of being dependent on only one *chhalla* or *tuquru* species, Walateño flute makers have reached a sophisticated diversification over time, allowing them to substantially shorten naturally recurring scarcity cycles. When one musical bamboo type senesces and collectively dies in one sourcing region, another type is already maturing and ready for collection in another.

Under the following two circumstances, Walateño flute makers have almost constant musical bamboo supply: there are no other reasons for supply-induced shortages (e.g., habitat destruction or overexploitation), and there are no material preferences in the musical use of distinct musical bamboo types. I have nuancedly dealt with deforestation-induced habitat destruction in the previous chapter and will come back to the aspect of overexploitation further below. Material preferences are often socially negotiated, and material selection often depends on the performance context (see Chapter Four). For example, remember the introductory case presented in Chapter One, where I drew attention to *chhalla* preferences among community-based *qantu* panpipe makers and rural Quechua speaking musicians in the Kallawaya region. Although other types were principally available, they exclusively used very thin-walled *chhalla* tubes with long internodes for making their *qantu* panpipes (Figure 48), since only these were said to produce the characteristic sounds of the lower *sanqa* panpipe registers and the entire *qantu* ensembles.

Figure 48: Qantu Panpipe Maker Joaquin Quispe (Source: André Langevin, 1984)

Quiabaya, Charazani Municipality, La Paz Department

Something similar is happening in the city today in the performance context of professional urban *zampoñas*. As shown in Chapter Four, professional urban panpipe players prefer very thin-walled *chhalla* bamboos, which are collected from one single woody bamboo species (*Rhipidocladum harmonicum*) in the Zongo valley. While Walateño flute makers have diversified the use of different *chhalla* species over time (also because the touristic making context does not dictate any musical bamboo use restrictions), material preferences in the city have produced new vulnerabilities to recurring scarcity periods.

Interestingly, as a result of this, some Walateño panpipe makers have tried to plant the *chhalla* bamboo from Zongo valley in the Inquisivi *yungas* around Licoma, where the similar 'Quime' *chhalla* type naturally grows. Apparently, the initiative was unsuccessful and the 'Zongo' *chhalla* quickly died in this much lower part of the central *yungas*. This indicates that these two *chhalla* types are distinct species with their individual environmental niches (see Chapter Five) having particular environmental requirements in the sense of Hutchinson (1957).

Returning to the city from my Zongo trip, I met several of my maker friends, among them Andrés and his brother Antonio. They were very interested in what I had to tell them about my trip. Of course, they approximately knew when the bamboo plants in the Zongo valley collectively died and when a new availability period will begin. While visiting Antonio in his workshop in Linares street, I had an interesting conversation with him about the price development of 'Zongo' *chhalla* bamboo. In response to him asking in which vegetative stage I had found the 'Zongo' *chhalla* bamboo, I answered: "It was still immature, and it will take at least two or even three more years to harden."[153] Antonio nodded knowingly, while stating that his stored tubes were almost used up.

"What will happen with the price, when it is available again?"[154], I asked.

He responded that "it is advantageous for us when the price is maintained like this. Hopefully, it will not decrease, we should regulate this."[155]

"In which sense regulate?"[156], I asked, to which he answered:

"Well, prices, and the *chhalla* [bamboo] from Zongo [valley]."[157]

Professional urban *zampoña* makers like Andrés and Antonio usually respond to recurrent shortages of 'Zongo' *chhalla* by storing huge numbers of mature internodes to bridge scarcity periods of at least four or five years.

---

[153] "Era todavía llullu [inmadura], y va a tardar dos, o incluso tres años más para endurecer."

[154] "¿Qué va a pasar con el precio cuando está disponible de nuevo?"

[155] "Nos conviene que el precio se mantiene así. Ojalá no baje, deberíamos regular esto."

[156] "¿En qué sentido regular?"

[157] "Pues, precios, y la chhalla de Zongo"

From an economic point of view, these scarcity periods are much more profitable for them since they can easily raise material prices under a scarcity discourse. As long as there are clients paying for them, there is no need for any price decrease. As argued in Chapter Four, these extremely elevated prices have become a mechanism of social exclusion and many clients with lower purchase power already cannot afford these thinner-walled *chhalla* tubes.

A new availability period for 'Zongo' *chhalla* tubes will begin in around 2021/2022. In mid-2020, it was still not sourced, and stored resources were depleting at the end of the current scarcity period. Professional panpipe makers are now speculating what will happen to material prices during the next availability period. My personal guess is that prices will slightly decrease, yet meanings about differences between *chhalla* tubes surely remain, which will also materialise in some sort of price difference (especially for thinner-walled 'Zongo' and 'Quime' *chhalla* tubes).

Viewed from a formalist economic perspective, Antonio talked about the potential advantage of something like a monopoly price under artificial scarcities. In a way, Walateño flute makers almost have monopolistic market power. With better social organisation, they could easily regulate available bamboo materials and set prices. However, reality is different and much more competitive, even within kin relationships. This sometimes extreme competition sets in motion a downward price spiral devaluing their artisanal work. Clients often bargain prices and are not always aware that the more or less fixed material prices for musical bamboo resources make up a third of the final price for the musical instrument (see Chapter Four). Where makers can often make a difference is with regard to the price of the artisanal work itself. All these aspects have surely contributed to those mechanisations and semi-industrial crafting processes described in Chapter Four.

In sum, this example of the ‘Zongo’ *chhalla* bamboo shows that temporal shortages are not always genuinely regarded as negative by Walateño flute makers, especially those panpipe makers using thinner-walled ‘Zongo’ and ‘Quime’ *chhalla* types. On the contrary, they are rather perceived as profitable from such a formalist economic perspective.

Bamboo Maturity and Selective Collecting

I have shown above how musical bamboo life cycles frame material availabilities in a general sense. However, this does not tell us anything about when a musical bamboo matures or is ready for collection. Besides phytogeographic and phenological issues, experienced flute makers and bamboo collectors well know the lignification (hardening) process of culms (joint stems) and internodes (part of a culm between two nodes) (see Figure 5), where they become woody. The development of timber quality can be basically divided into three main stages: Lignification, Stability, Decline. When musical bamboos are collected in the lignification stage, culms are immature and not resistant enough. When musical bamboos enter into the decline phase, the timber quality diminishes, and culms lose strength. Many culms of bamboos in bloom quickly show signs of senescence and deterioration.

Chhalla and *tuquru* bamboos harden approximately halfway through their life cycle. For example, *tuquru* bamboos with a ten-year life cycle harden after three or four years and rhizomes develop culms with different diameters of up to five centimetres after five years (different diameters are used for different *tuquru*-made flutes, see Chapter Four). The ‘Zongo’ and ‘Quime’ *chhalla* with a seven or eight-year life cycle harden after three or four years, while the ‘Bermejo’ and ‘Alto Beni’ types with a five- or six-year life cycle already mature after three years. Unlike trees having secondary growth, bamboo shoots grow out of the forest soil with its final diameter, thus only exhibit (an extremely fast) primary growth (Figure 49). Species-specific culm thickness therefore primarily depends on the development of the rhizome. On a clump, individual culms of different generations and ages can be found (uneven age structure). While mature culms can be collected, premature and still lignifying ones should be left in the clumps.

Figure 49: New *Tuquru* Shoot (Source: Own Photo)

Carijana, Charazani Municipality, La Paz Department

For example, before I started collecting *qipu chhalla* myself in Alto Beni (Figure 50), the local *chhallero* – we can call him Rafael here – initially instructed me how to recognise mature culms and cut them correctly. This very experienced *chhallero* explained to me that mature culms change colour from bright and shiny green into a darker green and later yellowish/grey tone. Once in the rainforest, with *chhalla* clumps in front of us, he pointed out the mature culms to be collected. These were situated in the centre of the clumps, while young and premature lignifying culms were growing towards its periphery. Depending on the distribution of culms, it was sometimes difficult to reach the centre without damaging younger culms in the periphery. I observed how Rafael managed to cut a tunnel-like entrance into the clump and removed mature culms from the centre.[158] He even left behind some mature or overaged culms, so that soft immature and lignifying ones on the periphery do not collapse.

Rafael further stated that mature culms should be cut from the first or second node onwards, counting four or five successive internodes. This is the standard length of traded *chhalla* bamboo culms, which facilitates counting internodes in the traded bundle (ay. *qhiwi*). These *qhiwis*, a word which derives from the Aymara verb *qhiwiña* meaning 'to carry a large and heavy thing over the shoulder', consist of 300 culms that each have four or five internodes. As *tuquru* tubes are longer and additionally sold per unit (not in a bundle), *tuquru* bamboos are usually cut per internode. Both *chhalla* and *tuquru* internodes are cut above the nodes since makers use internodes from the node downwards, with the node becoming the flute's foot joint (see Figure

[158] This collection method is similar to what is called "horseshoe" harvest method (e.g., Darabant et al., 2012, 2016; Rabik & Brown, 2003).

5). The part of the culm leaves is moister and softer and therefore not suitable for the flute’s foot joint.

Figure 50: *Qipu Chhalla* Bamboo Collection (Source: Own Photo)

Hernández, Alto Beni, La Paz Department

Natural clumps are sometimes extremely congested with tangled up culms under extreme tension. This frequently produces dangerous situations and care must be taken not to be injured by sharp-edged culms whipping back after being cut. It was very important to have an extremely sharp machete blade, so we had to sharpen it continuously. We removed all branches and leaves from the collected culms and brought them to a half-shaded place at the forest edge, leaning them out on a collapsed tree trunk for drying so that culms do not become rotten on the moist forest floor (Figure 51).

What I learnt from Rafael was that it is fundamental not to clear cut clumps because younger shoots are continuously growing from the rhizome and lignifying (vegetative growth/reproduction). Rafael said that, within certain intervals (annual or biannual), musical bamboos (both *chhalla* and *tuquru*) can be gathered from the same clump over several years (the stability phase), if done correctly.[159] As a general principle one can say that the more intense the collection practices, the lower shoot/culm recruitment and regeneration capacity (see Darabant et al., 2016).

Figure 51: Half-Shade Drying of *Qipu Chhalla* Culms (Source: Own Photo)

Rafael in the Background

It often happened previously, though, that Walateño flute makers simply did not return after once collecting bamboos. This was surely a question of formerly lower bamboo demands and the overall efforts of bamboo sourcing. Thus, musical bamboos usually had sufficient time to reproduce (vegetatively) in the absence of intensive collections. Nowadays, much of this specialised ecological knowledge about low-invasive and selective gathering practices has been lost. This is basically linked to two drivers of unsustainability, namely resource dilemmas and new forms of musical bamboo trade. Both have caused inappropriate musical bamboo collection practices with very negative ecological consequences.

[159] Darabant et al. (2016) argue in a case study about a village in Zhemgang, Bhutan, that collecting bamboos in annual intervals is not sustainable.

Resource Dilemmas and Overexploitations

The esteemed qualities attributed to certain native woody bamboos, well-exemplified with the thin-walled *chhalla* bamboo from Zongo valley, has caused resource dilemmas, which have had a severe impact on these bamboos' capacity for natural regeneration and reproduction. Those topographically accessible musical bamboos are quite limited and shared within a common resource pool. Thus, overexploitation in recognised sourcing regions is likely, and this had already happened over recent decades, for example in the Zongo valley. Overexploitation appears when musical bamboos are collected at an unsustainable rate in relation to mortality and capacity for natural reproduction. The ecological consequences are extinction at population or even species levels.

Such overuse may result from resource dilemmas known in the literature of natural resource management as the "tragedy of the commons" (Hardin, 1968). Poorly organised collective action may lead to the depletion of a shared common pool resource under the premise that involved individual users behave according to their own short-term self-interest. With regard to musical bamboos, there are basically two ownership regimes: Either musical bamboos are owned privately as they grow in forests on private lands (sp. *lotes*) or they are owned commonly by members of a lowland community as they grow in forests on communal land.[160]

The following story well exemplifies ongoing resource dilemmas. In contrast to most other Walateño flute makers, who purchase traded musical

[160] In some cases, musical bamboos also grow in national parks, where the use is formally restricted by national or departmental administration (see Chapter Five).

bamboos in the city (see below), Ignacio still sporadically travels to *yungas* communities himself and purchases *tuquru* bamboos at the home base of bamboo-collecting locals. This is often time and energy consuming. However, as he makes high-quality autochthonous *musiñu* flutes and is well-known among clients for his crafting abilities, he willingly invests time and energy to source quality *tuquru* tubes, even when this requires him to undertake exhausting sourcing travels. But this also has several advantages. He has first-hand access to musical bamboos and can select the best tubes for himself. Unit prices are much lower due to omitted transportation costs. When he transports his purchased *tuquru* tubes, he does so in the luggage compartment of the bus in which he is himself travelling, a strategy which often pays off, saving him money.

In one such case, we travelled together to Baja Minas and Umamarka (Arcopongo, Inquisivi province, La Paz department) in order to purchase *kjirki tuquru* tubes. I tried to travel to Arcopongo before, but I had to cancel all my trips because of violent armed conflicts in the region among gold mining cooperatives. We passed by the crossroads to Choquetanga in the *kimsa krus* mountain range in the Inquisivi province, where the sun was rising over the snow-capped mountain tops in the midst of dense early morning fog. At that moment, I asked Ignacio why he did not travel to Choquetanga as these *tuquru* populations in that area had been providing mature tubes during my fieldwork (2016-2019). Many *musiñu* makers highly esteem *tuquru* bamboos from Choquetanga due to their robustness and corrugated inner wall textures (facilitating air flow) (see Chapter Four). The *páramo* village of Choquetanga is also much closer to the city than Umamarka in Arcopongo, which is about twelve hours’ bus ride from El Alto. He immediately responded that all *tuquru* bamboos in the Choquetanga region (including Choquetanga Chico and San Juan Jahuira) were already depleted, since they are collected very quickly when they regrow, including sometimes while still immature. He mentioned other places close to the city of La Paz, and thus with easier access to *tuquru* populations, where the same phenomenon occurred, for example Cotapata, Chuspipata, Mina Chojlla, or Lambate.

Such resource dilemmas, however, were much more acute when Walateño flute makers still collected bamboos themselves, i.e. during the second half of the twentieth century. They knew not to collect immature bamboos, but when they left culms behind, it frequently happened that another maker colleague travelled to the same sourcing site and collected them in the meantime. The secrecy about sourcing sites mentioned in several parts of this thesis was one of the consequences of this social dilemma in the first place. Although the majority of makers no longer undertake such sourcing travels, I was still asked by many Walateño flute makers not to share any concrete information about sourcing sites with other makers, including their own family members. In this situation of mistrust and non-coordinated bamboo gathering, there was always the expectation that a maker colleague would gather musical bamboos at recognised sourcing sites before you. Additionally, sourcing travels were usually long and bamboo collection exhausting, time/energy consuming, and extremely dangerous. In order to make the investment (of money and time) worthwhile, some makers did not always consider long-term interests and collected as much as they could.

Higher demands in a thriving tourist instrument-making context, in which no material preferences or bamboo quality standards are established, have furthermore increased the musicultural pressure on musical bamboo populations in recognised sourcing regions. These were favoured due to a mixture of several components like proximity to the city, easy access to musical bamboo populations, harmonious alliances with local bamboo collectors, or musical value of bamboos, such as in the cases of Zongo or Choquetanga. In many sourcing regions musical bamboos have already disappeared from former habitats and become extinct at the population level.[161] Resource dilemmas have caused inappropriate collection practices and overexploitation, which in turn resulted in reduced bamboo productivity over the short-term, and loss of reproduction capacity and eventual destruction of populations over the long-term.[162] Deforestation is one important factor for understanding the destruction of musical bamboo habitats in some sourcing regions, for example the *yungas* of La Paz, Alto Beni, or Pojo (see Chapter Five). But resource dilemmas, as a driver of unsustainable collection practices and overexploitation, explain the extinction of musical bamboo populations in sourcing regions with low deforestation rates.

Besides resource dilemmas, another aspect of particular relevance, when it comes to inappropriate collection practices, is the shifting musical bamboo trade. In former times, Walateño flute makers travelled to *yungas* communities, contacted locals, and collected musical bamboos themselves. Against this background, remember Julio’s statement in Chapter Four that former experienced Walateño flute makers like his father Sebastián perfectly

---

[161] Botanists like Judziewicz et al. (1999) and Londoño (1990) also drew attention to this phenomenon in relation to *Aulonemia queko*, which is used in Ecuador for musical instrument making. It is similar to *tuquru*, which also grows in primary montane forests and is threatened by habitat destruction and overexploitation.

[162] See Sulthoni (1996) for a similar example in East Java, Indonesia, where inappropriate collection has caused reduced culm productivity, ceasing of natural regeneration and destruction of bamboo populations.

knew how to collect musical bamboos correctly and to manage natural clumps in a more sustainable way. As flute makers, they clearly knew how to properly collect suitable internodes (in terms of maturity and morphology) and how these must be processed after collection (in terms of drying and transport).

However, sourcing strategies have shifted since the time that flute makers became reliant on external musical bamboo traders. Nowadays, either highland bamboo traders from Walata Grande's neighbouring community of Walata Chico carry out bamboo sourcing travels, or locals, in sourcing regions, directly collect and trade musical bamboos themselves. Both groups of actors usually bring musical bamboo tubes directly La Paz and El Alto, where they are sold to Walateño flute makers (often bulk purchasers) at makers' homes or at central redistribution points (see Chapter Four). Within these new forms of musical bamboo trade, there are two tendencies that can be observed. On the one hand, local bamboo collectors often do not possess the same knowledge about bamboo ecology and appropriate gathering practices that Walateño flute makers (especially elderly ones) had when collecting for themselves. On the other hand, non-flute making traders do not tend to regard musical bamboos as valuable natural materials for flute making but as commodities, that is objects of trade.

Loss of Ecological Gathering Knowledge

During my field trip to the Carrasco-Amboró sourcing region (municipalities of Pojo, Cochabamba department and Comarapa, Santa Cruz department), I met a local bamboo collector who we will call Ernesto. He took me on his motorcycle from Kara Wasi to Diam Pampa as he wanted to show me *chhalla* bamboos is his village. The next day, we climbed the hillsides outside the village, crossing deforested and prepared lands for agriculture, towards the *chhalla* populations in this extremely threatened part of the Carrasco cloud forest. All clumps were in bloom and already very much deteriorated. Suddenly, Ernesto said that "something is really strange, because when we cut these [*chhalla* bamboos], they disappear and do not return. It seems that, like people, they get annoyed and leave."[163]

What he so vividly expressed in an anthropomorphising manner suggests poor collection practices and extinctions at population level from an ecological perspective. At the same time, I thought, it is not at all too absurd to think that musical bamboos are living beings that can really get annoyed when they are being cut, especially when done inappropriately. In fact, locals in Kara Wasi and Diam Pampa only recently started to trade musical bamboos and as yet seem to lack appropriate knowledge about musical bamboo ecology and gathering practices.

Ignacio and I were confronted with another example on our *kjirki tuquru* sourcing expedition to Arcopongo. Arriving at Baja Minas after a twelve-hour bus ride from El Alto, we saw several bundles of *kjirki tuquru* tubes, ready for transport (see Front Picture). Ignacio approached the owner and immediately started to negotiate, even though the tubes were already reserved for another Walateño flute maker, who had got there before us. Ignacio haggled over the price, insisting that half of the tubes were immature, while the much younger *tuqurero* did not want to yield; the two were unable to find a consensus.

[163] "Algo es muy extraño, por qué cuando las cortamos, desaparecen y no regresan. Parece que se enojan como gente y se van."

The next day, we contracted a driver, who took us to Umamarka. On our way to the *páramo* village, from the opposite mountain slope, we could already see huge *tuquru* plants with light green leaves in the *páramo* of the *yungas* forest (Figure 52). Umamarka lies in the *yungas páramo* region, at exactly the altitude that *tuquru* bamboos grow (compare with conclusions in Chapter Five). We only had to walk down to some pastureland, five minutes from the village, to reach the upper *yungas páramo* forests with abundant *tuquru* populations.

Figure 52: *Páramo Yungas* Cloud Forest with *Kjirki Tuquru* (Source: Own Photo)

Umamarka (Arcopongo), Inquisivi Province, La Paz Department

The recently completed dirt road was only opened the day before we arrived at Umamarka. Before that, the few families living in this remote hamlet had to walk several hours to reach the nearest central road connection. Because of this remote location, the departmental electricity company of La Paz, even until today, refuses to supply Umamarka with mains electricity. No mobile signal can be received in the hamlet, which has its own water supply from abundant springs in the mountains (*uma marka* in Aymara means 'land of water').

Umamarkeños are subsistence farmers, herders, and seasonal migrant workers. Selling *tuquru* bamboos when seasonally available is therefore a welcome additional source of income. The same is true for the other sourcing regions, where locals generally dedicate themselves to other economic activities and start trading musical bamboos opportunistically once they mature and lignify. Because of its periodic character, the musical bamboo trade is not usually a core aspect of people's livelihoods (although, for an exception, see below).

In Umamarka, we met the local *tuquru* collector Eduardo and one of his sons. Both had already collected and dried internodes on the forest floor. It was the first time that a Walateño flute maker visited them in Umamarka. Before the road was build, Eduardo took dried *tuquru* internodes by mule to Frutillani (approximately five hours walk by foot), where Walateño flute makers purchased and collected them. Ignacio inspected the dried *tuquru* tubes and stated that some of them already exhibited black stains of decomposition. They had been laid down horizontally on the moist ground of the *páramo* grassland, where they later began to go rotten (Figure 53). He further noticed that some internodes had been incorrectly cut, below the nodes rather than above them (see Figure 5). I often witnessed this same problem during subsequent trips to other sourcing regions. Eduardo, for example, stated that they must have been cut by his son, who does not yet know how to cut tubes correctly.

Figure 53: Drying of *Tuquru* on Moist *Páramo* Grassland (Source: Own Photo)

Umamarka (Arcopongo), Inquisivi Province, La Paz Department

Moreover, Ignacio realised that Eduardo and his son did not seem to let *tuquru* plants develop to the full adult stage as they had only collected tubes with smaller diameters of about one or two centimetres. These are the standard sizes used for making souvenir *qina* or *pinkillu* flutes in most tourist flute-making contexts. This is a good example of how the shifting landscapes of the flute-making culture/economy on the highlands have impacted on bamboo-sourcing practices in the *yungas* lowlands. However, for crafting larger sizes of *musiñu* flutes, called *eraso* and *saliwa* in Aymara, Ignacio uses longer *tuquru* tubes with larger diameters of about four or five centimetres. Before we returned to Baja Minas, Ignacio briefly instructed Eduardo in how he wants tubes to be collected and dried and left an advance payment for the next collection round.

Commodification and the Fate of Extractivism

These are just two out of many examples where bamboo collection is nowadays undertaken inappropriately by recently-involved locals. As mentioned above, this is mainly linked to a lack of knowledge about musical bamboo ecology and appropriate gathering practices. Notwithstanding, and regardless of questions surrounding knowledge transmission, current bamboo traders, both Yungueño locals and Walata Chico highlanders, further embody a quite different economic logic of bamboo gathering. Under a logic of resource provisioning, Walateño flute makers, in former times, usually tended to regard musical bamboos as valuable natural materials for their own flute-making practices (although they also sometimes collected them in unstainable ways in contexts of resource dilemmas). In contrast, today's non-flute making traders primarily consider musical bamboos as commodities, that is objects of trade on urban musical bamboo markets. For example, organised groups of highland bamboo traders from Walata Chico spend months travelling to distinct sourcing regions to collect musical bamboos in large numbers. During the period of my research, Walata Chico *chhalleros* frequently travelled to Alto Beni and Bermejo. Antonio once told me that every second or third month up to 300 *qhiwi* of *chhalla* bamboo were traded in metropolitan La Paz by different musical bamboo traders. With a regular *qhiwi* price of about 300 Bolivianos (~30 GBP), this makes almost 100,000 Bolivianos (~10,000 GBP) in total.

Furthermore, this suggests that Walata Chico traders travel all year around, although many stated during our conversations that they travel more frequently over the dry season (ay. *awti pacha*). Agricultural tasks are much more frequent over the rainy season (ay. *jallu pacha*), which does not allow longer absences from their Altiplano community of origin. Also, heavy rains soften extremely dry soils on the eastern Andean slopes, which frequently produces landslides. Thus, continuous rainfall between November and April is a major obstacle to safe travels along narrow *yungas* dirt roads. In any case, if traded in large numbers, musical bamboos (more *chhalla* than *tuquru*) can provide a considerable economic income, which often outweighs the dangers and efforts of bamboo sourcing and travelling. Since musical bamboo internodes are sold per unit, local collectors and highland traders often clear cut clumps, even if culms are immature.

According to many makers, the arrival of immature culms and tubes in La Paz and El Alto has significantly increased over the last decades. Beside the fact that material loss in the city is extreme (see Chapter Four), the ecological consequences of this intensive extractivist collecting over the long term are well known: the loss of musical bamboos' reproduction capacity, their eventual extinctions at population level, and irrevocable disappearances from former viable habitats. However, this should not be interpreted as an accusation directed solely at profit-maximising musical bamboo traders. In fact, the root cause for these shifting modes of musical bamboo trade with all the devastating ecological consequences for the viability of bamboo populations in preferred sourcing regions can also be identified in the changing economic structure of flute making on the highlands itself. Walateño flute makers are mostly aware of these current dynamics in sourcing regions. They accept them since they have become dependent on external bamboo traders to provision their own labour-intensive mass production of extremely cheap souvenir flutes without musical purpose. This includes making use of immature tubes which they can often buy more cheaply than mature ones (see Chapter Four). Thus, they indirectly incentivise and support the extractivist and environmentally unsustainable practices of local bamboo collectors.

Over the past few decades, makers' dependence on musical bamboo traders gave rise to competition among Walateño flute makers over trade relationships and alliances, especially with highland bamboo traders from Walata Chico. Walateño flute makers developed protection mechanisms via ceremonial forms of clientelisation (shared meals, collectively passing offerings for prosperous negotiations) creating mutual social obligations. In fact, this situation has the potential to motivate conflict and increase social division among makers, although a strong social organisation is actually needed in order to confront the drivers of unsustainability. I have experienced this tension myself, as explained in Chapter Three.

Only very few makers, mostly those in the autochthonous and professional flute-making contexts, occasionally instruct locals how to properly collect and dry musical bamboos; and further reject immature tubes, which, at best, produces indirect learning processes. However, the problem lies deeper and is rooted in the current economic logic of both highland flute makers and musical bamboo traders. In the context of the general extractive and (neo)developmental economy of Bolivia, ecologically destructive modes of natural resource extraction have not stopped at the musical bamboo trade, which has had devastating ecological consequences for musical bamboo populations in recognised sourcing regions. These new forms of musical bamboo trade furthermore contain an extremely negative and socially irresponsible component.

Middleman Trading and System of Exploitation

In the process of redefining the musical bamboo trade over the last two decades, the middleman has become to play an extremely ambiguous role. In some sourcing regions, locals are hired to collect musical bamboos. Highland bamboo traders from Walata Chico often act in those cases as middlemen between Walateño flute makers in the city and local bamboo collectors in sourcing regions. As middlemen, they cheaply buy bamboo resources from bamboo collecting locals, bring them to the city, and resell them at a higher price to Walateño flute makers.

In some cases, economic intermediation processes assume trade asymmetries, unequal exchanges, and power-laden forms of exploitation of both local population and natural resources. This becomes especially visible in one particular *chhalla* bamboo-sourcing region, the agriculturally dominated and former colonisation area of Alto Beni. The pre-Andean tropical forests and *chhalla* bamboo populations (*lluq'a* and *qipu*) of Alto Beni are much more easily accessible than the steep topographies of the Zongo valley or Inquisivi *yungas*. This is furthermore linked to better road infrastructure and the many human settlements in the region. However, this is a mixed blessing. Deforestation and the conversion of tropical forests into agricultural lands is so extreme that *chhalla* habitats have been continuously destroyed for quite some time now (see Chapter Five).

Over the second half of nineteenth century, the exploitation of cinchona trees, whose bark was used to make quinine, had played a central economic role in Alto Beni (Pérez, 1998). Since the mid-20th century, Altiplano *colonos* ('colonists/colonisers') settled in the region and started to heavily extract old-growth timber trees and highly-prized woods like mahogany (*Swietenia macrophylla*, *Cedrela odorata*) or criollo oak (*Amburana cearensis*). Through a local system of debt peonage known as *habilito* (from the Spanish word *habilitar* meaning 'to enable'), Mosetén labour was exploited for logging trees on their own territory (Ricco Quiroga, 2010; Sturtevant, 2016; see also Hachmeyer, 2016).

Sturtevant (2016) details how these debt peonage systems of recruiting cheap labour thrive in remote locations which do not have sufficient population to develop a conventional labour market and generally involves the exchange of manufactured goods and subsistence rations at inflated prices. Mosetén people gained easy access to cash and market goods but were bound to obligations to repay everything, with interest added. Their only goods were natural resources, such as timber, from which Andean *colonos* made further profit. Once all trees had been exploited for timber, Andean settlers began to turn old-growth forests into intensively worked agricultural lands under a fire-fallow cultivation logic.

The term *colono* has a genuinely negative connotation. The children and grandchildren of former Andean colonists, born in Alto Beni, are now rather seen to belong to the land. The term employed today for such people, 'interculturals' (sp. *interculturales*), which refers to this aspect of an intercultural identity between highland and lowland places, is a more value-free term that reflects these population dynamics. While Mosetén people live in their Indigenous territory, the 2001 recognised 'Communitarian Lands of Origin' (sp. *Tierras Comunitarias de Origen* or simply TCO), intercultural settlers mainly reside in and around Palos Blancos and Inicua.

In the intercultural community of Boopi, close to San Antonio in front of Palos Blancos, Jesika and I met an intercultural local called Eber. Eber, who is the grandson of a former Quechua settler from Potosí on the southern Altiplano, is not trading musical bamboos although *chhalla* clumps grow on his private land (sp. *lote*). Instead, he has commercial fruit and cacao plantations which actually produce higher and continuous revenues all the year around. Eber's example contrasts to a certain degree with the wide-spread image of the Andean colonist, who would genuinely "employ a market-based economic logic that treats land and other resources as commodities" (Sturtevant, 2016, p. 87). While it is true that he has commercial cacao and fruit plantations with which he makes his living, on the other hand he does not allow highland bamboo traders to collect *chhalla* bamboos on his *lote* because "they would extract everything"[164]. His *lote* is also one of the last places in Alto Beni, where precious timber trees like *huasicucho* (*Centrolobium ochroxylum*) still grow in preserved primary forests. He even told us about his intimate relationships with a jaguar mother and her two kittens struggling to survive in the highly degraded Alto Beni forests. "Others would have already killed them, but I made friends with them."[165]

Knowing the legacy of the debt peonage system in relation to the timber trade mentioned above, I was interested to learn local Mosetén people's view

[164] "Ellos sacarían todo."

[165] "Otros ya los hubieran matado, pero nosotros nos hemos hecho amigos."

of, and involvement in, *chhalla* bamboo collecting in the region. Jesika and I had already visited many Mosetén communities on their recognised Indigenous territory known as TCO Mosetén a few years earlier. Thus, travelling again to Mosetén communities meant reencountering friends and acquaintances. We headed towards Santa Ana de Mosetén, where we met Don Dario, a Mosetén elder in his 70s. Talking in his backyard about highland *chhalla* bamboo traders, he said that:

> They extract everything and do not leave behind a single plant. These *colonos* and *colla* people extract all our natural resources. They have deforested everything here. In former times, we had *sikudyei´* [Mosetén for 'land/terrain populated by panpipe bamboo'] here close to Santa Ana, but today you have to go far away, towards Inicua Bajo, Playa Verde, and Muchanes, and deep into the forest.[166]

One must understand this, somehow justified, anger in the context of his life experiences as a Mosetén elder, who had witnessed the deforestation of his territory, due to the timber trade, during the second half of the twentieth century. He was hugely critical of the Andean colonisation process and of the way some Andean settlers, for him genuine *colonos*, treated his land with an Andean logic of work, which was at odds with Mosetén lifeworlds and the economic logic of substantivism in the Mosetén "original affluent society" (Sahlins, 1972; see also Sturtevant, 2016). The system of *habilito* had developed in the region when, after exploiting nearby forests, Andean colonists realised that the only remaining trees to exploit for timber were on Mosetén territory. Thus, they developed a way to take advantage of

---

[166] "Ellos sacan todo y no dejan ni una sola planta. Estos colonos y la gente colla sacan todos nuestros recursos naturales. Han deforestado todo aquí. Antes, sikudyei´ había aquí cerca de Santa Ana, pero ahora tienes que ir lejos, hacia Inicua Bajo, Playa Verde y Muchanes, y dentro del bosque."

Moseténes by involving them in logging work on their own territory. The same process seems to have repeated itself in the musical bamboo trade.

Around intercultural communities (like San Antonio, Boopi or Puerto Carmen) on the west side of the Beni river, where *lluq'a chhalla* bamboos are sourced, old-growth forests have largely been cut down and burned as part of the slash-and-burn agriculture. Intercultural settlers prepare the forest by cutting down undergrowth (slash), which they leave to dry for several weeks. They often do not allow *chhalla* bamboo collecting, as they use the dried *chhalla* culms as part of the slash (Figure 57), which they later burn to produce the swidden with nutrient-rich layers of ash, making the soil temporarily fertile.

Figure 54: Slash with Dried-Up *Chhalla* Culms (Source: Own Photo)

Tucupi, Alto Beni, La Paz Department

I have once experienced such a forest fire in Alto Beni, which rapidly spread and developed huge fountains of fire of about 15 metres high, reaching over the tree-tops of the pre-Andean Amazonian forest. In August, approximately at the middle of the dry season, many La Paz inhabitants argue that the dense dust over the *chukiyawu* valley of La Paz city was a consequence of these forest fires in Alto Beni and the *yungas*, although I believe that it is also air pollution (particular matter) by vehicles with internal combustion engine (see Aldunate et al., 2006, p. 423). Having seen this in Alto Beni myself, I was reminded of one of my first conversations with Nicasio (see Chapter One), who stated that musical bamboos are cut down and burned as if they were weeds. This comment must have referred to these agricultural practices. In fact, *chhalla* is used as a natural fire accelerant.

Nowadays, the most abundant areas of *chhalla* bamboo are on remote Mosetén territory, in this case the south-eastern Covendo part of the TCO Mosetén around San José or Concepción. We talked to several locals in San José and I was shown abundant *lluq'a chhalla* populations close to the community by a middle-aged man, our friend, Sirilo. He talked with us about highland *chhalla* bamboo traders and in some cases denounced the same system of unequal exchanges and insidious exploitations experienced within the timber trade.

One case I heard about is especially perfidious. An intercultural *chhalla* trader from Palos Blancos once visited San José and made a deal with several young and middle-aged Mosetén. The *chhallero* paid money in advance and gave them manufactured goods including his motorcycle and new machetes for collecting. He 'enabled' (sp. *habilitar*) them and created social obligations and debts, while asking to be repaid in *chhalla* bamboos. He not only inflated the prices for his bestowed goods, but also depressed the prices for collected *chhalla* bamboos, as the Moseténes did not know anything about their monetary value in the city.

Sergio further told me that although suspicious of such treatment, they were confronted with a situation of powerlessness. Firstly, highland bamboo traders and/or local interculturals (with an Andean background) have contacts to musical bamboo purchasers in the city. And since they are usually given money in advance by Walateño flute makers (usual *adelanto*), they further have – unlike locals such as the Moseténes – the economic possibility to 'move' (sp. *moverse*), for example being able to invest in transporting bamboos to the city (e.g., renting a truck or lorry), or eventually 'enable' locals to collect musical bamboos for them.

In the sourcing sites of *qipu chhalla* bamboo on the eastern banks of the Beni river, towards Inicua Bajo and the north-western part of the TCO Mosetén, we can observe similar trends. Old-growth forests on intercultural *lotes* are exploited and continuously turned into agricultural lands. Highland bamboo traders from Walata Chico have already made inroads into more remote Mosetén territory. These developments promise conflictual potential in this part of the TCO Mosetén as well.

Rafael, the local *chhallero* introduced earlier on in this chapter, said that he prefers to source *chhalla* on intercultural *lotes* in order to avoid conflicts with Moseténes. Once he said to me that "we simply understand each other better, culturally."[167] Rafael originally comes from Cajuata in the Inquisivi *yungas*, where he formerly sourced 'Quime' *chhalla* bamboos in recurring collection seasons. He is one of the few musical bamboo collectors I met who is actually making his living to a large degree by trading *chhalla* bamboos. He described himself as a *chhallero* as if it was even his profession. He once

[167] "Simplemente nos entendemos mejor, culturalmente."

said that “I moved to Alto Beni because of my job”[168]. He linked this to the existence of two distinct *chhalla* species with relatively short and time-staggered life cycles (i.e. when the *lluq'a chhalla* dies, the *qipu chhalla* reaches maturity, and vice versa). This indeed provides constant working opportunities for a ‘professional’ *chhallero*.

Rafael usually works more frequently during the dry season, and only opportunistically over the rainy season, when weather allows for it. He said that *chhalla* bamboos regenerate over the rainy season and more care must be taken during collection. Additionally, *chhalla* bamboos would be more infested by insects, fungi, and borers, which is scientifically linked to higher starch (sugar) contents over the rainy season (Dransfield & Widjaja, 1995). In fact, his low-invasive and selective modes of *chhalla* collection introduced above must also be linked to his livelihood strategy. He would never clear cut *chhalla* clumps, as these are the material basis for his future economic wellbeing. Instead, he interprets the rapid expansion of the agricultural frontier and the destruction of *chhalla* habitats in Alto Beni as a major threat to his work. He is already in constant search of new *chhalla* populations, since year after year known sourcing sites are burned down.

Before Rafael agreed to take me on his collection trips, he instructed me that I should never talk with anybody about the monetary value of traded *chhalla* bamboos in the city. On the occasion when I accompanied him, Rafael offered the intercultural landowner help harvesting fruit on his plantations as compensation for permission to collect bamboo. Whether this was an unequal exchange surely depends on the hours he finally worked on

[168] “Me he movido aquí (Alto Beni) por mi trabajo.”

the fruit plantations. But for me Rafael's strategy was very clear. This example shows how a local intercultural bamboo trader does not hesitate to treat an intercultural with the same strategy with which Moseténes are treated. In a way, this is not very dissimilar either to what formerly self-collecting Walateño flute makers did. Remember their open barter efforts mentioned at the beginning of this chapter, which can easily be interpreted – and they were by some locals in sourcing regions – as a subtle form of deceit. I am therefore unsure how much Walateño flute makers are actually aware of the way their *adelanto* is being invested into 'enabling' locals to collect musical bamboos under circumstances of unequal exchange (not only in Alto Beni but also in other primary sourcing regions).

Discussion: Ecological Limits and Economic Decisions

This chapter has shown two things. Firstly, musical bamboo shortages in the city are to a certain degree natural and recur depending on the specific life cycles of monocarpic woody bamboos growing in their natural habitats. This ecological framing of flute-making activities through temporarily staggered musical bamboo scarcity periods has always been a reality for Walateño flute makers, who have adapted to it with practices of hoarding mature bamboo tubes in order to bridge scarcity periods. The impressive diversification evident in the use of distinct musical bamboo species, with temporarily staggered life cycles, is also linked to musical bamboo ecology-induced recurring scarcity periods. In relation to my analytical framework of sustainability, these aspects show that flute-making practices are ecologically embedded, and that the ecology of musical bamboos is key for understanding bamboo scarcity cycles in a more general way. Against this background, urban musical values have introduced material preferences and caused dependencies on certain monocarpic woody bamboo species with life cycles of different lengths. This is the case for thinner-walled ‘Zongo’ or ‘Quime’ *chhalla* bamboos, among others. In other words, musical appreciation – a factor within the cultural or aesthetical realm of sustainability – has caused new vulnerabilities to scarcities and also further triggered resource dilemmas and unsustainable sourcing practices, as argued in this chapter. In tourist flute-making contexts, neither material preferences nor bamboo quality standards are established. This links to the second conclusion.

New commercialisation strategies of highland flute makers in the light of shifting markets have engendered new forms of musical bamboo trade with negative ecological consequences. Inappropriate and extractivist modes of collection, of simply overexploitations, have caused extinctions of musical bamboos at population level in recognised sourcing regions. On the one hand, this is linked to social or resource dilemmas, economic pressures, and shifting economic logics for bamboo gathering. On the other, it reflects a rupture in local knowledge transmission of appropriate bamboo-gathering practices highlighting the importance of ecological knowledge for bamboo sustainability. Furthermore, the musical bamboo trade often involves unequal exchanges with local people in sourcing regions, who – as we have heard – have clearly expressed their opposition to these forms of exploitation. Locals, therefore, have started to collect and sell bamboos themselves. However, in Alto Beni, where there is historical precedent for the exploitation of both Mosetén people and natural resources, the conflictive potential is extremely high, also because of the demographic composition of the region. In terms of the analytical framework of sustainability presented in Chapter One, this links to issues of social responsibility and social aspects of sustainability.

Interestingly, Harris (1995) presented several examples in the Andes where these intermediation processes and unequal exchanges have occurred between *mestizo* middlemen and locally producing peasants in rural Andean Indigenous communities. Thus, ethnicity is consolidated as an economic relation. In the context of the musical bamboo trade, however, either Aymara Andean settlers in lowland regions such as Alto Beni or highland bamboo traders from Walata Chico take over the role of middlemen. Whether they are considered ethnically as *mestizos* due to their economic activity, as Harris (1995) suggested, remains unclear. In many cases, however, Mosetén people viewed Andean settlers as strangers and genuine 'colonists' with a formalist and rational economic orientation of profit maximisation.

Economic intermediation of commodities through supply chains implies various trades at different stages/prices and is generally problematic from a social responsibility perspective. This is especially the case when supply and value chains are global, involving centre-periphery relationships and unequal exchanges in a capitalist world-system (Ricci, 2019; see also Amin, 1976; Emmanuel, 1972). Bunker (1985) perfectly shows this with his example from the Brazilian Amazon, where extractive economies have been degrading natural-physical and human-social environments since the sixteenth century.

In the case of the Alto Beni region of Bolivia, unequal exchanges are not only present in the trade of musical bamboos, but also for natural resources such as fruits which are bought much more cheaply from the producer than they are finally sold to the consumer in the city. Transport is often mentioned as an important factor behind this price differential. However, from the plantation owner to the end consumer, they often pass through the hands of several intermediaries, increasing prices and making profit for each. These economic relations, which are more or less transparent, are fundamentally social. The underlying question is where these links in the chain are mutually beneficial and where they are exploitative.

Thriving systems of debt peonage, like *habilito* and the extractivist exploitations of natural resources in Alto Beni or the entire Bolivian lowlands, may be seen as failures of the modern state (see Bunker, 1985). In fact, what is needed is a broad discussion involving all principal stakeholders about the importance of social responsibility within these trading mechanisms. In the case of the musical bamboo trade, this would include musicians, Walateño flute makers, highland musical bamboo traders, and *yungas* or other lowland community members being involved in musical bamboo collection and trade. Rearticulating intimate direct links between Walateño flute makers and *yungas* locals through ecological complementarities is central in this regard. I will come back to these points in the final concluding chapter.

Chapter 7

The Broader Context of Sustainability

Summary and Outlook

As the previous chapters have shown, exploring sustainability issues in highland flute making and musical bamboo sourcing in the Bolivian Andes turned out to be a very complex issue. This complexity is mainly linked to, among others, the diversity of musical bamboos used in highland flute making, the different ecological and environmental issues surrounding particular species, the myriad of local contexts through which these various musical bamboo types are sourced, and the heterogeneity of involved actors with often divergent interests. Furthermore, many flute makers were generally reserved about collaborating in research about musical bamboo sustainability, an obstacle in many ways, as explained in this thesis. In this concluding chapter, I summarise the main findings of the thesis and attempt to outline the broader context of sustainability in flute making and musical bamboo use/sourcing in the Bolivian Andes.

The summary and outlook presented in this conclusion result from the use of an interdisciplinary mixed methods approach, which combined qualitative and quantitative methods in order to produce a more nuanced understanding of flute making, natural resources, and sustainability in the Bolivian Andes. Better understanding the complexity of the topic is needed when looking at the implications for possible practical interventions in the future. In this final chapter, in a first step, I analyse the main empirical findings against the background of the analytical framework of sustainability presented in Chapter

One. Then, I explore the wider contributions of this thesis focussing on different audiences. Closing the chapter, I explore prospects and outline some practical future-oriented perspectives, considering the possibilities and limitations of particular measures as regards confronting some of the issues raised in this thesis.

Synthesising Factors of Sustainability: Making Sense of Complexity

Summing up the chapters in this thesis, one can arrive at the conclusion that the question of sustainability in flute making as it relates to the use of natural resources (i.e. musical bamboos) is a complex, divergent, or "wicked" problem. Following Rittel and Webber (1973), this refers to problems for which it is difficult to define optimal solutions because of, among others, divergent knowledge bases, diverse short-term interests conflicting with long-term benefits, and ambiguous boundaries that prevent a universally agreed problem formulation (see also Balint et al., 2011; Duckett et al., 2016; Head et al., 2016).

Although I presupposed at the beginning of my fieldwork that questions surrounding the sustainability in musical bamboo use/sourcing were of particular relevance for Walateño flute makers, I would argue now that the perception of the problem among Walateño flute makers was rather diverse, with some makers identifying the current situation as commonplace and unexceptional. On the one hand, this links to the fact that some urban-dwelling Walateño flute makers identified the intermediation of musical bamboos as beneficial compared to undertaking exhausting travels to source bamboo themselves in former times. Some also benefit economically from seasonal shortages since they can easily raise prices under a discourse of scarcity. On the other hand, many makers regarded scarcities as a natural, bamboo ecology-induced phenomenon, recurring in more or less stable and known intervals of several years depending on the musical bamboo species. This well exemplifies how flute making is ecologically framed. In other words, flute making as a cultural and economic practice is somehow embedded or nested in the natural environment.

As I have shown in Chapter Four, because of these different perceptions of the problem, ideas about scarcities are very divergent too. In fact, the idea of scarcity is highly relational, and much depends on the spheres of flute making in which flute makers presently situate themselves. While autochthonous flute makers with relatively low bamboo demands tended to argue that there is no scarcity as such, professional and souvenir flute makers often experienced moments of shortages as their higher bamboo demand often superseded urban supply. Thus, scarcities emerge as a relation between bamboo demands and the number of musical bamboos traded in a particular moment of time. The former depends on the network of costumers and orders, while the latter is primarily determined by the maturation cycles of different musical bamboo species (phenology), and furthermore by functioning trade networks with bamboo collecting locals and highland traders. Thanks to the diversification of different musical bamboo species used, contemporary non-self-collecting Walateño flute makers can count on a relatively stable urban supply of musical bamboos in short time intervals; on the condition that musical bamboo trading and collection practices are not abandoned (which relates to economic and social factors such as precarity and harmonious trade relationships) and musical bamboo viability is secured (which links to unsustainable sourcing practices as well as broader environmental concerns about deforestation and habitat destruction in some cases).

In fact, makers very much adapted their flute-making activities to these recurring, bamboo phenology-induced availability cycles, developing highly specialised ecological knowledge about different tropical woody bamboo species, thereby bridging long maturity cycles. However, when musicultural norms came to determine the use of a particular musical bamboo species in specific contexts (musical appreciation), then makers and musicians were confronted with the relatively long bamboo life cycle and its monocarpism. This is, for example, the case for professional panpipe making and the highly sought after thin-walled 'Zongo' *chhalla* bamboo. Relating this to the analytical framework of sustainability, the cultural or aesthetic realm has engendered in this case a material preference that has caused new vulnerabilities to natural bamboo scarcities and increased environmental pressure on recognised bamboo populations, particularly in the Zongo valley. With regard to the latter, one might say that the musical appreciation of thin-walled *chhalla* bamboo determines concrete economic actions and therefore mediates the appropriation of bamboo resources within the professional panpipe-making sphere.

Besides the basic tensional relation between flute makers' bamboo demands and the availability of musical bamboos on urban markets, which is in turn determined by bamboo growth cycles and functioning trade networks, flute makers began to realise over recent decades that musical bamboo plants had disappeared from formerly viable habitats. In former times, this was linked to resource dilemmas of formerly self-collecting Walateño flute makers, which caused overexploitation in the context of unorganised sourcing and collection practices. This is a social dilemma and therefore relates to the social factors of sustainability. Makers often preferred their individual short-term self-interest and collected musical bamboos in an unsustainable way, at odds with the reproduction capacity of bamboos. Current overexploitation, during which even immature bamboos are collected, is rather linked to new forms of musical bamboo trade, where profit-oriented traders and collectors began to regard musical bamboos as commodities rather than as valuable natural resources for making a variety of Andean flutes. Here, again, this must be related to social aspects of unsustainable bamboo sourcing practices, such as the organisation and division of labour between flute making and bamboo sourcing and the emergence of middleman trading.

These newly-involved lowlanders often lack ecological gathering knowledge that especially elderly Walateño flute makers have possessed. This knowledge is on the verge of being forgotten, while the consequences will only be felt in the near future, with more musical bamboos becoming extinct at population level, thus disappearing from former habitats. Invoking once more the analytical framework of sustainability, musical bamboo use and sourcing/collection in particular is thus culturally shaped. The loss of this ecological knowledge for more sustainable bamboo sourcing practices therefore relates to cultural factors of sustainability.

A particularly controversial aspect of musical bamboo sourcing is the question of unequal economic exchanges between involved actors. This formerly included self-collecting flute makers and *yungas* lowlanders, where a complex relationship between maker profit margins and lowlanders' value calculations about different traded goods was at play. After becoming aware of the monetary value of musical bamboos on urban markets, these *yungas* lowlanders have increased their control over the trade of musical bamboos and have begun to negotiate prices with more confidence. However, unequal economic exchanges more directly appear nowadays in current times of middleman trading between highland intermediaries and lowland bamboo collectors. In some cases, these unequal exchanges may even include mechanism of overt exploitation of both lowlanders' labour and natural resources, as witnessed in the Alto Beni region. These are potentially sensitive topics relating to social responsibility that Walateño flute makers usually avoid talking about.

The new musical bamboo trade was also the result of shifting economic structures of the highland flute-making culture/economy itself and, in particular, the rise of tourism-oriented commerce. Paradoxically, the diversification of markets and the related attempts to secure monetary incomes also became fundamental for the survival of more traditional flute-making practices, although at the same time contributing to unsustainable bamboo use and sourcing practices. Walateño flute makers have often continued to craft autochthonous flutes while simultaneously meeting the demands of tourism markets. Without the possibility of generating a more stable income through tourism commerce, Walateño flute makers would have probably abandoned flute-making activities all together, including the more traditional ones.

In addition to all these factors, where flute makers, middlemen traders, and collectors are directly implicated, deforestation-induced habitat destruction of some musical bamboos has taken place in areas with high deforestation rates. Examples include the *yungas* of La Paz and the Andean-Amazonian foothills of Alto Beni, where certain *chhalla* bamboo variants grow ('Quime' or 'Alto

Beni'). *Tuquru* bamboo, by contrast, has been largely unaffected by deforestation-induced habitat destruction since their endemic distribution is restricted to the upper *páramo* forests with significantly less deforestation. Rather, some *tuquru* species are particularly affected by the aforementioned overexploitation. Although existing anthropic areas (lowland communities, road infrastructure, etc.) in bamboo-sourcing regions and geographic proximity to the city are seen as fundamental components for guaranteeing easier access to musical bamboo populations in *yungas* forests with steep topographies and dense vegetation, the expansion of deforestation and further changes in land-use in principal sourcing regions also represent a threat for the viability of musical bamboos, having the potential to further increase supply-induced scarcities. Interestingly, many parts of the *yungas* of La Paz already experience forest regenerations as deforested areas are left unexploited over time. In this regard, long-term studies about the role of musical bamboos in secondary ecological successions and shifting plant communities after (human) disturbances are desirable, in addition to more botanical and taxonomic work in Bolivia on the bamboo subfamily (*Bambusoideae*) in general.

I often had the impression that Walateño flute makers mentioned deforestation as a main cause for musical bamboo shortages in order to downplay their own responsibilities, thereby avoiding internal reflections regarding their own economic actions. However, as I have shown in this thesis, talking about musical bamboo shortages and sustainability in urban flute-making workshops requires a much more nuanced understanding of local environmental changes, musical bamboo ecology, and shifting musical bamboo sourcing. In practice, attributing musical bamboo scarcities in urban flute making workshops to either of these factors mentioned in this section is not always very straightforward. But the thesis also raises ethical questions concerning the continuation of highland flute making practices. The standpoint adopted is an ecological and environmental one: The future of cultural practices, their creative reproduction, or “constant recreation” (UNESCO, 2003) must necessarily depend on the sustainable use of natural resources. Where this is not the case, I advocate entering into discussions about the broader ecological and environmental context in which cultural practices are embedded and looking at the globalised unethical and growth-oriented social and economic structures in which cultural reproduction nowadays might take place. In the following section, and in relation to my literature review, problem stating, and lacuna descriptions presented in Chapter One, I discuss the wider contributions of this thesis and the different audiences it addresses.

Wider Contributions and Audiences

This thesis, which is based on interdisciplinary mixed methods research, makes various contributions to different academic and non-academic discussions, thereby addressing a variety of audiences. First and foremost, within the growing field of study called ecomusicology, it offers a new case study about woody bamboos used in musical instruments making, thus adding to the corpus of literature about other materials, particularly woods. Moreover, it develops theoretical and conceptual discussion about sustainability, by a) empirically applying one of the proposed frameworks of sustainability as an analytical lens (Allen, 2019), and by b) adding new perspectives and insights from critical social-ecological theory (e.g., coupled human-environment systems) to the debate. Finally, in relation to recent discussions about the need for more robust interdisciplinary mixed methods applications in ecomusicology, this thesis contributes to methodological progress in the field by providing a specific interdisciplinary mixed-methods framework for genuinely problem-based research. As I draw on and apply concepts from plant ecology (niche theory), human ecology (human-environment relationships), and conservation ecology/geography (species distributions modelling), I ultimately consolidate a more robust understanding within ecomusicology of ecology as the science of the interrelation between biotic and abiotic components of the environment.

Another contribution of this thesis is made within the broader discipline of botany. It develops certain botanical work on native woody bamboos in the Bolivian Andes and can therefore be considered a groundwork for further economic botanical research about the use and selection of native woody bamboos in highland flute making (similarly to what Bennett 2016 did concerning wood selection for guitars and other chordophones). On the one hand, it synthesises Walateño flute makers' knowledge about the use of different native woody bamboo types used in Andean flute making, something identified in this thesis as a specific limitation of botanists lacking interdisciplinary perspectives and ethnomusicological knowledge (see Chapter One and Two). On the other hand, it can be considered a specific study about the phenology of different native woody bamboos in the Andes (specifically those species used in Andean flute making).

Concerning the disciplines of phytogeography or botanical geography, this thesis has developed a systematic case study about the distribution of tropical native woody bamboos in Bolivia based on species distribution models and a spatial analysis with a geographic information system (GIS). Against the background of conservation efforts of geographers using GIS and computer mapping techniques (Convis, 2001), my study furthermore identifies potential hotspots of species richness in the Bolivian Andes, which could potentially be used for native woody bamboo conservation action in the future. In my species distribution modelling approach and mapping discussion, I draw on both scientific and local Indigenous knowledge and categorisations of bamboos, which allows me to engage in a discussion about knowledge hierarchies.

Another audience for this thesis is Andean music scholars in a broader sense, including ethnomusicologists and organologists. As outlined in Chapter One, there is a longstanding tradition in Andean music scholarship focussing on musical instruments and the music played with them in a myriad of local contexts. Against this background, this thesis responds to disciplinary lacunas regarding the origin of natural materials used in Andean flute making, flute makers' local classifications of both *chhalla* and *tuquru* bamboo types, and formerly relegated environmental and ecological issues surrounding their use and sourcing. With regard to the latter, this thesis has developed novel ethnographic accounts covering these urgent issues. On the one hand, drawing on theoretical implications of critical social-ecological theory, I have constructed a material-oriented ethnography aimed at studying bamboo use and material demand in urban flute-making workshops, thus further developing former materialist ethnographies that have sidestepped the use of natural materials. On the other hand, drawing on recent ecomusicological studies in human geography about guitar making and wood use (Gibson, 2019; Gibson & Warren, Forthcoming), I have traced the bamboo flute through a multi-sited ethnography all the way back to the cloud forest. This ethnographic account has further allowed me to engage in a discussion about central concepts in natural resource management such as resource dilemmas.

As a minor contribution to music archaeology of the Americas, this thesis describes certain implications of the use of native woody bamboos in pre-Hispanic music cultures on the Altiplano and provides important clues about the provenance of bamboo materials of pre-Hispanic bamboo-made panpipes from different archaeological sites on the highlands and related valleys. This was, however, more of a contextualising move in order to create the context for the actual case study, rather than a specific music archaeological study in its own right.

Finally, the specific research context and the description of the research process allowed me to develop a discussion about activist approaches in ethnomusicology in relation to Indigenous peoples' struggles, drawing on pioneering scholarship of Charles Hale (2001, 2006, 2008). Based on fieldwork experiences regarding the functioning of Aymara community factionalism, I engaged in a critical discussion about the dynamics and transformations of my own ethical standpoint during the research process in relation to a myriad of involved local actors. These dynamic changes not only highlighted the need of gaining prior detailed knowledge about any potential activist research situation but also paved the road for thinking about activist research endeavours going beyond the merely human realm, a novel approach to activist scholarship that may find resonance in various disciplines in times of the Anthropocene and overarching ecological and environmental crises.

Beyond these contributions to academic communities, debates, disciplines, and fields of study, my research, and this thesis in particular, has also aimed at raising awareness of the topic with all its complexities in Bolivian society (see also Hachmeyer, 2018). Surprisingly, very little is known among autochthonous and folklore musicians and advocates about the origin of the native woody bamboos used in Andean flute making, or about the life cycles of these flutes and how the ecology of bamboos fundamentally shapes Andean flute making, or what the other difficulties and (social, political, economic, environmental, and ethical) problems are in contemporary musical bamboo sourcing. I can also further imagine that this thesis – through systematising existing knowledge of Walateño elders – can be an interesting source of knowledge for new generations of Walateño flute makers, who became totally reliant on intermediaries and, to a certain degree, lack specific bamboo-related geographical, ecological, and gathering knowledge.

I sincerely hope that the implications of my study, which I outline in the final section of this thesis, will find resonance in different Bolivian communities, such as Andean flute musicians/advocates, autochthonous musical collectives, flute makers of any kind, bamboo traders and collectors, Indigenous musical activists, and state functionaries, in order to help understand the complexities at work and finding viable solutions to some issues raised in this thesis. For this sake, and in the rest of this chapters, I will give an outlook and a practical view towards the future closing the thesis.

Outlook and a Practical View Towards the Future

Deforestation is a national problem often with transnational drivers (Müller et al., 2014). The debilitated social organisation and internal struggles of Walateño flute makers have little influence on national agricultural policies, which often tend to incentivise deforestation and burning of tropical forests.

This can be contrasted with strong syndicalist organisations of Yungueño coca farmers, whose interests have been highly relevant to national politics, not least because Evo Morales himself was raised as a syndicalist spokesperson for coca producers in the tropics of Cochabamba.[169] Thus, the potential for Walateño flute makers to confront deforestation-induced musical bamboo habitat destruction is extremely limited. Flute makers would need a much stronger lobby in order to promote the ecosystem protection of musical bamboos. These protection claims of tropical forests containing musical bamboos could effectively be linked to the reproduction of musicultural practices of highland flute making.

That musical bamboos disappear from viable habitats is nowadays mainly linked to shifting musical bamboo trades. In the light of these new forms of trading musical bamboos as commodities, where inexperienced, profit-oriented lowlanders get involved, the ecological gathering knowledge of Walateño flute makers, especially elderly ones, is a valuable resource for more sustainable musical bamboo collection practices. Considering that musicultural practices and related knowledge of flute making now lack intergenerational transmission, cultural safeguarding is usually approached as a national-scale measure aimed at empowering Indigenous communities, contributing to knowledge transmission, and making flute-making practice safe for the future (possibly an aspect of cultural resilience and adaptive reorganisation).

[169] Nevertheless, there are outright conflicts between coca growers from Cochabamba and those from the *yungas* of La Paz, which were even more exacerbated at the moment when the Morales administration passed the new Coca Law in 2017 (Hachmeyer, 2017c).

However, in the current form, in which Walateño flute makers envision the reproduction of their flute-making practices as cultural intangible heritage (search for new sales markets, commercialisation opportunities, and protectionist economic measures), the idea of cultural safeguarding is probably not the best solution. My concern here links to the aspects of development, tourism, and commercialisation inherent in cultural heritage management (Bigenho & Stobart, Forthcoming; Bigenho et al., 2015, 2018; du Cros & McKercher, 2015; Hachmeyer, 2018a; Mújica, 2014c). These aspects have – until now at least – contributed to, if not produced in the first place, the current environmentally and ecologically unsustainable situation regarding musical bamboo use/trade/sourcing.

Everything finally boils down to the question of whether musical bamboos will continue to be the material basis for highland flute-making practices in the future. One can surely argue, as some representatives in the Bolivian Ministry of Cultures and Tourism did during informal conversations, that the cultural reproduction of highland flute-making practices does not depend solely on musical bamboos since the trend nowadays shows that other materials are gaining importance (for example woods or plastic). However, the use of these alternatives – if this is a valid term – also has environmental implications, which should not be ignored in cultural safeguarding projects.

Personally, I rather conclude that musical bamboos continue to be of fundamental importance in highland flute making, which would justify future actions towards more sustainable bamboo uses. They are essential parts of negotiating values and meanings attributed to different kinds of Andean music being played, both in Bolivian metropoles like La Paz and El Alto or in more rural areas. We are only beginning to understand the cosmological and ritual significance of musical bamboos in rural Andean Indigenous music making (Hachmeyer, 2018d; Hachmeyer & Stobart, 2019). Cultural safeguarding as an institutionalised form of cultural sustainability could possibly contribute to musical bamboo health, if it focused on both musicultural knowledge about flute making and ecological knowledge about musical bamboo gathering. It should be clear, however, that this is only a symptomatic treatment. Addressing underlying structural challenges – in the form of the economic vision of flute makers and the social organisation of flute making and bamboo sourcing – is perhaps the more difficult task.

In this regard, I once conversed with a friend of mine, who worked during the presidential terms of Evo Morales in the so-called 'Viceministry of Decolonisation', a subdepartment of the 2009 created Ministry of Cultures and Tourism[170], about national decolonisation policies in relation to Andean music. He explained that the Viceministry organised festivals and opened up other spaces, where autochthonous music groups (both rural and urban) had the chance to perform (which reminded me of MNR policies after the national revolution, see Chapter Two). He further outlined how strategies were being developed to professionalise autochthonous musicians in order to reach equal status with academy musicians.

Against this background, it is noteworthy that there are certain differences between rural and urban groups when it comes to musical practice, sometimes further engendering tensions and conflict between them. These include

[170] The Ministry of Cultures and Tourism was closed as I wrote up this thesis at the beginning of 2020 as a consequence of the coronavirus pandemic. This was argued to be necessary by the interim government that replaced the Morales administration after the 2019 post-election crisis. This Ministry was later shut down entirely by the same interim government in June for political reasons.

questions of authenticity in musical performances and sometimes authorship. Professionalising autochthonous musicians might make sense from an equality perspective in a modern society. However, it is rather at odds with the social significance of rural Indigenous music in the Andes, which was – and still is in some contexts – largely played in particular ritual and festive contexts and connected with enhancing community values and articulating human/non-human relationships. This does not necessary mean that urban groups do not involve some of these same principles either. In a more general way, I would say that there is a need for more detailed study of the dynamics (social, cultural, musical, political, etc.) surrounding autochthonous music performances in the city, the diversity of urban autochthonous music groups, and the tensions that exist between rural and urban autochthonous musical spaces.

All in all, everything depends on the aims of decolonisation and how it is defined. Concerning autochthonous music and flute making, I could perhaps mention some more critical and more concrete aspects beyond opening up spaces for autochthonous musical performances, for example the expansion of the western tonal system, the domination and supposed professionalism of standard equal temperament, or the way flute makers have internalised the craft knowledge they have inherited as subaltern and lacking value. Developing a profound debate or discussion about decolonising Andean music or the arts in general in contemporary Plurinational Bolivia, however, is not my aim here (for such a discussion, see Rozo, 2014). Rather, my point is that not a single decolonisation policy has been developed to date, addressing, for example, the current capitalist economic vision of flute makers and musical bamboo collectors, or the unsustainable social organisation of flute making and musical bamboo sourcing. Many ministerial functionaries I conversed with simply lacked concrete knowledge about Andean music, highland flute making, and musical bamboos. In this regard, this thesis, and the cultural-ecological work presented in it, can be very informative for ministerial functionaries in many productive ways.

Moreover, the Viceministry of Decolonisation has been generally critiqued for only producing decolonisation policies on the symbolic stage, for example, announcing the end of capitalism with a radically indigenised political language without really addressing concretely the material economic base of society, which continues to be grounded in extractivist economies and neo-developmentalist agendas (e.g., industrialisation of particular economic sectors like hydrocarbons and agroindustry) (Burman, 2020; Rivera C., 2014). As often argued by the then governing MAS party, such a transition from a capitalist to a post-capitalist society needs time, as structures are deeply engrained in minds, perceptions, and actions (on social, political, and economic levels, as well as in private and public spaces). However, the economic developments in the flute-making sector, at least since the turn of the millennium, have perfectly fitted the overall growth-oriented and extractivist economic vision of the Plurinational State of Bolivia.

Despite these critical aspects, the economic activity implicit in highland flute making is an important factor for guaranteeing the continuation and reproduction of these musical instrument making practices, since flute makers must obviously make their living with what they do (under continuously increasing consumer prices). If tourism now offers a more stable economic source, it is only understandable that Walateño flute makers have shifted their crafting focus towards this market niche. However, when shifting economic modes of flute making and bamboo sourcing become a threat to the viability of musical bamboo populations, then this, in turn, becomes problematic.

What is needed is a broader societal debate, where stakeholders (such as flute musicians, flute makers, musical bamboo collectors, and highland traders) come together and collectively discuss solutions. But motivations to deal with aspects surrounding the future of highland flute making and a more sustainable musical bamboo sourcing are often very limited.[171] In fact, questions surrounding the sustainability in musical bamboo use/sourcing were not the primary matter of concern for many Walateño flute makers I talked to, although they arguably have direct and concrete implications for the continuation of flute-making practices. Many middle-aged and elderly makers argued that they will be the last generation of Walateño flute makers. They even incentivise their offspring nowadays not to continue with their legacies since flute making would be too precarious as a career. There is no doubt that musical bamboo shortages further increase the economic precariousness of flute making, being an additional reason why dealing with the sustainability issues in flute making as it relates to musical bamboo use/sourcing is important.

Many Walateño flute makers asked me if commercial cultivation and plantations of musical bamboos could be a solution to enhance more sustainability in musical bamboo sourcing. In Chapter Six, I have already discussed the incentives of panpipe makers to buy land in Alto Beni in the 1980s. Another group recently proposed a similar initiative, envisioning state-

[171] My own attempts to organise such discussions were not always very successful. For example, for the round table discussion that I organised as part of the Annual Meeting of Ethnology in 2017 in MUSEF, it was very difficult to bring all stakeholders together.

owned bamboo plantations with a more sustainable management of clumps. However, as argued in Chapter Six, particular musical bamboo species have different ecological niches. This means a tremendous logistic effort to implement bamboo plantations in different sourcing regions. Moreover, musical bamboos are not profitable from an economic point of view, since harvest can only be undertaken periodically at very prolonged intervals. The ecological aspect of gregarious flowering and the collective death of monocarpic woody bamboos would be, in any case, a fundamental challenge for musical bamboo cultivation. All in all, the question that would arise would be how to politically justify public investments into state-run commercial musical bamboo plantations, as I doubt there would be broad societal acceptance.

Personally, I would argue in a more general way that central state measures could only be useful – if at all – when they aim at controlling deforestation in recognised sourcing regions. Protected areas already cover some parts of the tropical forests where musical bamboos grow. However, human intervention, that is musical bamboo collection, is usually forbidden if not explicitly implemented in the management plans. Thus, nowadays illegal collection activities in protected areas must pass over into forms of legal sustainable management.

In order to address unequal economic exchanges and the exploitation inherent in middleman trading, it is perhaps necessary to rearticulate and strengthen the links between highland flute makers and lowland musical bamboo collectors. This would stress ecological complementarities and equality between actors and reduce the potential for perceptions of injustice. However, this would possibly result in makers needing to raise the prices of their flutes in order to compensate for more costly bamboo materials, which in turn raises questions about consumer acceptance and the viability of markets. In any case, these rearticulated links would have to include constant forms of ecological knowledge transmissions of musical bamboo gathering from flute makers to musical bamboo collectors. At its best, this also further contributes to new human-bamboo relationships going beyond objectifying musical bamboos as commodities. Whether this finally includes aspects of recognising musical bamboos as valuable and renewable natural resources for highland flute making or even interspecific respect to musical bamboo plants as living beings on a more spiritual level (going beyond the notion of natural resources), is open for future debate.

I will close the thesis with an anecdote regarding the latter aspect. After having returned from one of my fieldwork trips to bamboo collection sites in Alto Beni, I suddenly experienced scary nightmares over several weeks and seemed to be haunted by illness caused by 'bad spirits' (ay. *ñanqha ajayu*). I went to see our confidential *amawt'a* Don Carlos in order to ask him what was happening to me. I told him that I had recently returned from a *chhalla* bamboo collection trip to Alto Beni and that we had resided and worked for several days in the pre-Andean Amazon forests collecting *chhalla* bamboos. He asked me if before collecting bamboos we had requested permission from the forest spirits by doing a *ch'alla* libation or giving some offerings such as selected coca leaves (ay. *k'intu*). I had to admit that we had not. Quickly interrupting, he asked: "What would you say if a stranger entered your house without requesting permission?"[172] He suggested that the source of my feeling

[172] "¿Qué dirías si un extraño entra a tu casa sin pedir permiso antes?"

ill might be related to this incident and prepared the burning of a ritual offering (sp. *mesa*) for the disrespectfully treated forest spirits. At that moment, I wondered how bamboo collection might look in the context of such respectful treatments of other living beings. Since this time, I always ask permission to enter forests and collect musical bamboos, not only to land-owing humans, but first and foremost to the real owners of the place.

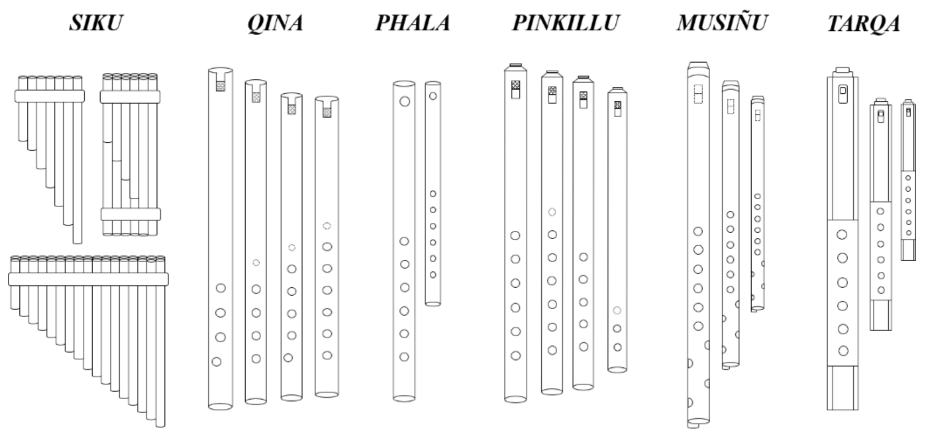
Appendices

Appendix 1 Classification Hornbostel-Sachs System

Contemporary bamboo-made flutes are edge-blown non-free aerophones (421). The flutes without duct (421.1) are divided into three generic types. *Qina* are individual open single end-blown (notched) flutes with fingerholes (421.111.12), *siku* are sets of end-blown flutes or open raft panpipes (421.112.11), and *phala* are single open side-blown flutes with fingerholes (421.121.12). *Pinkillu*, *musiñu*, and *tarqa* are single open flutes with internal duct and fingerholes (421.221.12).

Table A1.1: Main Flute Types of the Aymara Altiplano (Source: Own Elaboration)

Edge-Blown Non-Free Aerophones (421)			
Without duct (421.1)			With Duct (421.2)
End-Blown (421.11)		Side-Blown (421.12)	Internal Duct (421.22)
Set (421.112.)	Individual (421.111)	Single (421.121)	Single (421.221)
Open (421.112.1)	Open (421.111.1)	Open (421.121.1)	Open (421.221.1)
Raft (421.112.11)	Fingerholes (421.111.12)	Fingerholes (421.121.12)	Fingerholes (421.221.12)
SIKU	**QINA**	**PHALA**	**PINKILLU MUSIÑU TARQA**



Appendix 2 Diversity of Local Flute Variants

All tables containing local variants of generic flute types (*siku*, *qina*, *phala*, *pinkillu*, *musiñu*, *tarqa*) are based on Borras (1995). For more detailed organological information about these local flute variants, see Borras (1995).

<u>Selected Variants of *Siku* Raft Panpipes</u>

***Siku* Style**	**Mode**	**Tubes**	**Reg.**	**Texture**	**Longest Tube (mm)**	**Scale**
Suri	uniform	17	3	parallel octaves	209 309 615	(nearly) Equitonal
Huaylli	uniform	8	3	parallel octaves	147 285 570	Pentatonic
Mimula	uniform	10	3	parallel octaves	107 215 426	Pentatonic
Chokela	uniform	8	3	parallel octaves	132 265 530	Pentatonic
Llano	uniform	8	3	parallel octaves	115 228 456	Pentatonic
Chiriwano	complementary	3-4	3	parallel octaves	112 220 440	Anhemitonic pentatonic
Kantu	complementary	6-7	6	parallel fifths, octaves	128 172 255 342 510 675	E/A or E/B Major
Huayruru	complementary	6-7	3	parallel octaves	172 343 690	E Major
Pri. Taquiña	complementary	6-7	3	parallel octaves	153 303 604	F# Major
Seg. Taquiña	complementary	6-7	4	parallel octaves	143 285 570 1140	G Major
Ter. Taquiña	complementary	6-7	4	parallel octaves	131 258 510	A Major
Villa Potosi	complementary	6-7	3	parallel octaves	190 380	D Major

					750	
Pandillero	complementary	6-7	3	parallel octaves	112 225 445	B Major
Once-Doce	complementary	11-12	4	parallel octaves	212 425 850 1700	G Major
Chiriwano	complementary	7-8	3	parallel octaves	208 418 835	Eb Major
Inka	complementary	7-8	3	parallel octaves	157 315 630	Ab Major
Lakita	complementary	7-8	4	parallel octaves	71 152 305 610	F# Major
Jach'a Siku	complementary	7-8	4	parallel octaves	178 347 690 1380	G Major

Selected Variants of *Qina* Notched Flutes

***Qina* Style**	**Holes**	**Sizes**	**Lengths mm**	**Diameters mm**
Inka	5 + 1	1	333	21
Kena Kena	6 + 1	2	500 330	27 22
Chokela	6 + 1	1	452	28
Chichilay Chokela	5 + 1	2	506 338	27 22
Chatripuli	6 + 1	1	438	25
Pusi P'iya Santiago de Llallagua	4	2	714 478	28 24
Pusi P'iya Wila Rojo	4	2	860 600	30 25
Kena Mollo Grande	6 + 1	2	615 420	30 22
Kena Mollo Mediano	6 + 1	2	570 380	30 22
Llano Collana	6 + 1	2	590 400	30 23
Llano Colquencha	6 + 1	2	565 395	30 23
Aywaya	4 + 1	3	671 447 300	30 27 22
Koana	5	2	630 405	30 25

Selected Variants of *Phala* Transverse Flutes

Phala Style	Holes	Sizes	Lengths (mm)	Diameters (mm)
Phala	6	3	640 440 305	28 25 22
Auki-Auki	6	2	520 330	29 24
Chunchus	6	2	435 350	30 27

Selected Variants of *Pinkillu* Duct/Fipple Flutes

Pinkillu Style	Holes	Sizes	Lengths (mm)	Diameters (mm)
Waka Pinkillu	3	1	435	27
Pakochi	3	2	520	25
Paceño	5	2	445 290	25 17
Waycheño	5	1	475	30
Komancheño	5	2	516 320	30 25
Koyko	6	2	545 365	28 22
Montonero	6 + 1	1	485	27
Portun	6	2	660 432	30 25
Alma Pinkillu	6	3	670 443 295	33 26 20
Wairu	6	1	537	30
Aguinaldo	6	1	550	32
Phuna	6	1	400	30

Selected Variants of *Tarqa* Duct/Fipple Flutes

Tarqa Style	Fingerholes	Sizes	Lengths (mm)
Tropa Ullara	6	3	486 322 237
Tropa Kurawara	6	3	535 352 250
Tropa Salinas	6	3	590 393 260
Tropa Potosina	6	3	648 427 280

Selected Variants of *Musiñu* Duct/Fipple Flutes

Musiñu Style	Fingerholes	Sizes	Lengths mm
Tropa 70 "Challwiri"	6 (4 "falsos")	3 (+1)	(340) 500 680 1000
Tropa 75	6 (4 "falsos")	7	385 425 500 565 750 1120 1500
Tropa 80	6 (4 "falsos")	6	400 453 553 600 800 1175
Tropa 85	6 (4 "falsos")	3	636 850 1260
Tropa 85 "Doble Voces"	6 (4 "falsos")	6	510 580 637 850 1020 1260
Tropa 90	6 (4 "falsos")	4	680 900 1350 1800
Tropa 93	6 (4 "falsos")	5	465 620 930 1235 1580
Tropa 95 "Alonso"	6 (4 "falsos")	5	475 710 950 1040 1410

Appendix 3 Methodology of Species Distribution Modelling

Species-distribution modelling consists of the application of ecological niche theory to questions about the observed and potential spatial distributions of species (Peterson et al., 2011). Considering the important history of niche theory in ecology (Pocheville, 2015; Chase & Leibold, 2003), I firstly clarify a few theoretical concepts which lie at the conceptual base of my species distribution modelling of Bolivian tropical woody bamboos (*Bambuseae*).

According to British Ecologist George Evelyn Hutchinson (1957, 1978), the ecological niche can be defined as the set of environmental states in a multidimensional space within which a species is able to survive.[173] Among these multidimensional environmental states (Hutchinson's n-dimensional "hypervolume"), two types of variables are commonly distinguished. Firstly, linked or dependent variables, which are impacted by the species through consumption or modification, and secondly unlinked or independent variable, which by contrast have an impact on the species.

These different types of variables correspond to two traditions within ecological niche theory, which Peterson et al. (2011, p. 13) call "niche-as-requirements" versus "niche-as-impact". In accordance with the geographic meaning of niche, I will follow the "niche-as-requirements" tradition and focus on the unlinked, independent environmental, or as Hutchinson (1978) has termed them, scenopoetic ('setting the scene') variables (as opposed to the linked, dependent, and non-scenopoetic, so-called bionomic variables).

[173] Hutchinson (1957) further divided the niche into two subtypes, the fundamental niche, in which a species free of interactions could potentially use the full range of conditions and resources, and the realised niche or the subset of the fundamental niche which the species actually occupies as the result of interactions.

Scenopoetic variables, which are in most cases abiotic conditions, are useful for constructing a multidimensional environmental space of which ecological niches are subsets (Peterson et al., 2011). This niche concept is commonly referred to as the environmental or Grinnellian niche concept, which describes the suite of environmental conditions within which a species can maintain populations and which is commonly applied in species distribution models assuming that a species is in (quasi)equilibrium with its environmental requirements (Peterson et al., 2011; Franklin, 2010).[174]

The relations between environmental and geographic spaces are conceptually important for species distribution models. Environmental space is comprised of Hutchinson's scenopoetic or abiotic variables defining the environmental states, while geographic space, which Hutchinson (1957) called the "biotope", is composed of grid cells covering a particular region.

"Hutchinson's niche-biotope duality" describes the relation between environmental niches and corresponding geographic distributions (Colwell & Rangel, 2009). Particular environmental states can variously appear (or not at all) in different geographic regions, while one point in geographic space only corresponds to one point in environmental space, that is to certain environmental conditions.

This niche-distribution duality applies to a set of defined subniches (Elith & Franklin, 2017; Franklin, 2010): fundamental niche is the set of abiotic

[174] This is opposed to the Eltonian niche concept in the "niche-as-impact" tradition, which is mainly concerned with the impact of the species on its environment (related to linked and dependent variables, the trophic level, and ecological roles). For a comprehensive description of modern Eltonian niche theory, see Chase and Leibold (2003). Joseph Grinnellian (1917) and Charles Elton (1927), and later George Evelyn Hutchinson (1957), are nowadays considered the pioneers of modern niche theory.

conditions that allows persistence, free of interaction, defining the abiotically-suitable distributional area if mapped into geographic space; the potential distribution is the subset of a species' fundamental niche actually existing in the biotope at a given time, which often is not fully occupied; the realised niche is the physical expression of the fundamental niche, a subset of it, reduced by biotic interactions, dispersal limitations, and/or disturbances.

Most species distribution models are based on the generation of a statistical function that characterises the distribution of the species in terms of environmental variables or states (in environmental space) in order to indicate the degree to which each section in geographic space is suitable for the species. Although there is ongoing controversy in the field of species distribution modelling linking to the aforementioned traditions, I basically follow Franklin's (2010) understanding that most studies identify the description of the (Grinnellian) realised niche as the outcome of species-distribution modelling.

This is given because data on actual species occurrences are used, so that the model extrapolates in geographical space the conditions associated with species occurrence in environmental space.[175] Mapping this realised niche

[175] Soberón and Peterson (2005), and later Peterson et al (2011), have instead argued that species distribution models based on coarse scale scenopoetic variables describe the fundamental niche, and therefore only the abiotically suitable area. However, Franklin (2010, p. 38) states: "This concept is elaborated by Hirzel and Le Lay (2008) who noted that biotic interactions (competition, predation) tend to occur at short distances, and that dispersal limitations and fine-scale environmental heterogeneity allow inferior competitors to evade negative interactions by persisting in competitor-free locations. Thus, they conclude, the realized and fundamental niche may not differ that much in practice, especially when predicted from coarser-scale environmental factors such as climate."

described by the statistical model in geographical space represents the potential distribution or habitat suitability (Franklin, 2010).

My species-distribution modelling approach of Bolivian tropical woody bamboos (*Bambuseae*) and the main musical bamboos of *chhalla* and *tuquru* was basically guided by the comprehensive summaries of the emerging field presented by Peterson et al. (2011) and Franklin (2010). It was comprised of four phases (Table A3.1): 1) creation of datasets, 2) preparation for species distribution modelling, 3) modelling with Maxent and 4) post-processing of modelling outputs.

Phase I: Creation of Datasets

For my species distribution modelling of Bolivian tropical woody bamboos, I gained access to the grass family (*Poaceae*) database of the National Herbarium of La Paz (LPB). The LPB has the largest digital botanical database in Bolivia, where most botanical information of the country is gathered. I extracted the registers (442) for all known and reported tropical woody bamboo (*Bambuseae*) species mentioned in the Bolivian Catalogue for vascular plants (Jørgensen et al., 2014).[176] The assessment of digital data bases of smaller, more local herbariums in Bolivia (Santa Cruz, Cochabamba, and Sucre) did not produce any additional reliable woody bamboo species occurrence data. I therefore complemented the information from the LPB with available online information of the Missouri Botanical Garden (MO, Tropicos). Tropicos is the world’s largest botanical database, which also contains information of botanical specimens from Bolivia. This raw dataset contained 715 registers for 49 tropical woody bamboo species, representing

[176] Ongoing project. See: http://www.tropicos.org/Project/BC.

90% of all known and reported tropical woody bamboo species (53) described in Bolivia to date.

As part of the data cleaning phase, I eliminated all registers (132) without taxonomic identification at species level, because taxonomic inaccuracy and the use of unidentified specimens distort potential geographic distributions. Next, I eliminated all registers (102) without geographic coordinates, as I require georeferenced species locations for the occurrence records used in species distribution modelling. In some cases, for example if few occurrence data are available, it makes sense to assume geographic coordinates according to collectors' descriptions of sample locations (see Meneses et al., 2014). I did not opt for this method, as I found location descriptions in the LPB database sometimes very superficial and therefore unreliable. All geographic coordinates were transposed into decimal degrees with three decimal places.

It is possible that LPB and MO databases have the same entries, because LPB botanists have access to Tropicos and upload (to a certain degree) their reliable botanical information. Since I combined both sources for my first dataset (tropical woody bamboos), double registers appeared, which I consequentially eliminated (196). The identification of double registers was done by comparing the date, name, and number of collection.

With regard to the sample locations of the specimens in the dataset, a geographic space sampling bias towards more accessible areas (such as roads) is notable. This is not surprising considering the steep topographies and inaccessible areas of the eastern Andean slopes in Bolivia (also one of the main obstacle for musical bamboo sourcing, as I have shown in the thesis).

In their study about predicting species distribution in poorly studied landscapes, Hernández et al. (2008) consider 5-21 observed locations per species to be a small sample size. Pearson et al. (2007) argue that small samples of observed localities are constituted by less than 25 registers, while using species with only four registers as the absolute minimum. According to van Proosdij et al. (2016), the minimum number of records required to produce good model performance, i.e. the characterisation of how well a model achieves a particular goal related to prediction (Peterson et al., 2011), depends on the species' prevalence, i.e. the proportion of the study area covered by the species' distributional area. The prevalence is typically unknown (Merow et al., 2013), but Proosdij et al. (2016) show for a virtual study area and based on different relevance classes that the absolute minimum sample is three registers for narrow-ranged species. Following their study, I deleted all species (22) that had less than three registers of different georeferenced sample locations. In any case, my compiled dataset must be interpreted as a small sample size ranging between 3 and 23 registers per species, with no modelled species transcending 25 observed localities (Table A3.2).

Sparse presence information did not allow me in all cases to take into consideration a) reasonable timespan of collections (the great majority of registers collected before 2000) and b) taxonomic expert knowledge on tropical woody bamboo species identification. These are principle weak points in the data sampling design.[177] The final cleaned dataset used in the species distribution modelling contained 306 registers for 31 tropical woody

[177] With regard to the latter aspect, I only got to know one self-identifying expert in bamboos during my fieldwork. Local botanists in the LPB explained to me that they would choose their specialisations according to the probability of attracting external funds and projects, rather than through personal dedication (Beck, 2017, pers. comm.). Apparently, botanic research on bamboos in Bolivia plays a minor role compared to other research areas.

bamboo species, which is approximately 60% of all known and reported tropical woody bamboo species (53) in Bolivia (Table A3.2).

Given the general lack of taxonomic work in Bolivia on the bamboo subfamily, it was not possible to gather more reliable occurrence data of more tropical woody bamboo species. Nevertheless, the dataset retains a certain representability by analysing the configuration of missing species (22). Both species of *Bambusa* are adventitious and cultivated. They have been eliminated during the minimum register cleaning step (they would have been eliminated anyway as they are adventitious and cultivated species).

All species within the Andean montane bamboo genera of *Aulonemia*, *Arthrostylidium*, and *Chusquea* are endemic to the montane cloud forest ridge (Villavicencio et al., 2014). Consequentially, the missing species of these three genera (17) would not have made any big difference with regard to the overall tendency of the geographic distribution of these genera. The remaining missing species belong to the lowland tropical bamboo genus of *Guadua*, which in itself is well-represented in the analysis (75%).

The second dataset for my species distribution modelling of Bolivian musical bamboos (*chhalla*, *tuquru*) was created in the following manner. During my fieldwork at central musical bamboo sourcing sites, I collected botanical specimens of *chhalla* and *tuquru* bamboos and took geographic coordinates of their specific geographical locations in the *yungas* cloud forests with a standard GPS receiver. In some cases, the GPS receiver only received weak GPS signals due to steep topographies and the dense vegetation of the *yungas* cloud forests on the eastern slopes of the tropical Andes. These collected musical bamboo samples and the geographic coordinates built the base for my second dataset about musical bamboos, which I complemented with additional botanical information (*Rhipidocladum* and *Aulonemia* species) for those sourcing sites I have not visited myself (see also Chapter Five). Table A3.3 shows an overview of sample locations of both *chhalla* and *tuquru* bamboo, indicating own samples and additional botanical specimens. The second dataset contained 21 *chhalla* samples from main *chhalla* sourcing regions as well as 14 *tuquru* samples from main *tuquru* sourcing regions (compare Figures 32 and 33 in Chapter Five). These samples covered the main *chhalla* and *tuquru* sourcing regions in Bolivia and must also be considered small sampling sizes (less than 25 registers for each musical bamboo type).

Phase II: Preparation for Species Distribution Modelling

Many species distribution modelling approaches are based on species occurrence data, as they are easier to collect than true and definitive absence data (consider historical occurrence records of herbaria or gathered occurrence records during *in situ* fieldwork). In their in-depth synthesis of concepts in the field of environmental niche and species distribution modelling, Peterson et al. (2011, p. 102f) classify existing modelling algorithms according to their biological input data required:

Presence-only approaches rely solely on presence records, without making any reference to other samples or other information drawn from the study area; Presence/absence approaches contrast sites of species presence with sites of species absence, and therefore require both presence and absence data; Presence/background approaches assess how the environment, where the species is known to occur, relates to the environment across the entire study area (environmental variation). Therefore, these approaches use presence records along with environmental data drawn from the study area; Presence/pseudoabsence approaches sample ‘pseudoabsences’ from the study area and compare known occurrence localities with a set of localities having some probability of constituting presence localities being below unity.

The factor that determines the choice of an adequate modelling algorithm is the type of primary data, which the case study is based on. In my case, approaches involving absence data (true or pseudo) are not adequate, as I only rely on species presence or occurrence records. In relation to presence-only approaches, I prefer to include background information of the study area, as these methods may frequently have better discriminatory power and improve predictions (Peterson et al., 2011).

In the present case study, which is based on relatively small datasets, it is important to choose an algorithm which performs well with small sample sizes and sample bias. Such is the case for the maximum entropy algorithm, as many scholars emphasize (Elith et al., 2011; Hernández et al., 2006, 2008; Meneses et al., 2014; Pearson et al., 2007; Phillips et al., 2006, 2009). Moreover, Meneses et al. (2014) modelled the distribution of grasses (*Poaceae*) in Bolivia with similar methodological implications concerning data compilation. Following up on already existing modelling studies in Bolivia, I decided to apply the maximum entropy algorithm using Maxent software (Phillips et al., 2004, 2006, 2017), to the disadvantage of other presence/background approaches such as Ecological Niche Factor Analysis (ENFA) with the Biomapper software (Hirzel et al., 2002).

The Maxent software is used in many disciplines such as sustainability studies, conservation and reserve planning, ecology, botany, epidemiology, and invasive species management (Phillips et al., 2006; see also Elith et al., 2011). It produces continuous predictions and inductive-correlative models, as it correlates the reported presence of given species with the environmental conditions of the sites where they occur. The logistic output of Maxent shows the occurrence probability of a species in a given environment (Elith et al., 2011; Peterson et al., 2011; Phillips & Dudík, 2008).

In a first step, I prepared the datasets for the species presence record used in Maxent. I therefore created comma-separated value (CSV) files (.csv) with Microsoft Excel for every tropical woody bamboo species and musical bamboo type (*chhalla*, *tuquru*) in my datasets. The environmental conditions in these particular places are coded in different environmental layers, which need to be added in order to correlate the environmental condition of the sites of known presence to sites with similar environmental conditions of the entire study area.

The number of predictor variables used in the models has implications for the predictions. If too few variables are used, models might miss important information, resulting in an under-characterisation of niches and the production of overly broad potential distributions (Peterson et al., 2011). On the other hand, the excessive use of variables can lead to overfit models and the geographic distributions may be underrepresented, particularly with small numbers of occurrence records used (Peterson et al., 2011; see also Peterson & Nakazawa, 2008). Henceforth, a smaller number of occurrence records requires a moderate use of predictor variables, which in turn helps to avoid the risk of overfitting.

The selection of environmental variables is an important step in the calibration of the model (called ‘training’) (Peterson et al., 2011). It is based on biological reasoning and depends on which environmental factors

(Hutchinson's "scenopoetic variables") are known or supposed to have a physiological role in limiting species distribution. The majority of species distribution models rely on climatic variables (temperature and humidity) as the main driver at coarse resolutions on a global/continental/regional spatial scale, while other environmental factors on lower spatial scales such as topographic features (elevation, slope, aspect), land cover, or even edaphic and geological information may critically improve the predictive power of the models (Petersen et al., 2011; Franklin, 2010).

In their study about Bolivian grasses, Meneses et al. (2014) use standard bioclimatic variables, a digital elevation model, and the map of complex ecological systems by Navarro & Ferreira (2011). Layers such as vegetation type or ecological systems are categorical variables, as opposed to continuous variables such as climate or elevation. Both types are applicable in Maxent, although with different underlying assumptions. In the case of categorical variables, Maxent attributes to each category a different occurrence probability, which sometimes tends to cause predictions which are too narrow, tending towards the category of the species presence site (overfitting), particularly in sampling designs with small sample sizes and few occurrence records.

Nevertheless, I still expect vegetation to be important. Tropical woody bamboos, including *chhalla* and *tuquru*, are wild-growing plants in areas with remaining natural intact vegetation and anthropogenically untransformed habitats. Fortunately, continuous vegetation layers are available, for instance MODIS vegetation continuous fields, thus avoiding prediction problems (i.e. overfitting) concerning categorical variables and small sample sizes.

In the light of human modification of the environment, it further makes sense to incorporate variables such as land use or deforestation. According to Peterson et al. (2011), environmental data reflecting human modification of the environment can either be directly included as predictor variables in the modelling process or considered on the potential species distribution predictions via post-processing steps. Based on the reasoning above, I did not directly introduce them into the Maxent software as predictor variables, as they are categorical variables. Therefore, I will explain the use of additional deforestation and anthropic land use layers in the post-processing phase.

After having conceptually discussed environmental factors controlling Andean woody bamboo species distributions with botanical and ecological experts from the National Herbarium and the Centre of Spatial Analysis (Institute of Ecology, UMSA) in La Paz, I decided to select the following environmental layers and continuous predictor variables for my Maxent models: 1) 19 standard global bioclimatic variables of WorldClim 1.4 (Hijmans et al., 2005); 2) a digital elevation model (DEM) and derived topographic features (slope, aspect) generated by the NASA Shuttle Radar Topography Mission (SRTM); and 3) the Collection Vegetation Continuous Fields (VCF) V006 derived from MOD 44b MODIS/Terra from 2000 (Dimiceli et al. 2015).

Standard global bioclimatic variables (19) were downloaded in geographic coordinate system (WGS84) and GeoTiff (.tif) format with 1km spatial resolution from the first version of the online available WorldClim dataset (Hijmans et al., 2005). These standard global bioclimatic variables are derived from monthly temperature and rainfall values of the years 1960-1990, representing annual trends, seasonality, and extreme and limiting environmental factors.

Although WorldClim global climate layers use elevation to correct the interpolation made from weather station data (Hijmans et al., 2005), I included a separate digital elevation model (DEM) and derived topographic features (aspect and slope) due to Bolivia's highly heterogenous topography which was a limiting environmental factor, especially for tropical woody bamboos of the Andean montane cloud forests. The DEM was generated by the NASA Shuttle Radar Topography Mission (SRTM) with 90m resolution. Tiles were downloaded in geographic coordinate system (WGS84) and GeoTiff (.tif) format and merged together. Posteriorly, topographic features like aspect and slope were produced using ArcGIS spatial analyst tool 'Surface'. The degree slope feature was calculated in South American Albers equal area conic projection and then projected into a standard geographic coordinate system (WSG84).

Ultimately, global surface vegetation cover from 2000 was downloaded from the Vegetation Continuous Fields (VCF) V006 collection (MOD 44b MODIS/Terra) as gradations of three ground cover components, being percentage tree cover, percentage non-tree cover (herbaceous), and percentage non-vegetated (bare) (Dimiceli et al., 2015). Tiles were downloaded in sinusoidal projection and Hierarchical Data Format-Earth Observing System (HDF-EOS). I merged all tiles together, converted them into GeoTIFF (.tif) format and projected them into a standard geographic coordinate system (WGS84). The selection of vegetation layers of the year 2000 is justified by the additional aim of my study to explore musical bamboo habitat destruction due to deforestation, which is divided into historical (before 2000) and recent (2000-2016) deforestation (see below and Chapter Five).

All environmental layers were clipped out with a shape file of the study area (Bolivia) in order to be posteriorly modified to be the same extent and resolution (grain), i.e. geographic bounds and cell size. As the models were produced for a relatively huge study area (1,098,581 km²), the resolution and extent of the bioclimatic variables (1km) were used in order to modify all other environmental layers. This is the most typical grain in many applications with coarse scale variables (Peterson et al., 2011). Ultimately, all environmental layers were converted into ASCII (asc.) grid format for the use in the Maxent software.

Correlation between different environmental variables, for instance bioclimatic variables or topographic features, is highly probable (Hijmans et al., 2005). In this regard, I did not perform a separate statistical correlation analysis. On the one hand, Maxent contains a form of regularisation excluding variables from the final model (Phillips et al., 2006; see also Petersen et al., 2011). On the other hand, correlation in itself does not greatly affect the predictive quality of models but rather limits the possibility of analysing the influence of each variable on the prediction (Huang et al., 2011). This is not a main concern of my case study.[178]

[178] Notwithstanding, some authors have argued that using input variables without pre-processing to reduce correlations provides best model performances (e.g., Drake et al., 2006, for models with the Support Vector Machine).

Phase III: Modelling with Maxent

After the preparation of the presence record and the environmental (predictor) variables, I ran the Maxent software in default setting, producing logistic outputs in ASCII format and pictures of predictions. In the logistic output, Maxent produces model predictions in a continuous surface based on probability values between 0 and 1. Every model's predictive accuracy is evaluated with the area under the receiver operating characteristic (ROC) curve (AUC), produced by the Maxent software. The AUC is a threshold-independent measure and ranges 0-1. The classification of model accuracy according to AUC values is based on Swets (1988), with 0.5-0.6 meaning random predictions, 0.6-0.7 meaning poor predictions, 0.7-0.8 meaning fair predictions, 0.8-0.9 meaning very good predictions and 0.9-1.0 meaning excellent predictions.[179] All models show high AUC values (between 0.915 and 0.999) (Table A3.4).

Phase IV: Post-Processing of Outputs

In the last phase, I postprocessed the Maxent modelling outputs. The first step was the conversion of Maxent outputs from continuous predictions into binary predictions of species 'presence' (1) and 'absence' (0). Binary predictions are necessary for combining models of multiple species to create predictions of potential species richness (Graham & Hijmans, 2006; Peterson et al., 2011), or selecting important areas for conservation action (Araújo & William, 2000; Peterson et al., 2011). To convert continuous into binary predictions, a threshold must be set, above which the species is predicted to

[179] For a detailed explanation of how the ROC and AUC is calculated, see Phillips et al. (2006) or Peterson et al. (2011)

occur. The objective selection of an appropriate threshold is fundamentally important, as it affects the binary prediction in the following sense: the more restrictive the condition on suitability (threshold), the more the proportional area being predicted as suitable decreases (Peterson et al., 2011).

The simplest data-independent method for setting a threshold is to apply an arbitrary fixed value according to the study purpose (but mostly 0.5 for continuous probabilities, e.g., Bailey et al., 2002). This approach often lacks ecological reasoning, while assuming a fixed threshold when different species require different ones (Liu et al., 2005, 2013; Peterson et al., 2011). Other methods for selecting thresholds usually depend on the type of biological data used. In my case study, methods involving absence data, such as equality of sensitivity[180] and specificity[181], maximization of sensitivity and specificity, and Kappa statistic (Peterson et al., 2011), are not suitable, as I only rely on presence data for my case study.[182]

For example, methods involving presence data are least- or minimum-training presence or fixed sensitivity approaches (Petersen et al., 2011, p. 119). The least- or minimum-training presence approach assumes that species presences are restricted to the sites at least as suitable as the occurrence localities (Pearson et al., 2007). As such, no occurrence sample will be excluded, which requires certain confidence in the dataset.

[180] Sensitivity is the proportion of presences correctly predicted (Peterson et al., 2011, p. 119).
[181] Specificity is the proportion of absences correctly predicted (Peterson et al. 2011, p. 119).
[182] For a detailed description of these presence/absence threshold selection methods, see Peterson et al. (2011, p. 120). Despite these explanations in Peterson et al. (2011), Liu et al. (2013) have mathematically shown that the sensitivity-specificity maximization threshold selection method can also be used for presence-only data. However, I will follow the more general modelling guide of Peterson et al. (2011) in my threshold selections.

In the context of a small sampling size and certain sampling biases, I prefer to choose the 10-percentile training presence threshold, which only includes a certain percentage of the dataset (fixed sensitivity of 0.9, 90% of the occurrence localities) in the prediction of the threshold (Pearson et al., 2004, 2007; Peterson et al., 2011). The threshold values of my modelled species vary between 0.134 and 0.734 with an overall trend of low threshold values (Table A3.5).

The conversion of continuous predictions into binary prediction according to particular threshold values has been done using the ArcGIS spatial analyst tool 'Reclass-Reclassify'. During reclassifying, I converted the predictions from ASCII (asc.) format into GeoTIFF (.tif) format. Posteriorly, I combined all binary predictions of those tropical woody bamboo species belonging to the same genus, thus arriving at species richness predictions for each tropical woody bamboo genus in my dataset. I combined all genera in order to obtain one potential species richness prediction for all tropical woody bamboos (*Bambuseae*). All combinations of binary predictions have been done using the ArcGIS spatial analyst tool 'map algebra-raster calculator'.

With regard to the binary predictions and potential distributions of *chhalla* and *tuquru* bamboos (and some selected *Aulonemia* and *Rhipidocladum* species, see Chapter Five), I further explored the impacts of deforestation. Deforestation in Bolivia can be divided into historical deforestation until 2000 and recent deforestation from 2000 onwards. I therefore selected vegetation covers (tree, herbaceous, and bare ground) from the MODIS vegetation continuous field collection before recent deforestation activities begun in 2000.

Deforestation layers of different periods (historical deforestation until 2000 as well as recent deforestation between 2000-2010, 2010-2013, 2013-2014, 2014-2015 and 2015-2016) have been derived as polygon feature classes from the 'Information and Forest Monitoring System' (sp. *Sistema de Informacion y Monitoreo de Bosques*, Acronym: SIMB) of the Bolivian Ministry of Environment and Water (sp. *Ministerio de Medio Ambiente y Agua*, Acronym: MMAyA) (MMAyA, 2017). Here, official deforestation data for Bolivia including the results from the Forest Cover Monitoring Project of the Amazon Cooperation Treaty Organisation is uploaded (ACTO, 2014).[183] Since this phytogeographic study has been mainly undertaken in 2017 as part of my interdisciplinary fieldwork in Bolivia, I restrict here my analysis to historical and recent deforestation until 2016.

In order to calculate remnant distributions and niche loss due to recent deforestation (2000-2016), I firstly converted the potential distributions (only presence values) from GeoTIFF (.tif) raster format into a polygon shapefile using the ArcGIS conversion tool 'Raster to Polygon' (without simplifying polygons). Posteriorly, I overlaid deforestation layers and clipped out (geoprocessing) from the potential distributions all converted natural lands by 2000. From these remnant distributions in 2000, I furthermore clipped out (geoprocessing) all natural lands which had been converted between 2000 and 2016. These areas define the potential habitat destruction due to recent deforestation between 2000 and 2016. Calculations have been done in South

[183] See also http://www.otca-oficial.info/projects.

America Albers equal area conic projection using cartographic characteristics for Bolivia.[184]

In order to analyse the distribution of sourcing sites vis-à-vis human presences in principal sourcing regions, I created a map indicating anthropic areas derived from Navarro & Ferreira's (2011) map of Bolivia's ecological systems. Each ecological system (142 in number) is the result of the fusion of corresponding vegetation series from Navarro & Ferreira's (2007) vegetation map. I got access to the map of ecological systems in Image Display and Analysis (IDA) (.img) raster format, converted all records for anthropic area (54,560 km²) in a separate polygon shapefile and inserted the layer onto the potential *chhalla* and *tuquru* distributions as well as sourcing sites and regions.

Finally, I created and exported maps (among them central bamboo sourcing sites and regions, tropical woody bamboo species richness, deforestation, potential and remnant distributions of musical bamboos including habitat destructions and land use) in high resolution JPEG (.jpg) format. The species richness map of tropical woody bamboos has been classified with 'Natural breaks (Jenks)', as I aim to identify species richness centres and therefore maximise the differences between classes.

[184] Cartographic characteristics for Bolivia can be found, for example, in MMAyA-DGGDF (2015a, p. 32) or MMAyA-DGGDF (2015b, p. 15).

Table A3.1: Overview of Species Distributing Modelling (Source: Own Elaboration)

Phase	*Step*	*Activity*
Phase I: Creation of Datasets	Data Collection	• Extraction of all tropical woody bamboo species registers from the database of the national herbarium of La Paz (LPB) • Collection of additional online data from Missouri Botanical Garden (www.tropicos.com) • Fieldwork in Bamboo Sourcing Sites
	Data Cleaning	• Elimination of registers without taxonomic identification at species level • Elimination of registers without geographic coordinates • Elimination of double registers • Elimination of species with less than three registers
Phase II: Preparation for SDM	Decision on Modelling Method	• Literature review and selection of modelling algorithm: maximum entropy algorithm with Maxent software (Phillips et al., 2006)
	Preparation of Occurrence Records	• Creation of CSV files (.csv) for every species of tropical woody bamboo (Bambuseae) in dataset
	Preparation of Environmental Layers (Predictor Variables)	• Literature review and selection of predictor variables • Download and preparation of predictor variables • Modifying predictor variables to be same extent (geographic bounds and cell size) and resolution (grain) • Conversion to ASCII (.asc) grid format
Phase III: Modelling with Maxent	Running of Maxent Software	• Creation of Maxent models for tropical woody and musical bamboos in datasets
	Model Testing	• Analysis of predictive accuracy (AUC values)
Phase IV: Post-Processing of Outputs	Preparation and Conversion of Output Data	• Conversion to binary predictions (absence/presence) with threshold value • Combination of binary predictions for species richness map
	Analysis of Deforestation and Land-Use	• Preparation of deforestation and land use data • Calculation of remnant distributions of musical bamboos and respective habitat destructions
	Creation of Final Maps	• Creation and export of map in high resolution and JPEG (.jpg) format

Table A3.2: Final Dataset of Woody Bamboos (*Bambuseae*) (Source: Own Elaboration)

Genera	*Reported Species*	*#*	*Modelled Species*	*#*	*# Registers Species*	*# Registers Genus*
Actinocladum	*A.verticillatum*	1	*A.verticillatum*	1	4	4
Arthrostylidium	*A.canaliculatum* *A.ecuadorense* *A.venezuelae*	3	*A.canaliculatum*	1	5	5
Aulonemia	*A.boliviana* *A.bromoides* *A.cochabambensis* *A.fuentesii* *A.herzogiana* *A.hirtula* *A.insignis* *A.longipedicellata* *A.madidiensis* *A.queko* *A.scritpa* *A.tremula*	*12*	*A.herzogiana* *A.hirtula* *A.tremula*	3	5 18 5	28
Bambusa	*B.tuldoides* *B.vulgaris*	2	-	0	0	0
Chusquea	*C.asymmetrica* *C.delicatula* *C.depauperata* *C.laegaardii* *C.longipendula* *C.lorentziana* *C.parodii* *C.paucispiculata* *C.peruviana* *C.picta* *C.ramoisissima* *C.renvoizei* *C.scadens* *C.serrulata* *C.spicata* *C.tessellata* *C.uniflora* *C.yungasensis*	*18*	*C.delicatula* *C.laegaardei* *C.longipendula* *C.lorentziana* *C.parodii* *C.pausicpiculata* *C.peruviana* *C.picta* *C.ramosissima* *C.scadens* *C.spicata* *C.tessellata*	12	13 4 3 16 4 3 9 5 7 21 6 7	98
Guadua	*G.angustifolia* *G.capitata* *G.chacoensis* *G.chaparensis* *G.glomerata* *G.paniculata* *G.paraguayana* *G.refracta* *G.sarcocarpa* *G.superba* *G.trinii* *G.weberbaueri*	*12*	*G.angustifolia* *G.chacoensis* *G.chaparensis* *G.glomerata* *G.paniculata* *G.refracta* *G.sarcocarpa* *G.superba* *G.weberbaueri*	9	7 17 3 18 24 4 24 21 22	140
Merostachys	*M.yungasensis*	*1*	*M.yungasensis*	1	3	3
Rhipidocladum	*R.harmonicum* *R.neumanii* *R.parviflorum* *R.racemiflorum*	*4*	*R.harmonicum* *R.neumanii* *R.parviflorum* *R.racemiflorum*	4	4 10 4 10	28
Bambuseae	**TOTAL**	**53**	**TOTAL**	**31**	**306**	

Table A3.3: Final Dataset of Musical Bamboos (Source: Own Elaboration)

Type	*Variety*	*Sample Location*	*Coordinates* S	W	*Sample Botanical Specimen*
Chhalla	Zongo	Zongo	16.109	68.053	Own
		Carijana	15.181	68.770	
	Quime	Palomani	16.752	67.235	
		Palomani	16.747	67.243	
	Alto Beni (lluq’a)	Boopi	15.712	67.155	
		Boopi	15.712	67.154	
		Boopi	15.709	67.150	
		Boopi	15.729	67.145	
		Boopi	15.707	67.148	
		Tucupi/Cocochi	15.772	67.034	
		Tucupi/Cocochi	15.769	67.044	
		San José	15.795	67.108	
	Alto Beni (qipu)	Hernández	15.342	67.352	
		Hernández	15.340	67.350	
	Pojo (Quime)	Diam Pampa	17.692	64.707	
		Diam Pampa	17.691	64.706	
		Diam Pampa	17.691	64.707	
	Kjirki	Carijana	15.206	68.699	
	Bermejo	Sidras	22.167	64.433	*J. Solomon 11200 (MO)*
		San Telmo	22.449	64.367	*A. Lliully 196 (MO)*
	Samaipata	Cuevas	18.150	63.717	*M. Nee 50453 (MO, NY)*
Tuquru	Lluq’a paceña	Choquetanga	16.783	67.283	*M. Lewis 38699 (LPB)*
		Colomi	17.200	65.900	*J. Wood 8484 (LPB)*
		Pajan	15.120	68.896	*A. Fuentes 16271 (LPB)*
		Tolapi	15.558	68.394	*G. Arellano 2334 (LPB)*
		Carijana	15.204	68.776	Own
		Carijana	15.203	68.775	
		Chuspipata	16.305	67.814	
		Palomani	16.757	67.265	
	Lluq’a cochabamba	Kara Wasi	17.729	64.749	
		Kara Wasi	17.739	64.726	
		Kara Wasi	17.741	64.723	
	Kjirki	Arcopongo	16.806	66.946	
		Arcopongo	16.729	66.949	
		Arcopongo	16.732	66.953	

Table A3.4: AUC Values (Source: Own Elaboration)

Genera of Bambuseae	*Modelled Species*	*AUC Value*
Actinocladum	*A.verticillatum*	0.971
Arthrostylidium	*A.canaliculatum*	0.997
Aulonemia	*A.herzogiana*	0.999
	A.hirtula	0.998
	A.tremula	0.991
Chusquea	*C.delicatula*	0.955
	C.laegaardii	0.999
	C.longipendula	0.998
	C.lorentziana	0.991
	C.parodii	0,984
	C.paucispiculata	0.990
	C.peruviana	0.987
	C.picta	0.991
	C.ramosissima	0.962
	C.scadens	0.974
	C.spicata	0.993
	C.tessellata	0.998
Guadua	*G.angustifolia*	0.927
	G.chacoensis	0.949
	G.chaparensis	0.999
	G.glomerata	0.975
	G.paniculata	0.955
	G.refracta	0.946
	G.sarcocarpa	0.936
	G.superba	0.938
	G.weberbaueri	0.960
Merostachys	*M.yungasensis*	0.997
Rhipidocladum	*R.harmonicum*	0.991
	R.neumanii	0.982
	R.parviflorum	0.961
	R.racemiflorum	0.915
Musical Bamboos	*Chhalla*	0.986
	Tuquru	0.994

Table A3.5: Threshold Values (Source: Own Elaboration)

Genera of Bambuseae	*Modelled Species*	*Threshold Values*
Actinocladum	*A.verticillatum*	0.470
Arthrostylidium	*A.canaliculatum*	0.304
Aulonemia	*A.herzogiana*	0.536
	A.hirtula	0.330
	A.tremula	0.476
Chusquea	*C.delicatula*	0.469
	C.laegaardii	0.446
	C.longipendula	0.682
	C.lorentziana	0.410
	C.parodii	0.228
	C.paucispiculata	0.440
	C.peruviana	0.254
	C.picta	0.376
	C.ramosissima	0.289
	C.scadens	0.334
	C.spicata	0.309
	C.tessellata	0.514
Guadua	*G.angustifolia*	0.290
	G.chacoensis	0.142
	G.chaparensis	0.649
	G.glomerata	0.299
	G.paniculata	0.367
	G.refracta	0.457
	G.sarcocarpa	0.165
	G.superba	0.381
	G.weberbaueri	0.134
Merostachys	*M.yungasensis*	0.734
Rhipidocladum	*R.harmonicum*	0.478
	R.neumanii	0.608
	R.parviflorum	0.571
	R.racemiflorum	0.400
Musical Bamboos	*Chhalla*	0.346
	Tuquru	0.395

Appendix 4 *Chhalla* and *Tuquru* Sourcing Sites

Table A4.1: *Chhalla* Sourcing Sites (Source: Own Elaboration)

Type	*Department*	*Province*	*Municipality*	*Mentioned Places*
'Zongo'	La Paz	Larecaja	Guanay	Chhallana
		Murillo	La Paz	Cambaya
				Chirimoyani
				Chururaqui
				Zongo
				Jarca
'Quime'	La Paz	Inquisivi	Licoma	Carahuata
				Kahara
				Licoma
				Tirco
			Cajuata	Cajuata
				Circuata
				Frutillani
				Palomani
			Inquisivi	Chilcani
		Sur Yungas	Irupana	Churubamba
'Alto Beni'	La Paz	Caranavi	Caranavi	Caranavi
				Taypiplaya
				Porvenir
				San Antonio
				Boopi
				Sararia
		Sur Yungas	Palos Blancos	San José
				Tucupi/Cocochi
				Agua Dulce
				Villa El Carmen
				Palos Blancos
				Lucero
				Vencedor
				Hérnandez
				Playa Verde
				Inicua Bajo
		Larecaja	Teoponte	Mayaya
'Bermejo'	Tarija	Arce	Bermejo	Bermejo
				Santa Rosa
			Padcaya	San Telmo
				Playa Ancha
				San Ramon
				Sidras
	Santa Cruz	Florida	Samaipata	Bermejo
				Comunidad Lajas
				Cuevas
				Samaipata
		Ibañez	El Torno	La Angustura
'Kjirki'	La Paz	Caranavi	Caranavi	La Cumbre

Table A4.2: *Tuquru* Sourcing Sites (Source: Own Elaboration)

Type	*Department*	*Province*	*Municipality*	*Mentioned Places*
lluq’a paceño	La Paz	Bautista Saavedra	Charazani	Pajan Carijana
		Larecaja	Tacacoma	Itulaya Consata
			Sorata	Sorata Tolapi
		Nor Yungas	Coroico	Cotapata Chuspipata
		Sur Yungas	Yanacachi	Unduavi Mina Chojlla
			Irupana	Santa Rosa Lambate
		Inquisivi	Quime	Choquetanga
			Cajuata	Cajuata
			Inquisivi	Chilcani Frutillani
	Cochabamba	Ayopaya	Independencia	Saylapata Carhuani
		Chapare	Villa Tunari	Paracti
			Colomi	Colomi
lluq’a cochabamba	Cochabamba	Carrasco	Pojo	Pojo Buena Vista
	Santa Cruz	Caballero	Comarapa	Siberia Churo
kjirki	La Paz	Inquisivi	Inquisivi	Arcopongo Janko Kalani Baja Minas Locotani
	Cochabamba	Ayopaya	Independencia	Pochanche Sivingani

Appendix 5 Tree Cover Loss (Global Forest Watch)

Table A5.1: Tree Cover Loss (Source: Own Elaboration based on Hansen et al. 2013)

Year	*Annual Loss[a] (km²)*	*Averages (km²)*		*Extent Forest Cover[a]*
2000				575.000 km²
2001	1,350			
2002	1,700			
2003	1,590			
2004	1,900			
2005	2,380	2001-2005:	1,790	
2006	2,070			
2007	1,850			
2008	3,480			
2009	2,130			
2010	4,370	2006-2010:	2,780	552,200 km²
2011	3,170			
2012	2,600			
2013	1,650			
2014	2,400			
2015	1,520	2011-2015:	2,300	
2016	4,390			536,500 km²
2017	4,340			
2018	2,800			
2019	7,940	2016-2019:	4,870	
Total	53,650		2,800	521,500 km²

[a] 50% Canopy Threshold

Glossary

Abiotic	Refers to the non-living chemical or physical parts in an ecosystem or environment.
Achachila	(Ay.) Grandfather. Sacred snow-capped mountain tops which are or embody male tutelar and guardian spirits are referred to as *achachila* in Aymara.
Adelanto	(Sp.) Payment in advance.
Affinity	Abbreviation: aff. (affinis). Botanical term meaning ‘akin to’, often used for a provisionally recognised but unnamed taxon considered close to that name.
Aka Pacha	(Ay.) (literally) ‘Here World’. One of the existential layers of the Andean multiverse referred to by Aymara Andeans as *pacha*. The world where humans reside and live.
Ajayu	(Ay.) Spirit. Animating force of life.
Ajayu Uywiri	(Ay.) (literally) ‘Breeding spirit’. Protectors and guardians of life in the Aymara cosmos (ay. *pacha*).
Ajuyani	(Ay.) Vocalic change: *Ajayuni* meaning ‘with spirit’. Name of the small lake above the community of Walata Grande.
Alma Pinkillu	Duct-flute with seven fingerholes made from *suqusa* (*Arundo donax*), only played during *Amaypacha* in November (around All Saints). Also called *muq’uni* (‘with node’) in Aymara, which refers to the physical shape of the *suqusa* (which for this instrument – and unusually – always includes a node between mouthpiece and fingerholes), or *quyqu* (*ayqu*), which refers to its whining, wailing, and crying sound (*quyquña*, *ayquña*).
Altiplano Paceño	Highlands of La Paz Department.
Alto Beni	*Chhalla* bamboo-sourcing region. Municipality in Caranavi province and natural geographic area/broader ecoregion, partially integrated within

	the departments of La Paz, Cochabamba, and Beni, situated in the syncline valley of the mid-course of the Beni river (also called Río Alto Beni, or Río Mosetén) in the Andean-Amazonian piedmont or foothills.
Altu/Baju	Flute crafting technique by which Aymara flute makers craft half of the *phala*, *qina* or *pinkillu* consort with slightly displaced fingerholes. Thus, the consort collectively produces notorious acoustic beats.
Amawt'a	(Ay.) Counsellor. One particular manifestation of Andean shaman/healer. See **Qulliri** and **Yatiri**
Amaya Ajayu	(Ay.) Spirit of the Dead. *Alma* in Spanish.
Amaypacha	(Ay.) (literally) 'World of the Dead'. One of the existential layers in the multiverse known as *pacha* by Aymara Andeans. The place where the dead spirits (*amaya ajayu*, *alma*) reside.
Anemophilous	Pollinated by wind-dispersed pollen.
Antara	(Qu.) Panpipe. Usually used to refer to pre-Colombian stone or clay-made panpipes, especially in Peru and Chile.
Añchañchu	(Ay.) Siren. Spirit of aqueous places like rivers, springs, or lakes. See **Sirinu/Sirina**
Apthapiña	(Ay.) to gather.
Aulonemia	Genus of Andean woody bamboos to which *tuquru* belongs (e.g., *Aulonemia hirtula* and *Aulonemia herzogiana*).
Awicha	(Ay.) Grandmother. Sacred snow-capped mountain tops which are or embody female tutelar and guardian spirits are referred to as *awicha* in Aymara.
Awki-Awki	Aymara dance played with *phala* transverse flutes during the dry season (mostly during the Festival of the Crosses in May) parodying elderly people.
Awti Pacha	(Ay.) (literally) 'Season of Hunger', Dry Season.

Ayarachi *Suqusa* (*Arundo donax*) made panpipe style on the southern Bolivian Altiplano. Based on (nearly) equitonal scales (Borras, 1998).

Ayllu Ancient Andean unit of social, political, economic, and spiritual organisation of several Aymara Indigenous communities, typically linked through kinship, ethnicity, territory, and leadership.

Aymara Indigenous or ethnic group on the highlands of Bolivia, Peru, and Chile. Andean highland Indigenous Language.

Ayni (Ay.) Reciprocity. Law of reciprocity and interdependency of all living beings in the Aymara cosmos called *pacha*. Mutual correspondence and help between human beings.

Aynuqa System of nuclear family plots (*chaqra*, *yapu*) within communal lands, which are designated for agricultural production under a system of crop rotation, varying according to each community between six and more than ten years. See **Chaqra**

Azanaques Region around the Cordillera Azanaques (part of the Cordillera Central) in Oruro department.

Bambuseae Tribe of tropical woody bamboos belonging to the grass subfamily of bamboos (*Bambusoideae*).

Bañié Mosetén name of a particular *tacuara* bamboo species (*Guadua weberbaueri*).

Barraca (Sp.) Local woodstore.

Bermejo *Chhalla* bamboo-sourcing region. City and same-named municipality in the Aniceto Arce province in Southern Bolivia, bordering with Salta province in Argentina.

Biotic Refers to the (once) living parts (organisms) in an ecosystem or environment.

Bombo Two-headed and straight-sided cylindrical drum with two usable membranes.

Boro Aymara name for Human Botfly (*Dermatobia hominis*).

Camino Viejo (Sp.) Old Road. Popular name for the interdepartmental route between Cochabamba and Santa Cruz, passing Pojo, Comarapa and Samaipata.

Cargo (Sp.) Position. Authority position in the communitarian government system in a rural Aymara community.

Casero (Sp.) ‘Frequent Client’. Form of clientelisation in popular economies in the Bolivian Andes.

Ceja de Monte (Sp.) ‘Eyebrow of the Forest’. transition area of the highlands towards the Yungas mountain cloud forests.

Chaqra (Qu.) Farming plot. *Yapu* in Aymara.

Charango Small Andean ukulele-like string instrument with five double strings.

Chhalla Aymara name for panpipe bamboo (mainly species in the Andean woody bamboo genus of *Rhipidocladum*, but recently also *Merostachys*). Also used to denominate dry maize culms.

Chhallero (Ay.) *Chhalla* bamboo trader/collector.

Chhaqaña (ay.) to disappear.

Chhaxi Wooden duct flute played in Aroma province (La Paz).

Chinlili A guitar-like string instrument from Ayacucho (Peru) with six courses and eight metal strings.

Chukiyawu Aymara name of the valley of La Paz.

Chullpa (Ay.) Burial Monument. Also used to denominate pre-humans (ay. *chullpa*) in the era of dawn or *chullpa pacha*.

Chullpa Pacha (Ay.) Era of Dawn. Local historical category. Denominates the time in Aymara cosmology before the sun has risen and pre-human *chullpa* walked upon earth or *aka pacha*.

Chuqui (Qu.) Lance, Spear. Quechua name for a *tacuara* species (*Guadua weberbaueri*) used in the Kallawaya region to craft *pifano* transverse flutes. See **Tacuara**

Chuwero (Ay.) Clay Plate Maker. Term used in the National Academy of Fine Arts "Hernado Siles" in La Paz in order to denigrate ceramics as functional artisanry.

Chuyma (Ay.) (literally) Lung, (figuratively) Heart.

Colono (Sp.) Colonist. Refers (in a negative manner) to Andean settlers in lowland territories such as Alto Beni, Chapare and Yapacaní.

Cumbia Latin American song and dance genre associated with Colombian origins. Most popular dance music in Bolivia, often recorded with electric guitars, bass, keyboards, and electronic drums.

Ch'alla (Ay.) Libation with alcohol.

Ch'aphi Tuquru (Ay.) Thorny *tuquru*. Aymara name for certain lowland *tacuara* bamboos (*Guadua*). Woody bamboo in the *Guadua* genus have notorious thorns at their nodes. See **Tacuara**

Ch'iqa (Ay.) Left. In the context of uniform *siku* (*suri*, *mimula*, etc.) playing meaning offbeat.

Ch'ixi (Ay.) (literally) Grey (small juxtaposed white and black spots). Concept developed by Silvia Rivera in order to conceptualise the process of *mestizaje* in the Andes.

Ch'umi (Ay.) (literally) Jungle. Referring to dense vegetation of Yungas cloud forests.

Ch'unch'u Aymara dance played with *phala* transverse flutes during the dry season parodying lowland Indigenous people.

Dom	Mosetén name of a particular *tacuara* bamboo species (*Guadua sarcocarpa*). In Spanish referred to as 'fine *tacuara'* (sp. *tacuara fina*) due to its smooth tube surface. See **Tacuara**
Duct Flute	A flute where a duct channel directs an air stream against a sharp edge (producing sound).
Encomienda	(Sp.) Assignment. Spanish system of communal slavery that rewarded conquerors with labour of Indigenous people in particular regions and communities.
Endemic	Ecological state of being unique and restricted to a defined geographic region, such as country, vegetation zone or habitat. Compare with **Native**
Eraso	One of the flute registers in a typical *musiñu* ensemble.
Gregarious	Collective and simultaneous flowering pattern (mass flowering) of all populations of a particular woody bamboo species.
Gremiales	(Sp.) Merchants (Guilds).
Habilito	(Sp.) Local debt and peonage system in the Amazon lowlands (for example in Alto Beni).
Hocket	Performance techniques by which the production of a melody is shared between two or more voices/registers. Also called interlocking.
Huaquero	(Ay.) Grave Robber.
Huasicucho	Hardwood Variety. Local name for *Centrolobium ochroxylum*.
Inka Pacha	(Ay.) Era of the Inca. Local historical category. Denominates the time when the highlands experience the presence of the Inka.
Interculturales	(Sp.) Interculturals. Refers to offspring of Andean 'colonists' (sp. *colonos*) in lowland territories. See **Colono**

Inti Jaqi (Ay.) (literally) “People of the Sun”. Denominates in Aymara cosmology the human beings living under the current sun (ay. *inti*) after *chullpa pacha*.

Jacha(ya)ña (Ay.) to cry/to make cry.

Jach’a Lakita (Ay.) (literally) ‘Huge Lakita’. Panpipe (*siku*) style played with panpipe registers tuned in parallel octaves (monophony) in Ilabaya in the province of Larecaja (La Paz).

Jach’a Siku (Ay.) (literally) ‘Huge Siku’. Panpipe (*siku*) style played with three panpipe registers tuned in parallel octaves (monophony) in the *marka* Umanata (*ayllu* Qullana, *ayllu* Kupi, *ayllu* Taypi, *ayllu* Sullka), Camacho province (La Paz).

Jach’a Wallata (Ay.) Andean goose (*Chloephaga melanoptera*). Gives its name to the flute-making community of Walata Grande. See **Walata Grande**

Jallu Pacha (Ay.) Rainy Season.

Jañchi (Ay.) (literally) Skin, (figuratively) Body.

Jaqi (Ay.) Person. Refers to the married person.

Jaqicha (Ay.) (literally) Making Person. Marriage.

Jawira (Ay.) River.

Jisk’a Pinkillu (Ay.) Small Pinkillu. Souvenir duct flute made from *suqusa* (*Arundo donax*).

Jukumari (Ay.) Andean Spectacled Bear (*Tremarctos ornatus*).

Jukumari Marka (Ay.) Land of the *Jukumari*.

Jula-Jula Panpipe style in the Bolivian highlands, especially the southern Altiplano, consisting of five panpipe registers played in parallel octaves. A very similar panpipe style played with three panpipe registers in parallel octaves is called *chiriwano* on the *altiplano paceño*. While the *jula-jula* panpipes are made from *suqusa* (*Arundo donax*), the *chiriwano* panpipes are made from *chhalla* bamboo (*Rhipidocladum*). See **Suqusa** and **Chhalla**

Juyphi Pacha (Ay.) Season of Frost (May/June/July).

Kharisiri (Ay.) Indigenous fat-stealing monster. For further details, see Burman (2018), Fernández (2006, 2008) and Spedding (2005).

Kilaña (Ay.) Opener/to open. Hand-tool and self-made knife used by Walateño flute makers to open a first aperture on a *tuquru* bamboo in order to perorate fingerholes with the *p'iyaña*. See **P'iyaña**.

Killaka Ancient Aymara nation south of Lake Poopó (Oruro).

Kimsa Krus (Ay.) Three Crosses. Cordillera in Inquisivi province. Part of the Cordillera Real in Bolivia.

Kjirki (Ay.) Rough. Refers to the *tuquru* type with a scabrous or rough surface. Opposed to *lluq'a* meaning soft.

Kupi (Ay.) Right. In the context of uniform *siku* (*suri*, *mimula*, etc.) playing meaning onbeat.

K'intu (Ay.) Offering of selected coca leaves to ask for permission from guardian and tutelar spirits.

Lakita Panpipe style played in Northern Chile.

Laq'a tiji (Ay.) Shelter of Earth.

Lignification Process of a woody bamboo turning into wood or becoming wood-like.

Lote (Sp.) Privately-owned land.

Lumen Cavity in the bamboo internode, varying according to the diameter of the internode and its wall thickness.

Lupaka Ancient Aymara nation at the shores of Lake Titicaca.

Lupilapak Pacha (Ay.) Season of the burning sun (October/November). See **Awti Pacha**

Luriri (Ay.) (Flute) Maker ('the one who makes')

Lluq'a (Ay.) Soft. Refers to the *tuquru* types with soft surface. Opposed to *kjirki*.

Madaké Japanese name for giant timber bamboo (*Phyllostachys bambusoides*).

Madrina (Sp.) Godmother.

Malta One of the panpipe registers, medium size.

Mama Quena (Sp.) Mother Quena. Bass variant of urban professional *quena* notched flute made from (*tuquru*) bamboo or wood tuned in G_3. Also called 'big *quena*' (ay. *jach'a quena)*.

Manqha Pacha (Ay.) (literally) 'Within World'. One of the existential layers of the multiverse known as *pacha* by Aymara Andeans. The place within earth, where (among others) the *añchañchu* resides. See **Añchañchu**

Manqha Yunka (Ay.) Low Warm Land/Territory. Category in the ecological verticality of Aymara nations (see Bouysse-Cassagne 1987). Denominates the lower subtropical territories on the eastern slopes of the tropical Andes. The dry warm territories towards the west and the Pacific Ocean are called *alaya yunka* ('high warm lands'), while the Altiplano highlands (ay. *suni*) are 'cold lands' (ay. *thayaña*).

Mara (Sp.) Local name for mahogany (*Swietenia macrophylla*).

Marka (Ay.) Political union of several *ayllu*. Often used as an Aymara synonym for 'land', 'territory', 'nation', or 'city'. Compare with **Ayllu**

Mautam (Literally) '*mau* Bamboo Death' in Mizo language. Cyclic ecological phenomenon occurring every 50 years in the north-eastern Indian states of Mizoram and Manipur. The collective death of a monocarpic woody bamboo called *mau* (*Melocanna baccifera*) is followed by a boom in rat population (rat flood) feeding on seeds. After these are exhausted, rats turn to stored gran and cause a devastating famine in the region.

Mazamorra (Sp.) Refers to a nature catastrophe, a flood of mud and stones.

Mesa (Sp.) (literally) Table. Ritual offering, where certain ingredients such as incense, copal, and sweets are burned in order to feed tutelar spirits.

Mestizaje Process of the mixing of European and Indigenous American cultures. See **Mestizo**

Mestizo In Hispanic America, denomination of a person with European and Indigenous American descent/heritage (nowadays used in the cultural sense).

Minifundio One category in the latifundio-minifundio land tenure structure. *Latifundios* are large commercial estates, while *minifundios* are subsistence-oriented smallholdings farmed by peasant households.

Mink'a Collective and communitarian labour based on reciprocity for the benefit of the community or a family.

Monocarpic Refers to plants that flower and set seeds once in a lifetime and then die.

Mosetén Lowland Indigenous people in the Andean-Amazonian foothills of Alto Beni. See **Alto Beni**

Música Chicha Andean music genre also known as *música tropical andina*. Modern huayno with elements from psychedelic rock and *cumbia*. For further details see Bailón (2004) and Montoya (1996).

Musiñu (Ay.) Flute type in the local Aymara organology. Rainy season duct flute ensemble originally from Loayza province played at least with four flute registers (*saliwa*, *eraso*, *requinto*, *tiple*) tuned in different intervals.

Native Naturally occurring in an area, but necessarily restricted to it. Compare with **Endemic**

Notched Flute A flute where through lip embouchure a direct air stream against a sharp edge produces sound.

Pachamama (Ay.) 'Mother Earth'. Andean female goddess.

Pachymorph Botanical term. Referring to the rhizome of musical bamboos (clumpers). Root-rearing section bigger than culms. Rhizome proper of a thick kind and sections/nodes close together with short necks. Contrary to leptomorph rhizomes of running bamboos having a long and thin rhizome proper and sections with longer necks.

Pago (Sp.) Payment. Reciprocal (returning) spiritual payment to Andean guardian spirits for something that one has received or wants to receive in the future.

Paisano Co-member of the same community or geographic region.

Pakaji Ancient Aymara nation south of Lake Titicaca.

Paltjata (Ay.) A small bag (ay. *awayu*) carried over a large one. Term used for the *musiñu* blowing bridge.

Páramo Higher parts of *yungas* cloud forests and neotropical high mountain biome.

Patruna Pacha (Ay.) Era of the Patrons/Hacendados (Landowners). Local historical category.

Phala (Ay.) Flute Type in the local Aymara organology. Dry season transverse flute with six fingerholes, made from *tuquru* bamboo on the *altiplano paceño*. In other parts of Bolivia (northern La Paz, lowlands) also made from *tacuara* bamboo (*Guadua weberbaueri* and *Guadua sarcocarpa*). See **Chuqui**

Phukuna Khuchuq	(Qu.) Flute Maker ('the one who cuts that which is blown").
Phusa	(Ay.) 'That which is blown'. Aymara terminology for flutes. From the Aymara verb *phusaña* or to blow.
Phusiri	(Ay.) (literally) 'The Blower'. Aymara terminology for flute player.
Pifano	(Qu.) Andean flute Type. Transverse flute with six fingerholes. See **Phala**
Pinkillu	(Ay.) Flute type in the local Aymara organology. *Tuquru* made rainy season flute with inter duct and three to six fingerholes, depending on the local *pinkillu* style.
Pongeaje	(Sp.) Andean form of servitude and slavery. Free domestic service which Indigenous tenants were obliged to. See **Pongo**
Pongo	(Sp.) Andean Indigenous Servant/Slave.
P'iyaña	(Ay.) Hole maker/to make holes. Hand-tool and self-made knife used by Walateño flute makers to perorate fingerholes on the outside body of the *tuquru* tube. See **Kilaña**
Qantu	Panpipe style played monophonically with six panpipe registers tuned in parallel fourth, fifths and octaves (monophony), which originated in the Kallawaya region in the northern Bolivian Andes (Bautista Saavedra, La Paz).
Qhatu	(Ay.) Mobile Street Stand. Nowadays also used as a generic term for market.
Qhiwi	(Ay.) Bundle. Used to refer to traded *chhalla* bamboo bundles of 1000-1500 tubes. Derives from the Aymara verb *qhiwiña*, which means carrying over the shoulder a large and heavy thing.

Qina (Ay.) Flute type in the local Aymara organology. *Tuquru* made notched flute with four to seven fingerholes, depending on the local *qina* style.

Qipu (Ay.) Fine Spines. Like on the prickly pear or *tuna* fruit (*Opuntia* sp.). The *qipu chhalla* from Alto Beni carries fine spines on the tube surface.

Quena (Sp.) Andean notched flute. The term is used to refer to urban professional notched flutes tuned in a Western scale and standard equal temperament. Opposed to *qina* in Aymara with local cuts. See **Qina**

Quime *Chhalla* bamboo-sourcing region. Quime is a village and municipality in Inquisivi province (La Paz department) through which the central Inquisivi *yungas* municipalities of Licoma and Cajuata are accessed.

Qulla Uta (Ay.) (literally) 'House of Medicine'. Consulting room of traditional Andean healer.

Qullasuyu (Qu.) (literally) 'Land of Medicine'. Southern provincial regions of the Inka State (*Tawantinsuyu*) covering the Altiplano.

Qulliri (Ay.) (literally) 'The one who heals' (with medical herbs). Traditional Andean herbalist. One particular manifestation of Andean shaman/healer. See **Amawt'a** and **Yatiri**

Quta (Ay.) Lake.

Q'asa (Ay.) (literally) 'chipped'. Refers to the notch of *qina* flutes. Also used as a local Aymara category to group all dry season flutes (*siku*, *qina*, *phala*).

Q'umer (Qu.) Verde. Quechua word locally denominating in the Kallawaya region the *kjirki chhalla* bamboo type. See **Kjirki**

Rapé (Sp.) Traditional Snuff. Smokeless tobacco.

Reducciones	(Sp.) Settlements created by Spanish rulers in colonies, into which Indigenous habitants pejoratively referred to as “Indians” were forcibly relocated. In the Andes, these reductions, mostly initiated after 1570, are linked to the rule of viceroy Francisco de Toledo.
Rhipidocladum	Genus of Andean woody bamboos to which *chhalla* belongs (e.g., *Rhipidocladum harmonicum*).
Richa/Richi	Local Aymara category denominating a pulsating (multiphonic) sound (roll effect). *Tara* in Quechua.
Saliwa	One of the flute registers in a typical *musiñu* ensemble (bass register).
Salteña	(Sp.) A Bolivian type of baked empanada.
Samaña	(Ay.) Breath/ to breath.
Samarañ Pata	(Ay.) (literally) ‘High Place for Resting’. A place in the flute-making community of Walata Grande.
Sanqa	One of the panpipe registers, large size, bass register.
Sayaña	Nuclear family land plot within a community on which the houses of a nuclear family are built.
Segunda Taquiña	A local panpipe style played on the Aymara Altiplano, based approximately on a G major scale. Nowadays widely used in *mestizo sikureadas* and *huayno siku*.
Shakuhachi	Japanese and ancient Chinese end-blown bamboo flute made from *madaké* (giant timber bamboo) (*Phyllostachys bambusoides*).
Siku	**(Ay.)** Flute type in the local Aymara organology. Dry season rural raft panpipes of several tubes (single or double rowed) mostly played with complementary pairs (*ira* and *arka*) in interlocking technique (hocketing), Crafted from *chhalla* bamboo (*Rhipidocladum*).

Sikuchhalla (Ay.) (literally) ‘Dried Cane of Panpipe’. Other word for *chhalla*. See **Chhalla**

Sikudjid Local Mosetén name which denominates panpipe bamboos known as (*siku*)*chhalla* in Aymara. See **Chhalla** and **Sikuchhalla**

Sikuluriri (Ay.) (literally) ‘The one who makes *siku*’. Andean panpipe maker.

Sikureada Urban mestizo panpipe style. For further information see (Río 2012).

Sikuya Aymara name for Andean feather grass (Stipa sp.). According to Walateño panpipe makers, the etymological origin of the word *siku*. See **Siku**

Sirinu/Sirina Other local terms for *añchañchu*. See **Añchañchu**

Suqus Tarqa Former *suqusa*-made *tarqa*. See **Tarqa**

Suqusa (Ay.) Giant Reed (*Arundo donax*). Used to make flutes in the Bolivian Andes.

Suri Siku Panpipe style played on the southern Altiplano between La Paz and Oruro department. The interlocking techniques is manifested through on- and offbeat blowing called *kupi*/*ch’iqa* in Aymara (right/left).

Tabla Membranophone percussion instrument from the Indian subcontinent.

Tabla Siku Rectangular panpipes with stoppers (natural bamboo nodes) inside the *chhalla* tubes. Often crafted with octave forming double rows. Mostly used for playing the *huayno siku* style. See **Sikureada**

Tacuara Local Spanish name mostly used for lowland bamboo species within the *Guadua* woody bamboo genus. *Guadua* bamboos have notorious thorns at their nodes and therefore *ch’aphini* in Aymara or ‘with thorns’.

Tambo/Tampu (Que.) Incan structure built for administration purposes along Incan roads, containing supplies and serving as lodging for itinerant state personnel.

Tapani (Ay.) (literally) 'With Block'. Combination of the Spanish word *tapa* meaning block and the Aymara suffix -*ni* indicating possession. Used as a local Aymara category to group rainy season duct flutes. The block is also referred to as *tapatiru* in Aymara, which is a phoneme translation (sp. *refonemización*) of the Spanish word *tapa*.

Tapatiru (Ay.) (Spanish phoneme translation) Duct Flute Block. See also **Tapani**

Tara Quechua word for the Aymara word *richa*. See **Richa**

Tari (Ay.) Colourful hand-woven textile for carrying coca leaves.

Tarqa (Ay.) Flute type in the local Aymara organology. Heavy wooden rainy season flute with internal duct and six fingerholes, which produces the notorious pulsating multiphonic sound phenomenon called *richa* in Aymara and *tara* in Quechua. See **Richa**

Tarq Luriri (Ay.) (literally) 'The one who makes *tarqa*'. Andean *tarqa* duct flute maker.

Tropa (Sp.) (literally) 'Troup'. Term used for collective flute consort.

Tucumana (Sp.) Bolivian variety of fried empanada.

Tupu (Ay.) (literally) 'Measure'. Measuring stick made from *tuquru* bamboo used by Andean flute makers to engrave organological information of generic flute types and their local variants.

Tuqurero (Ay.) *Tuquru* bamboo trader/collector.

Tuquru (Ay.) Aymara name for vertical and transverse flute bamboo (mainly in the Andean woody bamboo genus of *Aulonemia*, but recently also some *Guadua* and *Bambusa* species).

Tuqur Uma (Ay.) Water of *Tuquru*. *Tuquru* internode water used to heal lung diseases.

Tuyu One of the panpipe registers, extremely large size, bass register.

Uma Marka (Ay.) (literally) 'Land of Water'. *Páramo* community in Arcopongo canton in the Inquisivi municipality (La Paz department).

Uma Nayra (Ay.) (literally) 'Eye of Water'. Spring.

Vintana (Ay.) (Spanish phoneme translation) (literally) 'Window'. Used to denominate the labium in internal duct flutes.

Wak'a (Ay.) (literally) Sash. Refers to sacred places in the Andes, where ancestor tutelar spirits (*ajayu uywiri*) and their knowledge come together. Mostly related to immense rocks, where spiritual energy is centred.

Walata Chico Rural peasant community on the *altiplano paceño* in Achacachi Municipality, Omasuyos Province (La Paz department). Neighbouring community of Walata Grande. Many community members of Walata Chico have specialized in musical bamboo trading.

Walata Grande Rural peasant community on the *altiplano paceño* in Achacachi Municipality, Omasuyos Province (La Paz) specialised in Andean highland Indigenous flute making.

Wankara (Ay.) Two-headed and straight-sided cylindrical tabor with two membranes, one having a snare string with cactus spines.

Wari Q'asaya (Ay.) (figuratively) 'Making Vicuñas Cry Out'. Part of an Aymara saying about the strong frost during *juyphi pacha* (June, July).

Wiskhu (Ay.) Sandals made from Car Tyres.

Yatiri	(Ay.) (literally) 'The one who knows'. Sage/Wise man. One particular manifestation of Andean shaman/healer. In Quechua called *yachaj*. See **Amawt'a** and **Qulliri**
Yungas	Andean Ecoregion. Transitional zone between Andean highlands and eastern tropical lowland forests of the Amazon. Mostly covered by highly biodiverse cloud forests. Derives from the Aymara term *yunka* meaning 'warm or template earth/land'. See also **Manqha Yunka**
Zampoña	(Sp.) Andean raft panpipes. Used to denominate the professional urban panpipe tuned in a Western scale and standard equal temperament. Opposed to *siku* in Aymara with local cuts. See **Siku**
Zongo	*Chhalla* bamboo-sourcing region. Zongo is a community in the subtropical Yungas valley northeast of the city of La Paz of the same name. In the subtropical Zongo valley, a very thin-walled *chhalla* bamboo grows, particularly appreciated by folklore musicians and professional urban (concert) panpipes.

List of References

Abercrombie, T.A. (1998) *Pathways of Memory and Power: Ethnography and History Among an Andean People*. Madison: The University of Wisconsin Press.

Adhikari, U. (2013) *Bamboo Flowering, Human Security, and the State: A Political Ecological Study of the Impact of Cyclical Bamboo Flowering on Human Security and the Role of State in Mizoram.* PhD Thesis, University of North Bengal, Shiliguri, India.

Alberti, G. & Mayer, E. (1974) 'Reciprocidad Andina: Ayer y Hoy', in Alberti, G. & Mayer, E. (eds.) *Reciprocidad e Intercambio en los Andes Peruanos.* Lima: Instituto de Estudios Peruanos, pp. 13-33.

Albó, X., Sandoval, G. & Greaves, T. (1981-1987) *Chukiyawu: La Cara Aymara de La Paz*. (4 Vol.). La Paz: CIPCA.

Aldunate, P., Paz, O. & Halvarsen, K. (2006) 'Los Efectos de la Contaminación Atmosférica por PM10 sobre la Salud Ciudad de La Paz – Bolivia (3650 m.s.n.m.)', *Acta Nova*, 3(2), pp. 422-442.

Allen, A.S. (2012) '"Fatto di Fiemme": Stradivari's Violins and the Musical Trees of the Paneveggio', in Auricchio, L., Heckendorn Cook, E., & Pacini, G. (eds.) *Invaluable Trees: Cultures of Nature, 1660-1830*. Oxford: Voltaire Foundation, pp. 301-315.

_____ (2013) 'Ecomusicology', in *Groove Dictionary of American Music*. (2nd Ed.). New York: Oxford University Press.

_____ (2017) 'Sustainable Futures for Music Cultures: An Ecological Perspective', *Ethnomusicology Forum*, 26(3), pp. 400-405. DOI: 10.1080/17411912.2017. 1395288.

_____ (2018) 'One Ecology and Many Ecologies: The Problem and Opportunity of Ecology for Music and Sound Studies', *MUSICultures*, 45(1-2), pp. 1-13.

_____ (2019) 'Sounding Sustainable; or, The Challenge of Sustainability', in T.J. Cooley, T.J. (ed.) *Cultural Stainabilities*. Urbana: The University of Illinois Press, pp. 43-59.

Allen, A.S. & Hachmeyer, S. (Forthcoming) 'Sustainability, Interdisciplinarity, and Activism in Ecomusicology: A Conversation with Dr. Aaron S. Allen', *Contrapunto. Revista de Musicología*, tbc.

Allen, A.S. & Dawe, K. (eds.) (2016) *Current Directions in Ecomusicology. Music, Nature, Environment.* London and New York: Routledge.

Allen, A.S. & Libin, L. (2014) 'Sustainability', in *Grove Dictionary of Musical Instruments.* (2nd Ed.). New York: Oxford University Press.

Álvarez C., H.A. (2015) *Diversificación de la Producción y Cultivo de Coca en los Yungas del Departamento de La Paz, 2002-2012*. Licenciatura Thesis, Universidad Mayor de San Andrés, La Paz, Bolivia.

Amazon Cooperation Treaty Organisation (ACTO) (2014) 'Monitoring Forest Cover in the Amazon Region', Newsletter 1, ACTO, November 2014. Available at: http://www.otca-oficial.info/assets/documents/20170220/db5f4f49d05a2eb251ee46ef002c1b34.pdf (Accessed 16 December 2019).

Amin, S. (1976) *Unequal Development*. New York: Monthly Review Press.

Andersen, L.E. (2013) *The Drivers, Causes, and Actors of Deforestation in Bolivia*. La Paz: INESAD. Available at: http://inesad.edu.bo/images/stories/Sintesis/img/boletnsintesisnro8.pdf (Accessed: 18 June 2020).

_____ (2014) *La Economía del Cambio Climático en Bolivia: Impactos sobre la Biodiversidad*. Washington DC: Banco Interamericano de Desarrollo, Monografía No. 192.

Andersen, L.E. & Jemio, L.C. (eds.) (2015) *La Dinámica del Cambio Climático en Bolivia*. La Paz: Fundación INESAD.

Andersen, L.E. & Ledezma, J.C. (2019) 'Los Impactos de la Deforestación en la Biodiversidad de Bolivia', *SDSN Bolivia*, 28 May. Available at: https://www.sdsnbolivia.org/los-impactos-de-la-deforestacion-en-la-biodiversidad-de-bolivia/ (Accessed: 5 April 2020).

Andersen, L.E., Doyle, A.S., Del Granado, S., Ledezma, J.C., Medinaceli, A., Valdivia, M. & Weinhold, D. (2016) 'Net Carbon Emissions from Deforestation in Bolivia during 1990-2000 and 2000-2010: Results from a Carbon Bookkeeping Model', *PloS ONE*, 11(3), e0151241. DOI: 10.1371/journal.pone.015124.

Antequera, N. (2011) 'Itinerarios Urbanos: Continuidades y Rupturas Urbano Rurales', in Antequera, N. & Cielo, C. (eds.) *Ciudad sin Fronteras: Multilocalidad de lo Urbano Rural en Bolivia*. La Paz: Plural Editores, pp. 23-40.

_____ (2017) 'La Gestión de la Economía Rural desde los Centros Urbanos: El Control Vertical de los Pisos Socioeconómicos', in Fundación Tierra (ed.) *Repensando el Modelo Agrario Boliviano: Situación Actual y Dinámicas de Cambio*. La Paz: Fundación Tierra, pp. 141-146. Available at: http://www.ftierra.org/index.php?option=com_mtree&task=att_download&link_id=163&cf_id=77 (Accessed: 10 April 2020).

_____ (2019) 'El Control Vertical de los Pisos Socioeconómicos: La Multilocalidad como Estrategia de Ocupación Territorial Urbano Rural de las Comunidades Andinas de Bolivia', in Horbath, J.E. & Gracia, M.A. (eds.) *Indígenas en las Ciudades de las Américas: Condiciones de Vida, Procesos de Discriminación e Identificación y Lucha por la Ciudadanía Étnica*. Buenos Aires: Miño y Dávila, pp. 93-116.

Appadurai, A. (1986) 'Introduction: Commodities and the Politics of Value', in Appadurai, A. (ed.) *The Social life of Things: Commodities in Cultural Perspective*. Cambridge: Cambridge University Press, pp. 3-63.

Arauco, M.A. (2011) *Los Jairas y el Trío Domínguez, Favre, Cavour: Creadores del Neo-Folklore en Bolivia (1966-1973)*. La Paz: All Press Labores Gráficas.

Araújo, M.B. & William, P.H. (2000) 'Selecting Areas for Species Persistence using Occurrence Data*', Biological Conservation*, 96(3), pp. 331-345. DOI:10. 1016/S0006-3207(00)00074-4.

Araujo, N., Müller, R., Nowicki, C. & Ibisch, P. (eds.) (2010) *Prioridades de Conservación de la Biodiversidad de Bolivia*. Santa Cruz: Editorial FAN.

Araújo, S. (2008) 'From Neutrality to Praxis: The Shifting Politics of Ethnomusicology in the Contemporary World', *Muzikološki zbornik*, 44(1), pp. 13-30. DOI: 10.4312/mz.44.1.13-30.

Autoridad de Fiscalización y Control Social de Boques y Tierras (ABT) (2011) *Informe Anual 2010 y Balance de Década*. Available at: http://www. abt.gob.bo/images/stories/Transparencia/InformesAnuales/informe_anual_2 010_balance_decada.pdf (Accessed: 20 March 2019).

_____ (2016) *Deforestación en Bolivia (2012-2015)*. Available at: http://www .abt.gob.bo/images/stories/Transparencia/InformesAnuales/memorias-2012- 2015/Memoria_Deforestaci%C3%B3n_2012_2015_opt.pdf (Accessed: 20 March 2019).

_____ (2018) *Deforestación en el Estado Plurinacional de Bolivia: Periodo 2016-2017*. Available at: http://www.abt.gob.bo/images/stories/Transparencia/ InformesAnuales/memorias-2016.2017/Memoria_Deforestacion_2016_2017 _opt.pdf (Accessed: 20 March 2019).

Baber, Z. (2016) 'The Plants of Empire: Botanic Gardens, Colonial Power and Botanical Knowledge', *Journal of Contemporary Asia*, 46(4), pp. 1-21. DOI:10.1080/00472336.2016.1185796.

Bailey, S.A., Haines-Young, R.H. & Watkins, C. (2002) 'Species Presence in Fragmented Landscapes: Modeling of Species Requirements at the National Level', *Biological Conservation,* 108(3), pp. 307-316. DOI: 10.1016/S0006-3207(02)00119-2.

Bailón, J. (2004) 'La Chicha no Muere ni se Destruye, sólo se Transforma', *Íconos,* (18), pp. 53-62.

Balint, P.J., Steward, R.E., Desai, A. & Walters, L.C. (2011) *Wicked Environmental Problems: Managing Uncertainty and Conflict*. Washington: Island Press.

Banik, R.L. (2015) 'Morphology and Growth', in Liese, W. & Kohl, M. (eds.) *Bamboo: The Plant and its Uses*. Basel: Springer International Publishing, pp. 43-89.

Barraclough, S.L. & Ghimire, K.B. (2000) *Agricultural Expansion and Tropical Deforestation: Poverty, International Trade, and Land Use*. London: Earthscan.

Barragán, F. (2002) 'La Zampoña Criolla y su Relación con la Música Popular', in Sánchez C., W. (ed.) *La Música en Bolivia. de la Prehistoria a la Actualidad*. Cochabamba: Fundación Simón I. Patiño, pp. 331-353.

Barth, F. (1967) 'Economic Spheres in Dafur', in Firth, R. (ed.) *Themes in Economic Anthropology*. London: Tavistock Publications, pp. 149-174.

Bastien, J.W. (1985) 'Qollahuaya-Andean Body Concepts: A Topographical-Hydraulic Model of Physiology', *American Anthropologist,* 87(3), pp. 595-611. DOI: 10.1525/aa.1985.87.3.02a00050.

Bates, E. (2012) 'The Social Life of Musical Instruments', *Ethnomusicology,* 56(3), pp. 363-395. DOI: 10.5406/ethnomusicology.56.3.0363.

Baumann, M.P (1980) *Música Andina de Bolivia* [CD and Booklet]. Cochabamba: Centro Postales.

_____ (1982) *Musik im Andenhochland, Bolivien* [CD and Booklet]. Berlin: Museum für Völkerkunde Berlin.

_____ (1985) 'The Kantu Ensemble of the Kallawaya at Charazani (Bolivia)', *Yearbook of Traditional Music,* 17, pp. 146-166.

_____ (1988) 'La Aculturación y el Concepto de Grupos Musicales en las Zonas Rurales y Urbanas de los Andes Bolivianos', *Boletín Andino de Música,* 1, pp. 6-15.

_____ (ed.) (1996) *Cosmología y Música en los Andes*. Frankfurt am Main/Madrid: Vervuert/Iberioamericana.

Beaudry, N. (2008) 'The Challenge of Human Relations in Ethnographic Inquiry: Examples from Artic and Subartic Fieldwork', in Barz, G.F. & Cooley, T.J. (eds.) *Shadows in the Field: New Perspectives for Fieldwork in Ethnomusicology*. (2nd Ed.). Oxford: Oxford University Press, pp. 224-245.

Beck, S.G. (1998) 'Ecología y Fitogeografía de las Gramíneas en Bolivia', in Renvoize, S.A. (ed.) *Gramíneas de Bolivia*. London: Kew Publishing.

_____ (2014) 'Las Regiones y Zonas de Vegetación', in Jørgensen, P.M., Nee, M.H. & Beck, S.G. (eds.) *Catálogo de las Plantas Vasculares de Bolivia*. St. Louis: Missouri Botanical Garden Press, pp. 3-20.

Bellenger, X. (2007) *El Espacio Musical Andino: Modo Ritualizado de la Producción Musical en la Isla de Taquile y en la Región del Lago Titicaca*. Lima: IFEA.

Bendrups, D. & Schippers, H. (eds.) (2015) 'Sound Futures: Exploring Contexts for Music Sustainability', *The World of Music*, 4(1).

Bennett, B. C. 2016. 'The Sound of Trees: Wood Selection in Guitars and Other Chordophones', *Economic Botany*, 70 (1): pp. 49-63. https://doi.org/10.1007/s12231-016-9336-0.

Berardi, A., Tschirhart, C., Mistry, C., Bignante, E., Haynes, L., Albert, G., Benjamin, R., Xavier, R. & Jafferally, D. (2013) 'From Resilience to Viability: A Case Study of Indigenous Communities of the North Rupununi, Guyana', *EchoGéo*, 24(23). DOI: 10.4000/echogeo.13411.

Berkes, F. (2012). *Sacred Ecology*. (3rd Ed.). London and New York: Routledge.

Berkes, F. & Folke, C. (eds.) (1998) *Linking Sociological and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience.* New York: Cambridge University Press.

Berkes, F., Colding, J. & Folke, C. (eds.) (2003) *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*. New York: Cambridge University Press.

Bigenho, M. (2002) *Sounding Indigenous: Authenticity in Bolivian Music Performance*. New York: Plagrave.

_____ (2005) 'Making Music Safe for the Nation: Folklore Pioneers in Bolivian Indigenism', in Canessa, A. (ed.) *Natives Making Nation: Gender, Indigeneity and the State in the Andes*. Tucson: The University of Arizona Press, pp. 60-80.

_____ (2009a) 'To Sell or Not to Sell the Pomade: Andean Music Boom Stories and Bolivian Nationalism', *Diagonal: Journal of the Center for Iberian and Latin American Music*, 6, pp. 1-18.

_____ (2009b) ‘Para Repensar el Mestizaje a través del Folklore Boliviano: La Reorganización del Espacio Urbano Compartido en la Revolución de 1952’, in Wanderley, F. (ed.) *Estudios Urbanos: En la Encrucijada de la Interdisciplinaridad*. La Paz: CIDES-UMSA, pp. 243-268.

_____ (2012) *Intimate Distance: Andean Music in Japan*. Durham: Duke University Press.

Bigenho, M. & Stobart, H. (2016) ‘The Devil in Nationalism: Indigenous Heritage and the Challenges of Decolonization’, *International Journal of Cultural Property*, 23(2), pp. 141-166. DOI: 10.1017/S0940739116000114.

_____ (2018) ‘Grasping Cacophony in Bolivian Heritage Otherwise’, *Anthropological Quarterly*, 91(4), pp. 1329-1364. DOI: *10.1353/anq.2018.0067*.

_____ (Forthcoming) *Heritage Fever: Law and Cultural Politics in a Decolonizing Bolivia*. tbc.

Bigenho, M., Cordero, J.C., Mújica, R., Rozo, B. & Stobart, H. (2015) ‘La Propiedad Intelectual y las Ambigüedades del Dominio Público: Casos de la Producción Musical y la Patrimonialización’, in Rojas O., G. (ed.) *Lo Publico en la Pluralidad: Ensayos desde Bolivia y América Latina*. La Paz: Plural, pp. 131-162.

Bigenho, M, Stobart, H. & Mújica, R. (2018) ‘From *Indigenismo* to *Patrimonialismo*: An Introduction to the Special Issue on Music and Cultural Heritage Making in Latin America’, *TRANS-Transcultural Music Review*, 21-22. Available at: http://www.sibetrans.com/trans/public/docs/0d-en-trans-2018.pdf (Accessed: 25 April 2020).

Blok, A. & Jensen, T.E. (2011) *Bruno Latour: Hybrid Thoughts in a Hybrid World.* London and New York*: Routledge.*

Bohannan, P. & Bohannan, L. (1968) *Tiv Economy*. Evanston: Northwestern University Press.

Borras, G. (1992) ‘La Musique des Andes en France: L'Indianité ou comment la Récupérer’, *C.M.H.L.B. Caravelle,* 58(1), pp. 141-150.

_____ (1995) *Les Aerophones Traditionnels Aymaras dans le Département de La Paz (Bolivie)*. PhD Thesis, University of Toulouse, Toulouse, France.

_____ (1998) ‘“Poco Varía”: Le Sésame de l'Organologie Aymara’, in CORDAE-La Talvera (ed.) *Musiques d'Amérique Latine*. Cordes: CORDAE-La Talvera, pp. 33-46.

_____ (2000) ‘Lectura y Escritura en las Medidas de los Sikuluriri’, in MUSEF (ed.) *Anales de la Reunión Anual de Etnología, 18, 19, 20 y 21 de Agosto de 1999 (Vol. II)*. La Paz: MUSEF, pp. 171-181.

_____ (2001) ‘Músicas Tradicionales y Dinámicas Sociales entre los Aymaras del Altiplano Boliviano’, in MUSEF (ed.) *Anales de la Reunión Anual de Etnología, 23, 24, 25 y 26 de Agosto de 2000 (Vol. II)*. La Paz: MUSEF, pp. 133-143.

_____ (2002) ‘Una Lectura de la Práctica Musical Indígena Altiplánica en la Segunda Mitad del Siglo XX a partir del Archivo de Medidas de Walata Grande’, in Sánchez C., W. (ed.) *La Música en Bolivia. De la Prehistoria a la Actualidad*. Cochabamba: Fundación Simón I. Patiño, pp. 457-479.

_____ (2010) ‘Organología de la Tarka en la Zona Circunlacustre del Titicaca’, in Gérard, A. (ed.) *Diablos Tentadores y Pinkillus Embriagadores, Tomo I*. La Paz: Plural, pp. 41-67.

Bourdieu, P. (1977) *Outline of a Theory of Practice*. Cambridge: Cambridge University Press.

Bouysse-Cassagne, T. (1987) *La Identidad Aymara: Aproximación Histórica (Siglo XV, siglo XVI)*. La Paz: HISBOL-IFEA.

Boyle, W.A. & Waterman, E. (2016) ‘The Ecology of Musical Performance: Towards a Robust Methodology’, in Allen, A.S. & Dawe, K. (eds.) *Current Directions in Ecomusicology. Music, Nature, Environment*. London and New York: Routledge, pp. 25-39.

Bradley, B. (1982) ‘Resistance to Capitalism’, in Lehmann, D. (ed.) *Ecology and Exchange in the Andes*. Cambridge: The Cambridge University Press, pp. 97-122.

Brandt, P, Ernst, A., Gralla, F., Luederitz, C., Lang, D.J., Newig, J., Reinert, F., Abson, D.J. & Wherden, H. von (2013) ‘A Review of Transdisciplinary Research in Sustainability Science’, *Ecological Economics*, 92, pp. 1-15. DOI: 10.1016/j.ecolecon.2013.04.008.

Brandis, D. (1899) ‘Biological Notes on Indian Bamboos’, *Indian Forester*, 25(1), pp. 1-25.

Brémaud, I. (2012) ‘Acoustical Properties of Wood in String Instruments Soundboards and Tuned Idiophones: Biological and Cultural Diversity’, *The Journal of the Acoustical Society of America*, 131(1), pp. 807-818. DOI: 10.1121/1.3651233.

Brennan, M. & Devine, K. (2020) ‘The Cost of Music’, *Popular Music*, 39(1), pp. 43-65. DOI: 10.1017/S0261143019000552.

Budke, J.C., Alberti, M.S., Zanardi, C., Baratto, C. & Zanin, E.M. (2010) 'Bamboo Dieback and Tree Regeneration Responses in a Subtropical Forest of South America', *Forest Ecology and Management*, 260(8), pp. 1345-1349. DOI: 10. 1016/j.foreco.2010.07.028.

Buechler, H.C. (1980) *The Masked Media: Aymara Fiestas and Social Interaction in the Bolivian Highlands*. The Hague: Mouton Publishers.

Bunker, S.G. (1985) *Underdeveloping the Amazon: Extraction, Unequal Exchange, and the Failure of the Modern State*. Urbana: The University of Illinois Press.

Burman, A. (2016) *Indigeneity and Decolonization in the Bolivian Andes*. Lanham: Lexington Books.

_____ (2017) 'The Political Ontology of Climate Change: Moral Meteorology, Climate Justice, and the Coloniality of Reality in the Bolivian Andes', *Journal of Political Ecology*, 24(1), pp. 921-938. DOI: 10.2458/v24i1.20974.

_____ (2018) 'Are Anthropologists Monsters? An Andean Dystopian Critique of Extractivist Ethnography and Anglophone-Centric Anthropology', *Journal of Ethnographic Theory*, 8(1/2), pp. 48-64. DOI: 10.1086/698413.

_____ (2020) 'Black Hole Indigeneity: The Explosion and Implosion of Radical Difference as Resistance and Power in Andean Bolivia', *Journal of Political Power*, 13(2), pp. 179-200. DOI: 10.1080/2158379X.2020.1764802.

Bystriakova, N. & Kapos, V. (2006) 'Bamboo Diversity: The Need for a Red List Review', *Biodiversity*, 6(4): 12-16. DOI: 10.1080/14888386.2005.9712780.

Bystriakova, N., Kapos, V., Lysenko, I. & Stapleton, C.M.A. (2003a) 'Distribution and Conservation Status of Forest Bamboo Biodiversity in the Asia-Pacific Region', *Biodiversity and Conservation*, 12(9), pp. 1833-1841. DOI:10.1023/ A:1024139813651.

Bystriakova, N., Kapos, V., Stapleton, C. & Lysenko, I. (2003b) *Bamboo Biodiversity: Information for Planning Conservation and Management in the Asia-Pacific Region*. UNEP-WCMC/INBAR Biodiversity Series 14. Available at: https://archive.org/details/bamboobiodiversi03byst (Accessed: 28 November 2019).

Bystriakova, N., Kapos, V. & Lysenko, I. (2004) *Bamboo Biodiversity: Africa, Madagascar, and the Americas*. UNEP-WCMC/INBAR Biodiversity Series 19. Available at: https://archive.org/details/bamboobiodiversi03byst (Accessed 28 November 2019).

CAIT Climate Data Explorer (2019) 'Country Greenhouse Gas Emissions'. Washington, DC: World Resources Institute. Available at: http://cait.wri.org (Accessed: 16 March 2020).

Canessa, A. (2012) *Intimate Indigeneities: Race, Sex, and History in the Small Spaces of Andean Life*. Durham: Duke University Press.

Castelblanco, D. (2014) 'Soplando Sikus más allá del Titicaca: Conjuntos de Sikuris como Islas del Archipiélago Cultural Transandino en Buenos Aires, Santiago y Bogotá', *Revista de Crítica Literaria Latinoamericana*, 40(2), pp. 265-282.

_____ (2018) 'Sikuris Altiplánicos, Regionales y Metropolitanos: Revisión de un Esquema de Clasificación', in Sánchez H., C. (ed.) *Música y Sonidos en el Mundo Andino: Flautas de Pan, Zampoñas, Antaras y Ayarachis*. Lima: Fondo Editorial de la Universidad Nacional Mayor de San Marcos, pp. 485-510.

_____ (2019) 'Del Ayllu a la Metrópoli: Transformación de los Usos y Significados de la Música Aymara al Interior de una Comunidad Transnacional de Resurgentistas de la Música Andina', *Latin American Music Review*, 40(2), pp. 105-137. DOI: 10.7560/LAMR40201.

Cavour A., E. (2010) *Instrumentos Musical es de Bolivia*. (3rd Ed.). La Paz: Produccióntes Cima.

Céspedes, G.W. (1984) 'New Currents in Música Folklórica in La Paz, Bolivia', *Latin American Music Review*, 5(2), pp. 217-242.

Céspedes P., R. (2000) 'Excavaciones Arqueológicas en Piñami', *Boletín INIAM-UMSS*, No. 9. Available at: http://www.museo.umss.edu.bo/files/shares/virtuales/boletines/Boletin-INIAM-N9-Excavaciones-arqueologicas-en-Pi%C3%B1ami.pdf (Accessed: 12 May 2020).

_____ (2002) 'Instrumentos Musicales durante el Horizonte Medio (Caravanas Tiwanaku y su Influencia)', in Sánchez C., W. (ed.) *La Música de Bolivia: De la Prehistoria a la Actualidad*. Cochabamba Fundación Simón I. Patino, pp. 65-74.

Chacama, J. (2004) 'El Horizonte Medio en los Valles Occidentales del Norte de Chile (ca. 500-1200 d.C.)', *Chungara: Revista de Antropología Chilena*, 36 (Número Especial I), pp. 227-233. DOI: 10.4067/S0717-7356200400030 0025.

Chacama R., J. & Díaz A., A. (2011) 'Cañutos y Soplidos: Tiempo y Cultura en las Zampoñas de las Sociedades Precolombinas de Arica', *Revista Musical Chilena*, 65(216), pp. 34-57. DOI: 10.4067/S0716-27902011000200003.

Chambers, L. (2018) 'Feed the Soil, Not the Plant: Case Studies in the Sustainability of Ontario's Regional Orchestras', *MUSICultures*, 45(1-2), pp. 146-166.

Chase, J.M. & Leibold, M.A. (2003) *Ecological Niches: Linking Classical and Contemporary Approaches*. Chicago: The University of Chicago Press.

Chauhan, N.S. & Saxena, R.N. (1985) 'The Phenomenon of Bamboo Flowering and associated Increase in Rodent Population in Mizoram', *Journal of the Bombay Natural History Society*, 83(3), pp. 644-647.

Choque C., R. (1992) 'Historia', in van den Berg, H. & Schiffers, N. (eds.) *La Cosmovisión Aymara*. La Paz: UCB/Hisbol, pp. 59-80.

Clark, L.G. (1990) 'Diversity and Biogeography of Neotropical Bamboo (Poaceae: Bambuseae)', *Acta Botanica Brasilica*, 4(1), pp. 125-132. DOI:10.1590/S0102-33061990000100009.

_____ (1995) 'Diversity and Distribution of the Andean Woody Bamboos (Poaceae: Bambuseae)', in Churchill, S.P., Balslev, H., Forero, E. & Luteyn, J.L. (eds.) *Biodiversity and Conservation of Neotropical Mountain Forests*. New York. New York Botanical Garden, pp. 501-512.

_____ (2001) 'Diversification and Endemism in Andean Woody Bamboos (Poaceae: Bambusoideae)', *Bamboo Science and Culture, The Journal of the American Bamboo Society*, 15(1), pp. 14-19.

Clayton, W.D., Vorontsova, M.S., Harman, K.T. & Williamson, H. (2006 onwards) 'GrassBase - The Online World Grass Flora'. Available at: http://www.kew.org/data/grasses-db.html (Accessed: 19 March 2017).

Clifford, J. (1997) *Routes: Travel and Translation in the Late Twentieth Century*. Cambridge: Harvard University Press.

Cohen, E. (1989) 'The Commercialization of Ethnic Arts', *Journal of Design History*, 2(2/3), pp. 161-168.

Colque, G. (2014) *Expansión de la Frontera Agrícola: Luchas por el Control y Apropiación de la Tierra en el Oriente Boliviano*. La Paz: Fundación Tierra.

Colque, G., Tinta, E. & Sanjinés, E. (2016) *Segunda Reforma Agraria: Una Historia que Incomoda*. La Paz: Fundación Tierra.

Colwell, R.K. & Rangel, T. (2009) 'Hutchinson's Duality: The Once and Future Niche', *Proceedings of the National Academy of Science*, 106(Supplement 2), pp. 19651-19658. DOI: 10.1073/pnas.0901650106.

Convis, C.L. (2001) *Conservation Geography: Case Studies in Gis, Computer Mapping, and Activism*. Redlands: ESRI Press.

Cornejo-Mejía, M., Jørgensen, P.M., Macía, M.J., Loza, I., Fuentes, A. & Cayola, L. (eds.) (2011) *Memorias de los 10 Años de Investigación Botánica realizada en la Región Madidi: "Conociendo una de las Regiones más Biodiversas del Mundo"*. La Paz: Herbario Nacional de Bolivia, Missouri Botanical Garden.

Cortes, G. (2004) *Partir Para Quedarse. Supervivencia y Cambio en las Sociedades Campesinas Andinas de Bolivia*. La Paz: IRD, Plural, IFEA.

Cuéllar, S. & Larrea, D.M. (2016) 'Pérdida de Carbono por Deforestación Reciente (2010-2013) en las Tierras Bajas y Yungas de Bolivia'. *Ecología en Bolivia*, 51(1), pp. 15-25.

Cuéllar, S., Quintanilla, M.I. & Larrea, D.M. (2015) 'Deforestación', in Fundación Amigos de la Naturaleza (ed.) *Atlas Socioambiental de las Tierras Bajas y Yungas de Bolivia*. Santa Cruz: FAN, pp. 75-81.

Cuéllar, S., Rodríguez, A., Arroyo, J., Espinoza, S. & Larrea, D.M. (2012) Mapa de Deforestación de las Tierras Bajas y los Yungas de Bolivia 2000-2005-2010. Proyección Sistema de Coordenadas Geográficas, Datum WGS84. Santa Cruz: Fundación Amigos de la Naturaleza (FAN). 1 Mapa col. 75x70.

Curtis, J. (1993) 'Sustainability: An Issue Confronting Luthiers', *American Lutherie: The Quarterly Journal of the Guild of American Luthiers,* 33(1), pp. 40-45.

Dalagnol, R., Wagner, F.H. Galvão, L.S. Nelson, B.W. & Oliveira e Cruz Aragão, L.E. (2018) 'Life Cycle of Bamboo in the Southwestern Amazon and its Relation to Fire Events', *Biogeosciences*, 15(20), pp. 6087-6104. DOI: 10.5194/bg-15-6087-2018.

Dangl, B. (2019) *The Five Hundred Year Rebellion: Indigenous Movements and the Decolonization of History in Bolivia*. Edinburgh: AK Press.

Darabant, A., Rai, P.B., Staudhammer, C.L. & Dorji, T. (2012) 'Harvesting Method Optimizing Shoot and Culm Production in *Dendrocalamus hamiltonii*', in Gielis, J. & Potters, G. (eds.) *9th World Bamboo Congress Proceedings 10-12 April 2012, Vol 1*. Massachusetts: World Bamboo Organization, pp. 148-162. Available at: https://worldbamboo.net/wbcix/WBCIX_Part1_Proceedings.pdf (Accessed: 5 May 2020).

_____ (2016) 'Designing and Evaluating Bamboo Harvesting Methods for Local Needs: Integrating Local Ecological Knowledge and Science', *Environmental Management,* 58(2). DOI: 10.1007/s00267-016-0702-6.

Das, M., Bhattacharya, S., Singh, P., Filgueiras, T.S. & Pal, A. (2008) 'Bamboo Taxonomy and Diversity in the Era of Molecular Markers', *Advances in Botanical Research,* 47, pp. 225-268. DOI: 10.1016/S0065-2296(08)00005-0.

Dawe, K. (2001) 'People, Objects, Meaning: Recent Work on the Study and Collection of Musical Instruments', *The Galpin Society Journal*, 54(1), pp. 219–32. DOI: 10.2307/842454.

_____ (2005) 'Symbolic and Social Transformation in the Lute Cultures of Crete: Music, Technology, and the Body in a Mediterranean Society', *Yearbook for Traditional Music,* 37(1), pp. 58–68. DOI: 10.2307/S074015580001122X.

_____ (2007) *Music and Musicians in Crete: Performance and Ethnography in a Mediterranean Island Society*. Lanham: Scarecrow Press.

_____ (2013) 'Guitar Ethnographies: Performance, Technology, and Material Culture', *Ethnomusicology Forum*, 22(1), pp. 1-25. DOI:10.1080/17411912.2013.774158.

_____ (2016) 'Materials Matter: Towards a Political Ecology of Musical Instrument Making', in Allen, A.S. & Dawe, K. (eds.) *Current Directions in Ecomusicology: Music, Nature, Environment*. London and New York: Routledge, pp. 109-121.

De Carvalho, A.L., Nelson, B.W., Bianchini, M.C., Plagnol, D., Kuplich, T.M. & Daly, D.C. (2013) 'Bamboo-Dominated Forests of the Southwest Amazon: Detection, Spatial Extent, Life Cycle Length, and Flowering Waves', *PLoS ONE*, 8(1), e54852. DOI: 10.1371/journal.pone.0054852.

DeVale, S.C. (1990) 'Organizing Organology', in DeVale, S.C. (ed.) *Issues in Organology: Selected Reports in Ethnomusicology, Vol. 8*. Los Angeles: UCLA Ethnomusicology Publications, pp. 1-34.

Devine, K. (2015) 'Decomposed: A Political Ecology of Music', *Popular Music*, 34(3), pp. 367-389. DOI:10.1017/S026114301500032X.

_____ (2019) *Decomposed: The Political Ecology of Music*. Cambridge: The MIT Press.

Dimiceli, C., Carroll, M., Sohlberg, R., Kim, D.H., Kelly, M. & Townshend, J.R.G. (2015) *MOD44B MODIS/Terra Vegetation Continuous Fields Yearly L3 Global 250m SIN Grid V006* [Data set]. NASA EOSDIS Land Processes DAAC. Available at: https://doi.org/10.5067/MODIS/MOD44B.006 (Accessed: 27 March 2017).

Dirksen, R. (2019) 'Haiti's Drums and Trees: Facing Loss of the Sacred', *Ethnomusicology*, 63(1), pp. 43-77. DOI:10.5406/ethnomusicology.63.1.0043.

Dirzo, R. & Raven, P.H. (2003) 'Global State of Biodiversity and Loss', *Annual Review Environment and Resources*, 28, pp. 137-167. DOI: 10.1146/annurev.energy.28.050302.105532.

Domínguez F., N. & Presta, A.M. (2003) 'Homenaje a Thierry Saignes', *Revista Andina*, 21(1) (2003, No. 36), pp. 263-295.

Drake, J.M., Randin, C. & Guisan, A., (2006) 'Modelling Ecological Niches with Support Vector Machines', *Journal of Applied Ecology*, 43(3), pp. 424.432. DOI: 10.1111/j.1365-2664.2006.01141.x.

Dransfied, S. & Widjaja, E.A. (eds.) (1995) *Plant Resources of South-East Asia, No. 7: Bamboos*. Leiden: Backhuys Publishers.

Du Cros, H. & McKercher, B. (2015) *Cultural Tourism*. (2nd Ed). London and New York: Routledge.

Duckett, D., Feliciano, D., Martin-Ortega, J. & Muñoz-Rojas, J. (2016) 'Tackling Wicked Environmental Problems: The Discourse and its Influence on Praxis in Scotland', *Landscape and Urban Planning*, 154, pp. 44-56. DOI: 10.1016/j.landurbplan.2016.03.015.

Dudley, N. & Alexander, S. (2017) 'Agriculture and Biodiversity: A Review', *Biodiversity*, 18(2-3), pp. 45-49. DOI: 10.1080/14888386.2017.1351892.

Dudley, T.L. (2000) '*Arundo donax*', in Bossard, C.C., Randall, J.M. & Hoshovsky, M.C. (eds.) *Invasive Plants of California's Wildlands*. Berkeley: The University of California Press, pp 53-58.

Dumont, L. (1986) *Essays on Individualism: Modern Ideology in Anthropological Perspective*. Chicago: The University of Chicago Press.

Elith, J. & Franklin, J. (2013) 'Species Distribution Modelling', in *Encyclopedia of Biodiversity*. (2nd Ed.). Amsterdam: Elsevier. DOI: 10.1016/B978-0-12-384719-5.00318-X.

_____ (2017) 'Species Distribution Modelling', in *Reference Module in Life Sciences*. Amsterdam: Elsevier. DOI: 10.1016/B978-0-12-809633-8.02390-6

Elith, J., Phillips, S.J, Hastie, T., Dudík, M., Chee, Y.E. & Yates, C.J. (2011) 'A Statistical Explanation of MaxEnt for Ecologists', *Diversity & Distribution*, 17(1), pp. 43-57. DOI: 10.1111/j.1472-4642.2010.00725.x.

Elton, C.S. (1927) *Animal Ecology*. New York: The Macmillan Company.

Emmanuel, A. (1972). *Unequal Exchange: A Study of the Imperialism of Trade*. New York: Monthly Review Press.

Espinoza S., W. (1981) 'El Reino Aymara de Quillaca-Asanaque, Siglos XV y XVI', *Revista del Museo Nacional (Lima)*, 45, pp. 175-274.

Evans, G.L. (2000) 'Contemporary Crafts as Artefact and Functional Goods and their Role in Local Economic Diversification and Cultural Development', in Hitchcock, M. & Teague, K. (eds.) *Souvenirs: The Material Culture of Tourism*. Aldershot: Ashgate, pp. 127-146.

Fernández, G. (2006) 'Kharisiris de Agosto en el Altiplano Aymara de Bolivia', *Chungara: Revista de Antropología Chilena*, 38(1), pp. 51-62.

_____ (2008) *Kharisiris en Acción: Cuerpo, Persona y Modelos Médicos en el Altiplano de Bolivia*. Quito: Abya-Yala.

Ferreira, W.J. (2019) 'Estado de Situación de la Deforestación en Bolivia', in Fundación Tierra (ed.) *Madre Tierra, la Agenda Abandonada: Causas y Consecuencias*. La Paz. Fundación Tierra, pp. 97-110. Available at: http://www.ftierra.org/index.php?option=com_mtree&task=att_download&link_id=181&cf_id=77 (Accessed: 10 April 2020).

Ferreira, E., Kalliola, R. & Ruokolainen, K. (2019) 'Bamboo, Climate Change, and Forest Use: A Critical Combination for Southwestern Amazonian Forests?', *Ambio*, 49(8), pp. 1353-1363. DOI: 10.1007/s13280-019-01299-3.

Flaherty, M.G., Denzin, N., Manning, P.K. & Snow, D. (2002) 'The Crisis in Representation: A Brief History and Some Questions', *Journal of Contemporary Ethnography*, 31(4), pp. 478-516. DOI: 10.1177/ 0891241602031004004.

Foley, J.A., Defries, R.S., Asner, G.P., Barford, C.C., Bonan, G., …, Ramankutty, N. & Snyder, P.K. (2005) 'Global Consequences of Land Use', *Science*, 309(5734), pp. 570-574. DOI: 10.1126/science.1111772.

Food and Agriculture Organisation (FAO) (2007) *World Bamboo Resources: A Thematic Study Prepared in the Framework of the Global Forest Resources Assessment 2005.* Non-wood Forest Products No. 18. Rome: FAO. Available at: http://www.fao.org/3/a-a1243e.pdf (Accessed: 5 April 2020).

_____ (2010) *Global Forest Resources Assessment 2010 Main Report*. FAO Forestry Paper 163. Rome: FAO Available at: http://www.fao.org/3/i1757e/i1757e.pdf (Accessed: 5 April 2020).

_____ (2015) *Global Forest Resources Assessment 2015: How are the World's Forests Changing?* Rome: FAO. Available at: http://www.fao.org/3/a-i4793e.pdf (Accessed 5 April 2020).

_____ (2020) *Global Forest Resource Assessment 2020 Main Report*. Rome: FAO: Available at: http://www.fao.org/3/ca9825en/CA9825EN.pdf (Accessed: 1 August 2020).

Foster, J.B. (1999) 'Marx's Theory of Metabolic Rift: Classical Foundations for Environmental Sociology', *American Journal of Sociology*, 105(2), pp. 366-405. DOI: 10.1086/210315.

_____ (2000) *Marx's Ecology: Materialism and Nature*. New York: Monthly Review Press.

Foster, R.B., Parker III, T.A., Gentry, A.H., Emmons, L.H., Chicchón, A., Schulenberg, T., …, Donahue, P.K. & Barkley, L.J. (1994). *The Tambopata-Candamo Reserved Zone of Southeastern Peru: A Biological Assessment*. RAP Working Papers 6. Washington: Conservation International. Available at: https://www.conservation.org/docs/default-source/publication-pdfs/rap06_tambopata_candamo_peru_nov1994.pdf?Status=Master&sfvrsn=72f3b47a_3 (Accessed: 28 March 2020).

Franklin, J. (2010) *Mapping Species Distributions. Spatial Interference and Prediction*. New York: Cambridge University Press.

_____ (2013) 'Species Distribution Models in Conservation Biogeography: Developments and Challenges', *Diversity Distribution*, 19(10), pp. 1217-1223. DOI: 10.1111/ddi.12125.

Fuentes, A., Zenteno, F. & Cayola, L. (2017) 'Maderas y Fibras Vegetales de Uso Tradicional en la Región del Madidi (La Paz, Bolivia)', Paper presented at Reunión Anual de Etnología (La Rebelión de los Objetos, Cestería y Maderas), MUSEF, La Paz, Bolivia, 21-25 August 2017.

Gallegos, S.C., Zenteno-Ruiz, F.S., Beck, S.G. & López, R.P. (2019) 'Diversidad Arbórea del Bosque Tucumano-Boliviano en la Alta Cuenca del Río Bermejo (Tarija, Bolivia)', *Ecología en Bolivia*, 54(1), pp. 18-39.

Geertz, C. (1963) *Agricultural Involution: The Process of Ecological Change in Indonesia*. Berkeley: The University of California Press.

Gérard, A. (1997) 'Multifonías en Aerófonos Andinos de Bolivia', *Revista Boliviana de Física*, 3(1), pp. 40-59.

_____ (1998) 'Acústica de los Ayarachis: Una Original Sucesión de Alturas de Sonido', *Revista Boliviana de Física*, 4(4), pp. 136-151.

_____ (1999) *Acústica de las Siringas de Uso Actual en Bolivia*. (2 vol.). Potosi: Universidad Autónoma Tomas Frías

_____ (2002) 'Acústica de las Siringas Andinas de Uso Actual en Bolivia: Método y Conclusiones', in Sánchez C., W. (ed.) *La Música de Bolivia: De la Prehistoria a la Actualidad*. Cochabamba Fundación Simón I. Patino, pp. 497-526.

_____ (2009) 'Sonidos "ondulantes" en Silbatos Dobles Arqueológicos: ¿Una Estética Ancestral Reiterativa?', *Revista Española de Antropología Americana*, 39(1), pp. 125-144.

_____ (2010) 'Tara y Tarka: Un Sonido, Un Instrumento y Dos Causas (Estudio Organológico y Acústico de la Tarka)', in Gérard, A. (ed.) *Diablos Tentadores y Pinkillus Embriagadores, Tomo I*. La Paz: Plural, pp. 69-149.

_____ (2012) 'Sonidos en Movimiento', in Andreoli, E. (ed.) *Bolivia Contemporánea*. La Paz: Plural, pp. 161-167.

_____ (2013) 'Sonido Tara en Pifilcas Arqueológicas Provenientes de Potosí', *ArqueoAntropológicas*, 3(1), pp. 30-62.

_____ (2015) 'La Estética del Sonido Pulsante: Una Síntesis', in Stöckli, M. & Howell, M. (eds.) *Flower World: Music Archaeology of the Americas, Vol. 4*. Berlin: Ekho, pp 43-64.

_____ (2017) 'Flautas de Cañahueca: Aproximación Acústica (Acústica de Flautas)', Paper presented at Reunión Anual de Etnología (La Rebelión de los Objetos, Cestería y Maderas), MUSEF, La Paz, Bolivia, 21-25 August 2017.

_____ (2018) '¡No son Resonadores! La Segunda Hilera de Tubos de Sikus, Lakitas y Ayarachis: Un Enfoque Acústico', in Sánchez H., C. (ed.) *Música y Sonidos en el Mundo Andino: Flautas de Pan, Zampoñas, Antaras y Ayarachis*. Lima: Fondo Editorial de la Universidad Nacional Mayor de San Marcos, pp. 281-302.

Gianotten, V. (2006) *CIPCA y Poder Campesino Indígena: 35 Años de Historia*. La Paz: CIPCA.

Gibbs, H.K., Ruesch, A.S., Achard, F., Clayton, M.K., Holmgren, P., Ramankutty, N. & Foley, J.A. (2010) 'Tropical Forests Were the Primary Sources of New Agricultural Land in the 1980s and 1990s', *Proceedings of the National Academy of Sciences*, 107(38), pp. 16732-16737. DOI: 10.1073/pnas.0910275107.

Gibson, C. (2019) 'A Sound Track to Ecological Crisis: Tracing Guitars All the Way Back to the Tree', *Popular Music*, 38(2), pp. 183-203. DOI: 10.1017/S0261143019000047.

Gibson, C. & Warren, A. (2016) 'Resource-Sensitive Global Production Networks: Reconfigured Geographies of Timber and Acoustic Guitar Manufacturing', *Economic Geography*, 92(4), pp. 430-454. DOI: 10.1080/00130095.2016.1178569.

_____ (Forthcoming) *The Guitar: Tracing the Grain back to the Tree*. Chicago: The University of Chicago Press.

Gibson, L., Lee, T.M., Koh, L.P., Brook, B.W., Gardner, T.A., Barlow, J., …, Lovejoy, T.E. & Sodhi, N.S. (2011) 'Primary Forests Are Irreplaceable for Sustaining Tropical Biodiversity', *Nature*, 478(7369), pp. 378-381. DOI: 10.1038/nature10425.

Gill, L. (1987) 'Frontier Expansion and Settlement in Lowland Bolivia', *The Journal of Peasant Studies*, 14(3), pp. 380-398. DOI: 10.1080/03066158708438335.

Godelier, M. (1972) *Rationality and Irrationality in Economics*. London: New Left Books.

Goldstein, D.M. (2016) *Owners of the Sidewalk: Security and Survival in the Informal City*. Durham: Duke University Press.

González Bravo, A. (1936) ‘Sicus’, *Boletín Latino Americano de Música*, 2(2), pp. 224-229.

_____ (1937) ‘Kenas, Pincollos y Tarkas’, *Boletín Latino Americano de Música*, 3(3), pp. 23-33.

Gose, P. (2008) *Invaders as Ancestors: On the Intercultural Making and Unmaking of Spanish Colonialism in the Andes*. London: University of Toronto Press.

_____ (2018) ‘The Semi-Social Mountain: Metapersonhood and Political Ontology in the Andes’, *HAU: Journal of Ethnographic Theory*, 8(3), pp. 488-505. DOI: 10.1086/701067.

Graburn, N. H. H. (ed.) (1976) *Ethnic and Tourist Arts: Cultural Expressions from the Fourth World*. Berkeley, Los Angeles, London: University of California.

_____ (1984). ‘The Evolution of Tourist Arts’, *Annals of Tourism Research*, 11(3), pp. 393-419. DOI: 10.1016/0160-7383(84)90029-X.

Graeber, D. (2001) *Toward an Anthropological Theory of Value: The False Coin of Our Own Dreams*. New York: Palgrave.

Graham, C.H. & Hijmans, R.J. (2006) ‘A Comparison of Methods for Mapping Species Ranges and Species Richness’, *Global Ecology and Biogeography*, 15(6), pp. 578-587. DOI: 10.1111/j.1466-8238.2006.00257.x.

Grant, C. (2010) ‘The Links between Safeguarding Language and Safeguarding Musical Heritage’, *International Journal of Intangible Heritage*, 5, pp. 46–59.

_____ (2011) ‘Key Factors in the Sustainability of Languages and Music: A Comparative Study’, *Musicology Australia*, 33(1), pp. 95-113: DOI: 10.1080/08145857.2011.576648.

_____ (2012) ‘Rethinking Safeguarding: Objections and Responses to Protecting and Promoting Endangered Musical Heritage’, *Ethnomusicology Forum*, 21(1), pp. 39-59. DOI:10.1080/17411912.2012.641733.

_____ (2013) ‘Music Sustainability’, *Oxford Bibliographies in Music*. Oxford: Oxford University Press. DOI: 10.1093/obo/9780199757824-0105.

_____ (2014) *Music Endangerment: How Language Maintenance Can Help*. New York: Oxford University Press.

Grebe, M.E. (1974) ‘Instrumentos Musicales Precolombinos de Chile’, *Revista Musical Chilena*, 28(128), pp. 5-55.

Greenberg, J. B. 2016. ‘Good Vibrations, Strings Attached: The Political Ecology of the Guitar’, *Sociology and Anthropology*, 4(5), pp. 431-438. DOI: 10.13189/sa.2016.040514.

Grinnellian (1917) ‘The Niche-Relationships of the California Thrasher’, *The Auk*, 34(4), pp. 427-433. DOI: 10.2307/4072271.

Grogan, J., Blundell, A.G., Landis, R.M., Youatt, A., Gullison, R.E., Martinez, M., Kómetter, R., Lentini, M. & Rice, R.E. (2010) 'Over-Harvesting Driven by Consumer Demand Leads to Population Decline: Big-Leaf Mahogany in South America', *Conservation Letters*, 3(1), pp. 12-20. DOI: DOI: 10.1111/j.1755-263X.2009.00082.x

Groß, M. & Stauffacher, M. (eds.) (2014) 'Transdisciplinary Environmental Science: Problem-oriented Projects and Strategic Research Programs', *Interdisciplinary Science Review*, 39(4).

Grünewald, R. de A. (2006) 'Pataxó Tourism Art and Cultural Authenticity', in Smith, M.K. & Robinson, M. (eds.) *Cultural Tourism in a Changing World: Politics, Participation and (Re)presentation (Tourism and Cultural Change)*. Clevedon: Channel View, pp. 203-214.

Guerreiro, C.I. (2013) 'Flowering Cycles of Woody Bamboos Native to Southern South America', *Journal of Plant Research*, 127(2), pp. 307-313. DOI: 10. 1007/s10265-013-0593-z.

Gunderson, L.H. & Holling, C.S. (2002) *Panarchy: Understanding Transformations in Human and Natural Systems*. Washington: Island Press.

Gunderson, L.H., Allen, C.R. & Holling, C.S. (2009) *Foundations of Ecological Resilience*. Washington: Island Press.

Gutiérrez C., R. (1990) 'La Importancia de la Música en el Mundo Andino', in MUSEF (ed.) *Anales de la Reunión Anual de Etnología, 22, 23, 24 y 25 de Agosto 1989*. La Paz: MUSEF, pp. 187-294.

_____ (1991a) 'Instrumentos Musicales Tradicionales en la Comunidad Artesanal Walata Grande, Bolivia', *Latin American Music Review*, 12(2), pp. 124-159. DOI: 10.2307/780086.

_____ (1991b) 'La Dinámica Musical en el Mundo Andino', *Etnología: Boletín del Museo Nacional de Etnografía y Folklore*, 14(20), pp. 35-44.

_____ (1995) 'Instrumentos Musicales Tradicionales en Walata Grande', *Revista del Museo Nacional de Etnografía y Folklore*, 5, pp. 60-88.

_____ (2002) 'Walata Grande y Condo, Dos Centros Especializados en Construcción y Afinación de Instrumentos Aerófanos en Bolivia', in Sánchez C., W. (ed.) *La Música en Bolivia: De la Prehistoria a la Actualidad*. Cochabamba: Fundación Simón I. Patiño, pp. 377-411.

Gutiérrez C., R. & Gutiérrez C., I. (2009) *Música, Danza y Ritual en Bolivia: Una Aproximación a la Cultura Musical de los Andes, Tarija y el Chaco Boliviano*. La Paz: FATAUPO.

Gutiérrez C., R, Gutiérrez C., I & Veliz, V. (1999) ‘Los Artesanos de Condo y la Percepción del Sonido a partir del Conocimiento Cultural de la Chhalla (Bambú)’, in MUSEF (ed.) *Anales de la Reunión Anual de Etnología, 26,27,28 y 29 de Agosto de 1998 (Tomo II)*. La Paz: MUSEF, pp. 265-278.

_____ (2001) ‘Parámetros de Afinación y Principios de Estética y Armonía entre los Artesanos de Condo’, in MUSEF (ed.) *Anales de la Reunión Anual de Etnología, 18, 19, 20 y 21 Agosto de 2000 (Tomo II).* La Paz: MUSEF, pp. 145-164.

Guyette, M.Q. & Post, J. (2016) ‘Ecomusicology, Ethnomusicology, and Soundscape Ecology: Scientific and Musical Responses to Sound Study’, in Allen, A.S. & Dawe, K. (eds.) *Current Directions in Ecomusicology: Music, Nature, Environment*. London and New York: Routledge, pp. 40-56.

Hachmeyer, S. (2015) *Attracting and Banning Ankari: Musical and Climate Change in the Kallawaya Region in Northern Bolivia*. Masters Dissertation, University of Lund, Lund, Sweden.

_____ (2016) ‘Schulden aus Holz’, *Jungle World,* 24, pp. 10-11.

_____ (2017a) ‘Music, Climate, and Therapy in Kallawaya Cosmology (Part I): Sonorous Meshwork, Musical Performativity, and the Transformation of Pacha’, *Ecomusicology Review,* No. 5. Available at: https://ecomusicology.info/music-climate-and-therapy-in-kallawaya-cosmology-part-1/ (Accessed: 20 August 2019).

_____ (2017b) ‘Music, Climate, and Therapy in Kallawaya Cosmology (Part II): Dysfunction of Seasonal Change, Climatic Reversal, and Musical Worlding’, *Ecomusicology Review*, No. 5. Available at: www.ecomusicology.info/music-climate-and-therapy-in-kallawaya-cosmology-part-2-dysfunction-of-seasonal-change-climatic-reversal-and-musical-worlding/ (Accessed: 20 August 2019)

_____ (2017c) ‘Zwei Seiten eines Blattes’, *Jungle World,* 49, pp. 10-11.

_____ (2018a) ‘The Qantu and Music Therapy in the Kallawaya Heritage Context’, *TRANS-Transcultural Music Review*, 21-22. Available at: http://sibetrans.com/trans/public/docs/2d-en-trans-2018.pdf (Accessed: 25 April 2020).

_____ (2018b) ‘Modelando el Nicho Ecológico de los Bambúes Leñosos (Bambuseae, Poaceae) en Bolivia: Implicaciones para la Construcción de Aerófonos Autóctonos y la Conservación de los Bambúes Musicales’, in MUSEF (ed.) *Anales de la Reunión Anual de Etnología (La Rebelión de los Objetos, Cestería y Maderas), 21, 22, 23, 24 y 25 de Agosto de 2017*. La Paz: MUSEF, pp. 183-212.

_____ (2018c) ‘Los Bambúes Musicales en Estado de Emergencia’, *Contrapunto. Revista de Musicología*, 1(1), pp. 38-55.

_____ (2018d) ‘*Jacha(ya)ña* y el Llanto Musical de los Andes’, Paper presented at Taller Multidisciplinario de Acústica Musical y Sonoridades, Casa del Poeta, La Paz, Bolivia, 20 November 2018.

_____ (2019) ‘The Uncontrolled Equivocation of Music Therapy: Health, Illness, and Musical Healing among the Kallawaya in the Northern Bolivian Andes’, *Musicology Research Journal*, Issue 6, pp. 51-82. Available at: https://www.musicologyresearch.co.uk/publications/issue-6-spring-2019.

_____ (2021a) ‘“La Cultura de la Naturaleza”: Introducción al Ensayo de Carlos Yujra Mamani’, *Contrapuntos. Revista de Musicología*, tbc.

_____ (2021b) ‘Crónicas del Mohoseño y la Vida Musical de Mariano Quispe Quispe: Entrevista al Maestro Luriri de Walata Grande Ignacio Quispe Katunta’, *Contrapunto. Revista de Musicología*, (2)1: tbc.

_____ (Forthcoming) ‘The Use of Native Woody Bamboos in Flute Making among the Aymara Nations on the Pre-Colombian Altiplano: A First Approximation’, tbc.

Hachmeyer, S. & Mújica, R. (2018) ‘Entre los Caminos del Bambú y la Cañahueca: Desde la Diversidad Biológica Acústica hasta su Uso Musical y no Musical’, in MUSEF (ed.) *Anales de la Reunión Anual de Etnología (La Rebelión de los Objetos, Cestería y Maderas), 21, 22, 23, 24 y 25 de Agosto de 2017*. La Paz: MUSEF, pp. 180-182.

Hachmeyer, S. & Stobart, H. (2019) ‘While my Flute Forcefully Weeps: Reflections on Musical Crying, Weeping, and Whining in the Bolivian Andes’, Paper presented at the BFE/SFE Autumn Conference Music, Sound, Space, and Place: Ethnomusicology and Sound Studies, Department of Music, City, University of London, London, UK, 01 November 2019.

Halbmayer, E. (ed.) (2018) *Indigenous Modernities in South America*. Canon Pyon: Sean Kingston Publishing.

Hale, C.R. (2001) ‘What is Activist Research?’, *Social Science Research Council*, 2(1-2), pp. 13-15.

_____ (2006) ‘Activist Research v. Cultural Critique: Indigenous Land Rights and the Contradictions of Politically Engaged Anthropology’, *Cultural Anthropology*, 21(1), pp. 96-120. DOI: 10.1525/can.2006.21.1.96.

_____ (ed.) (2008) *Engaging Contradictions: Theory, Politics, and Methods of Activist Scholarship*. Berkeley: The University of California Press.

Hansen, M.C., Potapov, P.V., Moore, R., Hancher, M., Turubanova, S.A., Tyukavina, A., …, Justice, C.O. & Townshend, J.R.G. (2013) 'High-Resolution Global Maps of 21st-Century Forest Cover Change', *Science*, 342(6160), pp. 850-853. DOI: 10.1126/science.1244693.

Hardin, G. (1968) 'The Tragedy of the Commons', *Science*, 162(3859), pp. 1243-1248. DOI: 10.1126/science.162.3859.1243.

Hardion, L., Verlaque, R., Saltonstall, K., Leriche, A. & Vila, B. (2014) 'Origin of the Invasive Arundo donax (Poaceae): A Trans-Asian Expedition in Herbaria', *Annals of Botany*, 114(3), pp. 455-462. DOI: 10.1093/aob/mcu143.

Harris, O. (1982) 'Labour and Produce in an Ethnic Economy, Northern Potosí, Bolivia', in Lehmann, D. (ed.) *Ecology and Exchange in the Andes*. Cambridge: The Cambridge University Press, pp. 70-96.

_____ (1988) 'Etnomúsica en el Norte de Potosí', *Jayma*, 6(26-27), pp. 3-4.

_____ (1995) 'Ethnic Identity and Market Relations: Indians and Mestizos in the Andes', in Larson, B. & Harris, O. (eds.) *Ethnicity, Markets, and Migration in the Andes: At the Crossroads of History and Anthropology*. Durham and London: Duke University Press, pp. 351-390.

_____ (1997) 'Los Límites como Problema: Mapas Etnohistóricos en los Andes', in Bouysse-Cassagne, T. (ed.) *Saberes y Memorias en los Andes: In Memoriam Thierry Saignes*. Paris/Lima: IHEAL/IFEA, pp. 351-373.

Harrison, K. (2012) 'Epistemologies of Applied Ethnomusicology', *Ethnomusicology*, 56(3), p. 505-529. DOI: 10.5406/ethnomusicology.56.3.0505.

Head, B.W., Ross, H. & Bellamy, J. (2016) 'Managing Wicked Natural Resource Problems: The Collaborative Challenge at Regional Scales in Australia', *Landscape and Urban Planning*, 154, pp. 81-92. DOI: 10.1016/j.landurbplan.2016.03.019.

Henare, A., Holbraad, M. & Wastell, S. (2007) *Thinking Through Things: Theorising Artefacts Ethnographically*. London and New York: Routledge.

Henrici, J. (1999) 'Trading Culture: Tourism and Tourist Art in Pisac, Peru', Robinson, M. & Boniface, P. (eds.) *Tourism and Cultural Conflicts*. Wallingford: CABI, pp. 161-180.

Heredia, L.F. (2016) *Desdibujando Fronteras. Relaciones urbano-rurales en Bolivia*. La Paz: CIPCA.

Hernández, P.A., Franke, I., Herzog, S.K. & Pacheco, V.R. (2006) 'The Effect of Sample Size and Species Characteristics on Performance of Different Species Distribution Modelling Methods', *Ecography*, 29(5), pp. 773-785. DOI: 10. 1111/j.0906-7590.2006.04700.x.

_____ (2008) 'Predicting Species Distributions in Poorly-Studied Landscapes', *Biodiversity and Conservation*, 17(6), pp. 1353-1366. DOI: 10.1007/ s10531007-9314-z.

Hicks, D. (2010) 'The Material-Cultural Turn: Event and Effect', in Hicks, D. & Beaudry, M.C. (eds.) *The Oxford Handbook of Material Culture Studies*. Oxford: Oxford University Press, pp. 25-98.

Hijmans, R.J., Cameron, S.E., Parra, J.L., Jones, P.G. & Jarvis, A. (2005) 'Very High-Resolution Interpolated Climate Surfaces for Global Land Areas', *International Journal of Climatology*, 25(15), pp. 1965-1978. DOI:10.1002/ joc.1276.

Hirsch Hadorn, G., Bradley, D., Pohl, C., Rist, S. & Wiesmann, U. (2006) 'Implications of Transdisciplinarity for Sustainability Research', *Ecological Economic*, 6(1), pp. 119-128. DOI: 10.1016/j.ecolecon.2005.12.002.

Hirzel, A.H. & Le Lay, G. (2008) 'Habitat Suitability Modelling and Niche Theory', *Journal of Applied Ecology*, 45(5), pp. 1372-1381. DOI: 10.1111/j.1365-2664.2008.01524.x.

Hirzel, A.H., Hausser, J., Chessel, D. & Perrin, N. (2002) 'Ecological-Niche Factor Analysis: How to Compute Habitat-Suitability Maps without Absence Data?', *Ecology*, 83(7), pp. 2027-2036. DOI: 10.2307/3071784.

Hobsbawm, E. & Ranger, T. (eds.) (1983) *The Invention of Tradition*. Cambridge: Cambridge University Press.

Homer-Dixon, T.F. (1999) *Environment, Scarcity and Violence*. Princeton: Princeton University Press.

Hood, M. (1960) 'The Challenge of Bi-Musicality', *Ethnomusicology*, 4(2), pp. 55-59. DOI: 10.2307/924263.

Hornborg, A. (2013) 'Revelations of Resilience: From the Ideological Disarmament of Disaster to the Revolutionary Implications of (P)Anarchy', *Resilience*, 1(2): pp. 116-129. DOI: 10.1080/21693293.2013.797661.

Huang, Z., Brooke, B. & Li, J. (2011) 'Performance of Predictive Models in Marine Benthic Environments Based on Predictions of Sponge Distribution on the Australian Continental Shelf', *Ecological Informatics* 6(3-4), pp. 205-216. DOI: 10.1016/j.ecoinf.2011.01.001.

Hume, D.L. (2009) 'The Development of Tourist Art and Souvenirs - the Arc of the Boomerang: from Hunting, Fighting and Ceremony to Tourist Souvenir', *International Journal of Tourism Research*, 11(1), pp. 55-70. DOI: 10.1002/ jtr.665.

_____ (2014) *Tourism Art and Souvenir: The Material Culture of Tourism*. London and New York: Routledge.

Hutchinson, G.E. (1957) Concluding Remarks. *Cold Spring Harbor Symposia on Quantitative Biology*, No. 22, 415-427. DOI: 10.1101/SQB.1957.022.01.039.

_____ (1978) *An Introduction to Population Ecology*. New Haven: Yale University.

Ibisch, P.L. & Mérida, G. (eds.) (2003) *Biodiversidad: La Riqueza de Bolivia. Estado de Conocimiento y Conservación*. Santa Cruz: FAN.

Ingold, T. (2000) *The Perception of the Environment. Essays on Livelihood, Dwelling and Skill*. London and New York: Routledge.

_____ (2012) 'Towards an Ecology of Materials', *Annual Review of Anthropology*, 41(1), pp. 427-442. DOI: 10.1146/annurev-anthro-081309-145920.

_____ (2013) *Making: Anthropology, Archaeology, Art, and Architecture*. London and New York: Routledge.

Jaksic, F. & Lima, M. (2003) 'Myths and Facts on Ratadas: Bamboo Blooms, Rainfall Peaks and Rodent Outbreaks in South America', *Austral Ecology*, 28(3), pp. 237-251. DOI: 10.1046/j.1442-9993.2003.01271.x.

Janusek, J.W. (1993) 'Nuevos Datos sobre el Significado de la Producción y Uso de Instrumentos Musicales en el Estado de Tiwanaku', *Pumapunku*, 2(4), pp. 9-47.

Janzen, D.H. (1976) 'Why Bamboos Wait So Long to Flower', *Annual Review of Ecology and Systematics*, 7(1), pp. 347–39. DOI: 10.1146/annurev.es. 07.110176.002023.

Jiménez, I. (2016) 'Taxonomic Identity of "Tocoro", a Large Hollow Bamboo from Yungas of Bolivia (Poaceae, Bambusoideae, *Aulonemia*)', *Phytotaxa*, 263(1), p. 68-72. DOI: 10.11646/phytotaxa.263.1.8.

Jiménez, I. & Meneses, R.I. (2017) 'Identidad Taxonómica de Bambúes Nativos Usados en la Elaboración de Sikus y Moseños', Paper presented at Reunión Anual de Etnología (La Rebelión de los Objetos, Cestería y Maderas), MUSEF, La Paz, Bolivia, 21-25 August 2017.

John, C.K. & Nadgauda, R.S. (2002) 'Bamboo Flowering and Famine', *Current Science*, 82(3), pp. 261-262.

Jørgensen, P.M., Nee, M. & Beck, S.G. (eds.) (2014) *Catálogo de las Plantas Vasculares de Bolivia*. St. Louis: Missouri Botanical Garden Press.

Judziewicz, E.J. & Clark, L.G. (1993) 'The South American Species of Arthrostylidium (Poaceae: Bambusoideae: Bambuseae)', *Systematic Botany*, 18(1), pp. 80-99. DOI: 10.2307/2419790.

_____ (2007) 'Classification and Biogeography of New World Grasses: Anomochlooideae, Pharoideae, Ehrhartoideae, and Bambusoideae', *Aliso: A Journal of Systematic and Evolutionary Botany*, 23(1):303-314. DOI: 10. 5642/aliso.20072301.25.

Judziewicz, E.J., Clark, L.G., Londoño, X. & Stern, M.J. (1999) *American Bamboos*. Washington: Smithsonian Institution Press.

Kartomi, M. (1981) 'The Processes and Results of Musical Culture Contact: A Discussion of Terminology and Concepts', *Ethnomusicology*, 25(2), pp. 227-249. DOI: 10.2307/851273.

_____ (1990) *On Concepts and Classifications of Musical Instruments*. Chicago: The University of Chicago Press.

_____ (2005) 'On Metaphor and Analogy in the Concepts and Classification of Musical Instruments in Aceh', Yearbook for Traditional Music, Vol. 37, pp. 25-57.

Keeley, J.E. & Bond, W.J. (1999) 'Mast Flowering and Semelparity in Bamboos: The Bamboo Fire Cycle Hypothesis', *The American Naturalist*, 154(3), pp. 83-391. DOI: 10.1086/303243.

Kellermann, B. & Lacerda, A.E. (2019) 'Arrested Development? Investigating the Role of Bamboo in Araucaria Forest Succession in Southern Brazil', *Journal of Plant Ecology, 12(6), pp. 1034-1046. Doi:* 10.1093/jpe/rtz037.

Keogh, B. (2013) 'On the Limitations of Music Ecology', *Journal of Music Research Online*, 4(1), pp. 1-10. Available at: http://www.jmro.org.au/index.php/mca2/article/view/83 (Accessed: 9 December 2018).

Keogh, B. & Collinson, I. (2016) '"A Place for Everything, and Everything in its Place" - The (Ab)uses of Music Ecology', *MUSICultures*, 43(1), pp. 1-15.

Kessler, M. & Beck, S.G. (2001) 'Bolivia', in Kappelle, M. & Braun, A. (eds.) *Bosques Nublados del Neotrópico*. Santo Domingo de Heredia: Instituto Nacional de Biodiversidad (INBio), pp. 581-622.

Killeen, T. J., Calderon, V., Soria, L., Quezada, B., Steininger, M. K., Harper, G., Solórzano, L. A. & Tucker, C. J. (2007). 'Thirty Years of Land-Cover Change in Bolivia', *Ambio: A Journal of the Human Environemnt*, 36(7), pp. 600-606. DOI: 10.1579/0044-7447(2007)36[600:TYOLCI]2.0.CO;2.

Killeen, T.J., Guerra, A., Calzada, M., Correa, L., Calderon, V., Soria, L., Quezada, B. & Steininger, M.K. (2008) 'Total Historical Land-Use Change in Eastern Bolivia: Who, Where, When, and How Much?', *Ecology and Society,* 13(1), Art. 36. DOI: 10.5751/ES-02453-130136.

Killeen, T. J., Siles, T. M., Soria, L. & Correa, L. (2005). 'La Estratificación de Vegetación y el Cambio de Uso de Suelo en las Yungas y el Alto Beni de La Paz', *Ecología en Bolivia,* 40(3), pp. 32-69.

Kirsch, S. (2006) *Reverse Anthropology: Indigenous Analysis of Social and Environmental Relations in New Guinea*. Redwood City: Stanford University Press.

Lacerda, A.E. & Kellermann, B. (2017). 'Bambus Nativos Como Espécies Invasoras no Sul do Brasil', in Drumond, P.M. & Wiedman, G. (eds.) *Bambus No Brasil: Da Biologia à Tecnología*. Rio de Janeiro: Instituto Ciência Hoje, pp. 179-196.

_____ (2019) 'What is the Long-Term Effect of Bamboo Dominance on Adult Trees in the Araucaria Forest? A Comparative Analysis between Two Successional Stages in Southern Brazil', *Diversity,* 11(165), pp. 1-16. DOI: 10.3390/ d11090165.

Lamb, F.B. (1966) *Mahogany of Tropical America: Its Ecology and Management*. Ann Arbor: The University of Michigan Press.

Lambert, A.M., Dudley, T.L. & Saltonstall, K. (2010) 'Ecology and Impacts of the Large-Statured Invasive Grasses Arundo donax and Phragmites australis in North America', *Invasive Plant Science and Management,* 3(4), pp. 489-494. DOI: 10.1614/IPSM-D-10-00031.1.

Lang, D.J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., Swilling M. & Thomas, C.J. (2012) 'Transdisciplinary Research in Sustainability Science: Practice, Principles, and Challenges', *Sustainability Science,* 7(1S), pp. 25-43. DOI: 10.1007/s11625-011-0149-x.

Langevin, A. (1990) 'La Organización Musical y Social del Conjunto de *Kantu* en la Comunidad de Quiabaya (Provincia de Bautista Saavedra), Bolivia', *Revista Andina,* 8(1), pp. 115-137.

_____ (1992) 'Las Zampoñas del Conjunto de Kantu y el Debate sobre la Función de la Segunda Hilera de Tubos: Datos Etnográficos y Análisis Semiótico', *Revista Andina,* 10(2), pp. 405-440.

Larpkern, P., Moe, S.R. & Totland, Ø. (2011) 'Bamboo Dominance Reduces Tree Regeneration in a Disturbed Tropical Forest', *Oecologia,* 165(1), pp. 161-168. DOI: 10.1007/s00442-010-1707-0.

Larson, B. & Harris, O. (eds.) (1995) *Ethnicity, Markets, and Migration in the Andes: At the Crossroads of History and Anthropology*. Durham and London: Duke University Press.

Latour, B. (1993) *We Have Never Been Modern*. Cambridge: Harvard University Press.

Laurance, W.F., Sayer, J. & Cassman, K.G. (2014) 'Agricultural Expansion and Its Impacts on Tropical Nature', *Trends in Ecology & Evolution*, 29(2), pp. 107-116. DOI: 10.1016/j.tree.2013.12.001.

Layme Pairumani, F. (1996) 'La Concepción del Tiempo y la Música en el Mundo Aymara', in Baumann, M.P. (ed.) *Cosmología y Música en los Andes*. Frankfurt am Main/Madrid: Verveut/Iberoamerica, pp. 107-116.

Lecoq, P. (1985) 'Ethnoarchéologie du Salar d'Uyuni: Sel et Cultures Régionales Inter Salar', *Boletín del Instituto Francés* de *Estudios Andinos*, 14(1-2), pp. 57-84.

Ledezma, J.C. (2009) 'Un Departamento con una Dramática Biodiversidad', in Iturri S., J. (ed.) *Bicentenario 1809-2009 Años: De la Revolución del 16 de Julio*. La Paz: Gobierno Municipal, pp. 186-205.

Leguía A., J.D., Villegas Q., H. & Aliaga L., J. (2011) 'Deforestación en Bolivia: Una Aproximación Espacial', *Revista Latinoamericana de Desarrollo Económico*, 9(15), pp. 7-44. DOI: 10.35319/lajed.201115149.

Lehm A., Z. & Rivera C., S. (1988) *Los Artesanos Libertarios y la Ética del Trabajo*. La Paz: THOA.

Lehmann, D. (1982) *Ecology and Exchange in the Andes*. Cambridge: The Cambridge University Press.

Libin, L. (1994) 'Materials from Endangered Species in Musical Instruments', *CIMCIM Publications*, No.3, pp. 23-27.

Lizarazu, M.A., Rúgolo, Z.E. & Vega, A.S. (2011) 'A New Species of Merostachys (Poaceae, Bambusoideae, Bambuseae) and Synopsis of the Genus in Argentina and Neighboring Regions', *Systematic Botany*, 36(4), pp. 896-906. DOI: 10.1600/036364411X604912.

Lomax, A. (1968) *Folk Song Style and Culture*. Washington: American Association for the Advancement of Science.

_____ (1977) 'Appeal for Cultural Equity', *Journal of Communications*, 27(2), pp. 125-138. DOI: 10.1111/j.1460-2466.1977.tb01838.x.

Londoño, X. (1990) 'Aspectos sobre la Distribución y la Ecología de los Bambúes de Colombia (Poaceae: Bambusoideae)', *Caldasia*, 16(77), pp. 139-153.

Liu, C., Berry, P.M., Dawson, T.P. and Pearson, G. (2005) 'Selecting Thresholds of Occurrence in the Prediction of Species Distributions', *Ecography*, 28(3), pp. 385-393.DOI : 10.1111/j.0906-7590.2005.03957.x.

Liu, C., White, M. & Newell, G. (2013) 'Selecting Thresholds for the Prediction of Species Occurrence with Presence-Only Data', *Journal of Biogeography,* 40(4), pp. 778–789. DOI: 10.2307/23463638.

Malm, K. (1993) 'Music on the Move: Traditions and Mass Media', *Ethnomusicology Forum*, 37(3), pp. 339-352. DOI: 10.2307/851718.

Mamani Aruquipa, E. (2005) 'La Continuidad Dinámica y Práctica de la Música Instrumental Andina en los Artesanos de Walata Grande Residentes en la Ciudad de El Alto', *Textos Antropológicos*, 15(1), pp. 51-76.

_____ (2006) *Paradigma Otro: Producción y Conocimientos Locales de Instrumentos Musicales Aimara en Espacios Urbanos*. Masters Dissertation, Universidad Andina Simón Bolívar, Quito, Ecuador.

Mamani Pocoata, M. (1988) 'Los Instrumentos Musicales en los Andes Bolivianos', in MUSEF (ed.) *Anales de la Reunión Anual de Etnología, 25, 26 y 27 de Agosto de 1987 (Vol. III)*. La Paz: MUSEF, pp. 49-79.

Marcus, G.E. (1995) 'Ethnography in/of the World System: The Emergence of Multi-Sited Ethnography', *Annual Review of Anthropology,* 24(1)*, pp. 95-117. DOI:* 10.1146/annurev.an.24.100195.000523.

Marcus, G.E. and Fischer, M.F. (1986) *Anthropology as Cultural Critique: An Experimental Moment in the Human Sciences*. Chicago: The University of Chicago Press

Mardones C., P., &F Ibarra R., M.A. (2018) 'Lenguaje Musical e Identidad Lakita: Revitalización y Continuidad de una Práctica Ancestral y Contemporaena en el Norte de Chile', in Sánchez H., C. (ed.) *Música y Sonidos en el Mundo Andino: Flautas de Pan, Zampoñas, Antaras y Ayarachis*. Lima: Fondo Editorial de la Universidad Nacional Mayor de San Marcos, pp. 325-354.

Martinez-Reyes, J. (2015) 'Mahogany intertwined: Enviromateriality between Mexico, Fiji, and the Gibson Les Paul', *Journal of Material Culture,* 20(3), pp. 313-329. DOI:10.1177/1359183515594644.

Martínez, R. 1996. 'El Sajjra en la Música de los Jalq'a', in Baumann, M.P. (ed.) *Cosmología y Música en los Andes*. Frankfurt am Main/Madrid: Verveut/Iberoamerica, pp. 311-322.

_____ (2002) 'Tomar para Tocar, Tocar para Tomar: Música y Alcohol en la Fiesta Jalqa', in Sánchez C., W. (ed.) *La Música en Bolivia: De la Prehistoria a la Actualidad*. Cochabamba: Fundación Simón I. Patiño, pp. 413-434.

Masuda, S., Shimada, I. & Morris, E.C. (eds.) (1985) *Andean Ecology and Civilization: An Interdisciplinary Perspective on Andean Ecological Complementarity*. Tokyo: The University of Tokyo Press.

Matsunobu, K. (2013) 'Instrument-Making as Music-Making: An Ethnographic Study of *Shakuhachi* Students' Learning Experiences', *International Journal of Music Education*, 31(2), pp. 190-201. DOI: 10.1177/0255761413486858.

Mayer, E. (1974) 'Las Reglas del Juego de la Reciprocidad Andina', in Alberti, G. & Mayer, E. (eds.) *Reciprocidad e Intercambio en los Andes Peruanos.* Lima: Instituto de Estudios Peruanos, pp. 37-65.

Mazurek, H. (2008) 'Tres Preconceptos sobre Migración Interna en Bolivia', *Revista de Humanidades y Ciencias Sociales*, 14(1-2), pp. 203-228.

McClure, F.A. (1966) *The Bamboos. A Fresh Perspective*. Cambridge: Harvard University Press.

_____ (1973) *Genera of Bamboos Native to the New World (Gramineae: Bambusoideae)*. Washington: Smithsonian Institution Press.

McKercher, B. & duCros, H. (2002) *Cultural Tourism: The Partnership Between Tourism and Cultural Heritage Management*. New York: Haworth Press.

McLean, A. & Leibing, A. (eds.) (2007) *The Shadow Side of Fieldwork: Exploring the Blurred Borders between Ethnography and Life*. Oxford: Blackwell.

Meisch, L.A. (2002) *Andean Entrepreneurs: Otavalo Merchants & Musicians in the Global Era*. Austin: University of Texas Press.

Mendívil, J. & Romero, R.R. (2018) 'Prácticas Musicales Andinas a Comienzos del Siglo XXI', *Anthropologica*, 36(40), pp. 5-10. DOI: 10.18800/anthropologica.201801.001.

Mendoza S., D. (2009) *Comunidad Aymara de Walata Grande: Memoria e Identidad en la Construcción de Instrumentos Musicales (Patrimonio Cultural de Achacachi)*. La Paz: Gobierno Municipal de Achacachi.

Meneses, R.I., Larrea A., D.M., Beck, S.G. & Espinoza, S. (2014) 'Modelando Patrones Geográficos de Distribución de Gramíneas (Poaceae) en Bolivia: Implicaciones para su Conservación', *Ecología en Bolivia,* 49(1), pp. 3-19.

Merow, C., Smith, M.J. & Silander, J.A. (2013) 'A Practical Guide to Maxent for Modeling Species' Distributions: What it Does, and Why Inputs and Settings Matter', *Ecography,* 36(10), pp. 1058-1069. DOI: 10.1111/j.1600-0587.2013.07872.x.

Merriam, A.P. (1964) *The Anthropology of Music*. Evanston: Northwestern University Press.

Merton, R. (1973) *The Sociology of Science: Theoretical and Empirical Investigations*. Chicago: The University of Chicago Press.

Mignolo, W. (2000) *Local Histories/Global Designs: Essays on the Coloniality of Power, Subaltern Knowledges and Border Thinking*. Princeton: Princeton University Press.

_____ (2002) 'The Geopolitics of Knowledge and the Colonial Difference', *South Atlantic Quarterly*, 101(1), pp. 57-96. DOI: 10.1215/00382876-101-1-57.

_____ (2005) '"Un Paradigma Otro": Colonialidad Global, Pensamiento Fronterizo y Cosmopolitanismo Crítico', *Dispositivo*, 25(52), pp. 127-146.

Mignolo, W. & Escobar, A. (eds.) (2009) *Globalization and the Decolonial Option*. London and New York: Routledge.

Ministerio de Medio Ambiente y Agua (MMAyA) - Dirección General de Gestión y Desarrollo Forestal (DGGDF) (2015a) *Memoria Técnica de Mapa de Bosque 2013 (Clasificación por Tipo de Bosque)*. La Paz: MMAyA, SoB OCTA.

_____ (2015b) *Memoria Técnica Mapa de Deforestación de Bolivia 2010-2013*. MMAyA, SoB OCTA.

_____ (2017) Sistema de Información y Monitoreo de Bosques, Monitoreo de la Cubertura Boscosa (Subsistemas Bosque, Deforestación, Reforestación). La Paz: MMAyA.

Montoya, R. (1996) 'Música Chicha: Cambios de la Canción Andina Quechua en el Perú', in Baumann, M.P. (ed.) *Cosmología y Música en los Andes*. Frankfurt am Main/Madrid: Verveut/Iberoamerica, pp. 483-496.

Montti, L., Campanello, P.I., Gatti, M.G., Blundo, C., Austin, A.T., Sala, O. & Goldstein, G. (2011a) 'Understory Bamboo Flowering Provides a Very Narrow Light Window of Opportunity for Canopy Tree Recruitment in a Neotropical Forest of Misiones, Argentina', *Forest Ecology and Management*, 262(8), pp. 1360-1369. DOI: 10.1016/j.foreco.2011.06.029.

Montti, L., Campanello, P.I. & Goldstein, G. (2011b) 'Flowering, Die-back and Recovery of a Semelparous Woody Bamboo in the Atlantic Forest', *Acta Oecologica*, 37(4), pp. 361-368. DOI: 10.1016/j.actao.2011.04.004.

Morales, M., Gianotten, V., Devisscher, M. & Pacheco, D. (eds.) (2011) *Hablamos de Tierras: Minifundio, Gestión Territorial, Boques e Impuesto Agrario en Bolivia*. La Paz: Plural.

Mújica, R. (2014a) 'Música, Cultura y Transformación: Panorama de los Estudios sobre Antropología de la Música y las Tendencias en Bolivia en el Siglo XX', *ArqueoAntropológicas*, 4(1), 161-194.

_____ (2014b) *Qina Qina y Bandas en la Fiesta de San Pedro y San Pablo: Dinámicas Musicales y Culturales en la Localidad de Tiwanaku*. Licenciatura Thesis, Universidad Mayor de San Andrés, La Paz.

_____ (2014c) 'Cultura, Desarrollo y Patrimonialización: Acercamiento a la vinculación entre desarrollo y patrimonio cultural en Bolivia', Paper presented at II Congreso Plurinacional de Antropología, MUSEF, La Paz, Bolivia, 22-26 September 2014.

_____ (2017) 'Entre Sonidos de Bandas de Bronce y Qina Qina (Quena Quena): Dinámica Musical y Cultural en Tiwanaku', in MUSEF (ed.) *Anales de la Reunión Anual de Etnología (La Rebelión de los Objetos, Minería y Metales), 15, 16, 17, 18 y 19 de Agosto 2016*. La Paz MUSEF, pp. 165-194.

Mújica A., R. & Villarroel S., G. (2017) 'Musicalidades Presentes y Materiales Ausentes: Balance de los Estudios sobre Música, Cañahuecas y Bambúes en Bolivia, Primera Aproximación', Paper presented at Reunión Anual de Etnología (La Rebelión de los Objetos, Cestería y Maderas), MUSEF, La Paz, Bolivia, 21-25 August 2017.

Murra, J. (1968) 'An Aymara Kingdom in 1567', *Ethnohistory*, 15(2), pp. 115-151.

_____ (1975) 'El Control Vertical de un Maximo de Pisos Ecológicos en la Economía de las Sociedades Andinas', in Murra, J. (ed.) *Formaciones Económicas y Políticas del Mundo Andino*. Lima: IEP, pp. 59-116.

_____ (1985) '"El Archipiélago Vertical" Revisited', in Masuda, S., Shimada, I. & Morris, E. C. (eds.) *Andean Ecology and Civilization: An Interdisciplinary Perspective on Andean Ecological Complementarity*. Tokyo: The University of Tokyo Press, pp. 3-13.

Müller, R., Müller, D., Schierhorn, F., Gerold, G. & Pacheco, P. (2012) 'Proximate Causes of Deforestation in the Bolivian Lowlands - An Analysis of Spatial Dynamics', *Regional Environmental Change*, 12(3), pp. 445-459.

Müller, R., Pacheco, P. & Montero, J.C. (2014a) *The Context of Deforestation and Forest Degradation in Bolivia: Drivers, Agents, and Institutions*. Occasional Paper 108. Bogor: CIFOR.

Müller, R., Larrea A., D.M., Cuéllar, S. & Espinoza, S (2014b) 'Causas Directas de la Deforestación Reciente (2000-2010) y Modelado de dos Escenarios Futuros en las Tierras Bajas de Bolivia', *Ecología en Bolivia*, 49(1), pp. 20-34.

Nag, S. (1999) 'Bamboo, Rats and Famines: Famine Relief and Perceptions of British Paternalism in the Mizo Hills (India)', *Environment and History*, 5(2), pp. 245–52. DOI:10.3197/096734099779568317.

Nason, J. D. (1984) ‘Tourism, Handicrafts, and Ethnic Identity in Micronesia’, *Annals of Tourism Research*, 11(3), pp. 421-449. DOI: 10.1016/0160-7383(84)90030-6.

Navarro, G. & Ferreira, W.J. (2007) Mapa de Vegetación de Bolivia a Escala 1:250.000. CD-ROM. Santa Cruz: RUMBOL/The Nature Conservancy.

_____ (2011) Mapa de Sistemas Ecológicos de Bolivia a Escala 1:250.000. CD-ROM. Santa Cruz: RUMBOL/The Nature Conservancy.

Newbold, T., Hudson, L.N., Hill, S.L.L., Contu, S., Lysenko, I., Senior, R.A., …, Scharlemann, J.P.W. & Purvis, A. (2015) ‘Global Effects of Land Use on Local Terrestrial Biodiversity’, *Nature*, 520(7545), pp. 1045-1050. DOI: 10.1038/nature14324.

Ostrom, E. (1990) *Governing the Commons: The Evolution of Institutions for Collective Action*. New York: Cambridge University Press.

Pacheco, P. (2006) ‘Agricultural Expansion and Deforestation in Lowland Bolivia: The Import Substitution versus the Structural Adjustment Model’, *Land Use Policy*, 23(3), pp. 205-225. DOI: 10.1016/j.landusepol.2004.09.004.

Pacheco, P. & Mertens, B. (2004) ‘Land Use Change and Agriculture Development in Santa Cruz’, *Bois et Forêt des Tropiques*, 280, pp. 29-40. DOI: 10.19182/bft2004.280.a20237.

Parnwell, M.J.G. (1993) ‘Tourism and Rural Handicrafts in Thailand’, in M. Hitchcock, M., King, V.T. & Parnwell, M.J.G. (eds.) *Tourism in Southeast Asia*. London & New York: Routledge, pp. 234-257. DOI: 10.4324/9780429431395-12.

Parodi (1944) ‘Arthrostylidium Harmonicum, Nueva Especie de Bambúsea del Perú’, *Physis*, 19(54), pp. 478-481.

_____ (1946) La Planta Usada por los Indios del Perú para Fabricar las Quenas’, *Ciencia e Investigación*, 2(1), p. 25.

Pearson, R.G., Raxworthy, C.J., Nakamura, M. & Peterson, A.T. (2007) ‘Predicting Species Distributions from Small Numbers of Occurrence Records: A Test Case Using Cryptic Geckos in Madagascar’, *Journal of Biogeography*, 34(1), pp. 102-117. DOI: 10.1111/j.1365-2699.2006.01594.x.

Pearson, R.G., Dawson, T.P. & Liu, C. (2004) ‘Modelling Species Distributions in Britain: A Hierarchical Integration of Climate and Land-Cover Data’, Ecography, 27(3), pp. 285–298. DOI: 10.1111/j.0906-7590.2004.03740.x.

Pearson, A.K., Pearson, O.P. & Gómez, I.A. (1994) ‘Biology of the Bamboo Chusquea Culeou (Poaceae: Bambusoideae) in Southern Argentina’, *Vegetatio*, 111(2), pp. 93-126. DOI: 10.1007/BF00040331.

Pedelty, M. (2011) *Ecomusicology: Rock, Folk, and the Environment*. Philadelphia: Temple University Press.

Pellegrini C., A. (2016) *Beyond Indigeneity: Coca Growing and the Emergence of a New Middle Class in Bolivia*. Tucson: The University of Arizona Press.

Perdue, R.E. (1958) 'Arundo donax: Source of Musical Reeds and Industrial Cellulose', *Economic Botany*, 12(4), pp. 368-404. DOI:10.1007/BF02860024

Pérez, C. (1998) *Quinine and Caudillos: Manuel Isidoro Belzu and the Cinchona Bark Trade in Bolivia, 1848-1855*. Berkeley: The University of California Press.

Pérez de Arce, J. (1993) 'Siku', *Revista Andina*, 11(2), pp. 473-486.

_____ (2004) 'Influencia Musical de Tiwanaku en el Norte de Chile: El Caso del "Siku" y la "Antara"', in Rivera, M.A. & Kolata, A.L. (eds.) *Tiwanaku: Aproximaciones a sus Contextos Históricos y Sociales*. Santiago: Universidad Bolivariana, pp. 193-219.

Perlman, M. (2012) 'Ecology and Ethno/musicology: The Metaphorical, the Representational, and the Literal', *Ecomusicology Newsletter*, 1(2), pp. 1, 15-21.

Peterson, A.T. & Nakazawa, Y. (2008) 'Environmental Data Sets Matter in Ecological Niche Modelling: An Example with *Solenopsis invicta* and *Solenopsis richteri*', *Global Ecology and Biogeography*, 17(1), pp. 135-144. DOI: 10.1111/j.1466-8238.2007.00347.x

Peterson, A.T., Soberón, J., Pearson, R.G., Anderson, R.P., Martínez-Meyer, E., Nakamura, M. & Araújo, M.B. (2011) *Ecological Niches and Geogrpahic Distributions*. Princeton and Oxford: Princeton University Press.

Pettan, S. (2008) 'Applied Ethnomusicology and Empowerment Strategies: Views from Across the Atlantic', *Musicological Annual*, 44(1), pp. 85-99. DOI: 10.4312/mz.44.1.85-99.

Pettan, S. & Titon, J.T. (eds.) (2015) *The Oxford Handbook of Applied Ethnomusicology*. Oxford: Oxford University Press.

Phillips, S.J. & Dudík, M. (2008) 'Modeling of Species Distributions with Maxent: New Extensions and a Comprehensive Evaluation', *Ecography*, 31(2), pp. 161-175. DOI: 10.1111/j.0906-7590.2008.5203.x.

Phillips, S.J., Anderson, R.P. & Schapire, R.E. (2006) 'Maximum Entropy Modeling of Species Geographic Distributions', *Ecological Modelling*, 190(3-4), pp. 231-259. DOI: 10.1016/j.ecolmodel.2005.03.026.

Phillips, S.J., Anderson, R.P., Dudík, M., Schapire, R.E. & Blair, M.E. (2017) 'Opening the Black Box: An Open-Source Release of Maxent', *Ecography*, 40(7), pp. 887-893. DOI: 10.1111/ecog.03049.

Phillips, S.J., Dudík, M., Elith, J., Graham, C., Lehmann, A., Leathwick, J. & Ferrier, S. (2009) 'Sample Selection Bias and Presence-Only Distribution Models: Implications for Background and Pseudo-Absence Data', *Ecological Applications*, 19(1), pp. 181-197. DOI: 10.1890/07-2153.1.

Phillips, S.J., Dudík, M. & Schapire, R.E. (2004) 'A Maximum Entropy Approach to Species Distribution Modeling', in ICML (ed.) *Proceedings of the 21st International Conference on Machine Learning*. New York: ACM Press, pp. 655–662.

Platt, T. (1982) 'The Role of the Andean Ayllu in the Reproduction of the Petty Commodity Regime in Northern Potosi (Bolivia)', in Lehmann, D. (ed.) *Ecology and Exchange in the Andes*. Cambridge: The Cambridge University Press, pp. 27-69.

_____ (1995) 'Ethnic Calendars and Market Interventions among the Ayllus of Lipes during the Nineteenth Century', in Larson, B. & Harris, O. (eds.) *Ethnicity, Markets, and Migration in the Andes: At the Crossroads of History and Anthropology*. Durham and London: Duke University Press, pp. 259-296.

Pocheville, A. (2015) 'The Ecological Niche: History and Recent Controversies', in Heams, Th., Huneman, P., Lecointre, G. & Silberstein, M. (eds.) *Handbook of Evolutionary Thinking in the Sciences*. New York: Springer, pp. 547-586. DOI: 10.1007/978-94-017-9014-7_26.

Pohl, R.W. (1991) 'Blooming History of the Costa Rican Bamboos', *Revista de Biología Tropical*, 39(1), pp. 111-124.

Polanyi, K. (1957[1944]) *The Great Transformation: The Political and Economic Origins of Our Time*. Boston: Beacon Press.

Pollan's (2002) *The Botany of Desire: A Plant's Eye View of the World*. New York and Toronto: Random House Trade Paperback.

Posnansky, A. (1957) *Tihuanaco: The Cradle of American Man, Vol. III-IV*. New York: J.J. Augustin.

Post. J. (2011) 'Sharing Rosewood, Smuggling Ivory: The Global and Local Politics of Resource Use and Distribution in Musical Instrument Making', Paper presented at the Centre for Music Studies Research Seminar, City University of London, London, UK, 9 November 2011.

_____ (2019) ‘Tonewood, Skin, and Bone: Lutes and Local Ecologies along Eurasian Trading Routes’, in Witzleben, L. & Mei, X. (eds.) *Plucked Lutes of the Silk Road: The Interaction of Theory and Practice from Antiquity to Contemporary Performance*. Shanghai: Shanghai Conservatory of Music Press, pp. 3-21.

Post, J. & Pijanowski, B. (2019) ‘Coupling Scientific and Humanistic Approaches to Address Wicked Environmental Problems of the Twenty-first Century: Collaborating in an Acoustic Community Nexus’, *MUSICultures*, 45(1-2), p. 71-91.

Qureshi, R.B. (1997) ‘The Indian Sarangi: Sound of Affect, Site of Contest’, *Yearbook for Traditional Music*, 29, pp. 1-38. DOI: 10.2307/768295.

_____ (2000) ‘How Does Music Mean? Embodied Memories and the Politics of Affect in the Indian Sarangi’, *American Ethnologist*, 27(4), pp. 805-838. DOI: 10.1525/ae.2000.27.4.805.

Rabik, A. & Brown, B. (2003) *Towards Resilient Bamboo Forestry: A Reference Guide for Improved Management of Clumping Bamboo for Timber Bamboo*. Ubud: Environmental Bamboo Foundation.

Ramanayake, S.M.S.D. (2006) ‘Flowering in Bamboo: An Enigma!’, *Ceylon Journal of Science (Biological Sciences)*, 35(2), pp. 95-105.

Ramanayake, S.M.S.D. & Weerawardene, T.E. (2003) ‘Flowering in a Bamboo, Melocanna baccifera’, *Botanical Journal of the Linnean Society*, 143(3), 287-291. DOI: 10.1046/j.1095-8339.2003.00216.x.

Renfrew, C. (1975) ‘Trade as Action at a Distance: Questions of Integration and Communication’, in Sabloff, J.A. & Lamberg-Karlovsky, C.C. (eds.) *Ancient Civilization and Trade*. Albuquerque: The University of New Mexico Press, pp. 3-59.

Ricci, A. (2019) ‘Unequal Exchange in the Age of Globalization’, *Review of Radical Political Economics*, 51(2), pp. 225-245. DOI: 10.1177/0486613418773753

Ricco Quiroga, D. (2010) *Los “Dueños” del Monte: Las Relaciones Sociales que se Tejen en la Actualidad en Torno a la Extracción de Madera en la TCO Mosetén*. Licenciatura Thesis, Universidad Mayor de San Andrés, La Paz.

Rios, F.E. (2005) *Music in Urban La Paz, Bolivian Nationalism, and the Early History of Cosmopolitan Andean Music: 1936-1970*. PhD Thesis, University of Illinois at Urbana-Champaign, Illinois, United States.

_____ (2008) ‘La Flute Indienne: The Early History of Andean Folkloric-Popular Music in France and its Impact on Nueva Cancion’, *Latin American Music Review*, 29(2), pp. 145-189. DOI: 10.1353/lat.0.0022.

_____ (2010) ‘Bolero Trios, Mestizo Panpipe Ensembles, and Bolivia’s 1952 Revolution: Urban La Paz Musicians and the Nationalist Revolutionary Movement’, *Ethnomusicology*, 54(2), pp. 281-317. DOI: 10.5406/ethnomusicology.54.2.0281.

_____ (2012) ‘The Andean Conjunto, Bolivian Sikureada and the Folkloric Musical Representation Continuum’, *Ethnomusicology Forum*, 21(1), pp. 5-29. DOI: 10.2307/41417565.

_____ (2020) *Panpipes and Ponchos: Andean Music, Folklorization, and the Rise of a Bolivian National Tradition*. Oxford: Oxford University Press.

Rittel, H.W.J. & Webber, M.M. (1973) ‘Dilemmas in a General Theory of Planning’, *Policy Sciences*, 4(2), pp. 155-169.

Ritter, J. (2002) ‘Siren Songs: Ritual and Revolution in the Peruvian Andes’, *British Journal of Ethnomusicology*, 11(1), pp. 9-42. DOI: 10.1080/09681220208567327.

Rivera A., J.J. (Forthcoming) ‘Perspectivismo, Contienda, Ontografía y Música en los Andes’, *Contrapunto. Revista de Musicología*, tbc.

Rivera C., S. (2012) ‘Ch'ixinakax Utxiwa: A Reflection on the Practices and Discourses of Decolonization’, *The South Atlantic Quarterly*, 111(1), pp. 95-109. DOI: 10.1215/00382876-1472612.

_____ (2014) *Mito y Desarrollo en Bolivia: El Giro Colonial del Gobierno del MAS*. La Paz: Piedra Rota, Plural Editores.

_____ (2016) ‘La Destrucción de lo Común o el Mal Vivir del Proceso de Cambio’, in CIPCA (ed.) *Memoria Tercer Foro Internacional Andino Amazónico de Desarrollo Rural*. La Paz: CIPCA, pp. 146-155.

_____ (2020) *Ch'ixinakax utxiwa: On Decolonising Practices and Discourses*. Cambridge: Polity.

Rivière, G. (1994) ‘El Sistema de Aynuqa: Memoria e Historia de la Comunidad (Comunidades Aymara del Altiplano Boliviano)’, in Hervé, D., Genin, D. & Rivière, G. (eds.) *Dinámicas del Descanso de la Tierra en los Andes*. La Paz: IBTA-ORSTROM, pp. 89-105.

Roda, P.A. (2014) ‘Tabla Tuning on the Workshop Stage: Toward a Materialist Musical Ethnography’, *Ethnomusicology Forum*, 23(3), pp. 360–382. DOI: 10.1080/17411912.2014.919871.

Rodríguez G., H. (2012) *La Choledad Antiestatal: El Anarcosindicalismo en el Movimiento Obrero Boliviano (1912-1965)*. La Paz: Muela del Diablo.

Rodríguez, M.F. & Rúgolo de Agrasar, Z.E. (2015) 'La Confección de Sikus en el Noroeste Argentino, Área Centro-Sur Andina: Análisis de la Materia Prima Utilizada', *Entobiología*, 13(3), pp. 54-67.

Rozo, B. (2014) 'De Qué Estamos Hablando cuando Decimos Descolonización de las Artes' Paper presented at II Congreso Plurinacional de Antropología, MUSEF, La Paz, Bolivia, 22-26 September 2014.

Ruiz-Sanchez, E., Tyrrell, C.D., Ortiz-Rodriguez, A.E., Sosa, V. & Gómez-Domínguez, H. (2019) A new Species of Rhipidocladum (Poaceae: Bambusoideae: Arthrostylidiinae) from Mexico', *Phytotaxa*, 420(4), pp. 255-263. DOI: 10.11646/phytotaxa.420.4.1.

Ryan, R. (2015) '"Didjeri-dus" and "Didjeri-don'ts": Confronting Sustainability Issues', *Journal of Music Research Online,* 6(1), pp. 1-10. Available at: http://www.jmro.org.au/index.php/mca2/article/view/121/44 (Accessed: 9 December 2018)

_____ (2016) '"No Tree-no Leaf": Applying Resilience Theory to Eucalypt-Derived Musical Traditions', in Allen, A.S & Dawe, K. (eds.) *Current Directions in Ecomusicology: Music, Nature, Environment.* London and New York: Routledge, pp. 57-68.

Rymer, R. (2004) 'Saving the Music Tree', *Smithsonian*, 35(1), pp. 52-63.

Sahlins, M. (1969) 'Economic Anthropology and Anthropological Economics', *Social Science* Information, 8(5), pp. 13-33. DOI: 10.1177/053901846900800504.

_____ (1972) *Stone Age Economics*. Chicago: Aldine Atherton.

Saignes, T. (1986) *En Busca del Poblamiento Étnico de los Andes Bolivianos (Siglos XV y XVI).* La Paz: MUSEF.

Salazar, C. (ed.) (2009) *Migraciones Contemporáneas: Contribución al Debate*. La Paz: CIDES-UMSA.

Salomon, F. (1985) 'The Dynamic Potential of the Complementarity Concept', in Masuda, S., Shimada, I. & Morris, E. C. (eds.) *Andean Ecology and Civilization: An Interdisciplinary Perspective on Andean Ecological Complementarity*. Tokyo: The University of Tokyo Press, pp. 511-531.

_____ (1986) *Native Lords of Quito in the Age of the Incas: The Political Economy of North Andean Chiefdoms*. Cambridge: Cambridge University Press.

Sánchez, R. (1982) 'The Andean Economic System and Capitalism', in Lehmann, D. (ed.) *Ecology and Exchange in the Andes*. Cambridge: Cambridge University Press, pp. 157-190.

Sánchez Canedo, W. (1989) 'Música Autóctona del Norte de Potosí: El Calendario Musical e Instrumental', *Boletín CENDOCMB-CPCP*, No. 12.

Sánchez C., W. & Sanzetenea R., R. (2000) 'Instrumentos Musicales Prehispánicos de Bolivia', *Boletín INIAM-UMSS*, No. 17. Available at: http://www.museo.umss.edu.bo/files/shares/virtuales/boletines/Boletin-INIAM-N17-Instrumentos-musicales-prehispanicos-de-Bolivia.pdf (Accessed: 12 April 2020).

_____ (2002) 'Instrumentos Sonoros en las Culturas Prehispánicas: Un Primer Acercamiento', in Sánchez C., W. (ed.) *La Música en Bolivia: De la Prehistoria a la Actualidad*. Cochabamba: Fundación Simón I. Patiño, pp. 33-64.

Sánchez Huaringa, C. (2015) 'Los Primeros Instrumentos Musicales Precolombinos: la Flauta de Pan Andina o la "Antara"', *Arqueología y Sociedad*, 29(1), pp. 461-494.

_____ (2018) 'Introducción: Las Flautas de Pan Arqueológicas y Etnográficas de Latinoamérica del Sur', in Sánchez H., C. (ed.) *Música y Sonidos en el Mundo Andino: Flautas de Pan, Zampoñas, Antaras y Ayarachis*. Lima: Fondo Editorial de la Universidad Nacional Mayor de San Marcos, pp. 485-510.

Schampke, A. (2017) 'Indicadores de la Prehistoria Musical del Norte de Chile: Las Flautas de Pan del Sitio Arqueológico Azapa-6, Valle de Azapa', in Stöckli, M. & Howell, M. (eds.) *Flower World. Music Archaeology of the Americas, Vol.5*. Berlin: Ekho, pp. 11-23.

_____ (2018) 'Indicadores de la Prehistoria Musical en el Norte de Chile: Una Aproximación al Estudio de las Relaciones Interválicas entre Contextos Culturales Cabuza y Maytas-Chiribaya (ca. 500 a 1.200 Años DC.)', in Sánchez H., C. (ed.) *Música y Sonidos en el Mundo Andino: Flautas de Pan, Zampoñas, Antaras y Ayarachis*. Lima: Fondo Editorial de la Universidad Nacional Mayor de San Marcos, pp. 117-136.

Schiebinger, L. (2004) *Plants and Empire: Colonial Bioprospecting in the Atlantic World*. Cambridge: Harvard University Press.

Schiebinger, L. & Swan, C. (2005) *Colonial Botany: Science, Commerce, and Politics in the Early Modern World*. Philadelphia: The University of Pennsylvania Press.

Schippers, H. (2014) 'Ecology and Music Research in the Twenty-First Century: Facing the Challenges of Diversity and Sustainability in a Globalised World', in Suer C., C.C. & Penny, J. (eds.) *Sustainability in Music and the Performing Arts: Heritage, Performance and Education*. Tanjong Malim: UPSI Press.

_____ (2015) ‘Applied Ethnomusicology and Intangible Cultural Heritage: Understanding “Ecosystems” of Music as a Tool for Sustainability’, in Pettan, S. & Titon, J.T. (eds.) *The Oxford Handbook of Applied Ethnomusicology*. New York: Oxford University Press, pp. 134-157.

Schippers, H. & Bendrups, D. (2015) ‘Ethnomusicology, Ecology and the Sustainability of Music Cultures’, *The World of Music*, 4(1), pp. 9-19.

Schippers, H. & Grant, C. (eds.) (2016) *Sustainable Futures for Music Cultures: An Ecological Perspective*. New York: Oxford University Press.

Schipper, H. & Letts, R. (2013) ‘Community Music and Sustainability Worldwide: Ecosystems of Engaged Music Making’, in Veblen, K.K., Messenger, S.J., Silverman, M. & Elliot, D.J. (2013) *Community Music Today*. Lanham: Rowman & Littlefield, pp. 287-298.

Scholz, R.W. & Steiner, G. (eds.) (2015) ‘Special Feature: The Reality of Transdisciplinary Processes’, *Sustainability Science*, 10(4).

Scholz, R.W., Lang, D.J., Wiek, A., Walter, A.I. & Stauffacher, M. (2006) ‘Transdisciplinary Case Studies as a Means of Sustainability Learning: Historical Framework and Theory’, *International Journal of Sustainability in Higher Education*, 7(3), pp. 226-251. DOI: 10.1108/14676370610677829.

Schramm (1992) ‘Ist’apxam! Escuchen! Tradiciones Musicales y Orales Aymaras’, in van den Berg, H. & Schiffers, N. (eds.) *La Cosmovisión Aymara*. La Paz: UCB/Hisbol, pp. 309-347.

Seeger, A. (1987) *Why Suyá Sing: A Musical Anthropology of an Amazonian People*. Cambridge: Cambridge University Press.

_____ (2008) ‘Theories Forged in the Crucible of Action: The Joys, Dangers and Potentials of Advocacy and Fieldwork’, in Barz, G.F. & Cooley, T.J. (eds.) *Shadows in the Field: New Perspectives for Fieldwork in Ethnomusicology*. (2nd Ed.). Oxford: Oxford University Press, pp. 271-288.

_____ (2013) ‘Ecomusicology: Music, Culture, and Nature in the Mix’, Lecture given at Monash University, Melbourne, 14 November 2014.

Servicio Nacional de Áreas Protegidas (SERNAP) (2005) *Plan de Manejo del Parque Nacional y Área Natural de Manejo Integrado Cotapata*. La Paz: SERNAP.

_____ (2013) *Deforestación Y Regeneración De Bosques En Bolivia Y En Sus Áreas Protegidas Nacionales Para Los Periodos 1990-2000 Y 2000-2010*. La Paz: Servicio Nacional de Áreas Protegidas, Museo de Historia Natural Noel Kempff Mercado y Conservación Internacional.

Sherinian, Z. (2015) ‘Activist Ethnomusicology and Marginalized Music of South Asia’, in Pettan, S. & Titon, J.T. (eds.) *The Oxford Handbook of Applied Ethnomusicology*. New York: Oxford University Press, pp. 348-376.

Shiner, L. (2003) *The Invention of Art: A Cultural History*. Chicago: The University of Chicago Press.

Sillitoe, P. (2006) ‘Why Spheres of Exchange?’, *Ethnology*, 45(1), pp. 1-23. DOI: 10.2307/4617561.

Simonett, H. (2016) ‘Yoreme Cocoon Leg Rattles: An Eco-Organological Perspective’, *TRANS-Transcultural Music Review*, 20. Available at: http://www.sibetrans.com/trans/public/docs/06d-trans-2016_1.pdf (Accessed 20 April 2020).

Soberón, J. & Peterson, A.T. (2005) ‘Interpretation of Models of Fundamental Ecological Niches and Species’ Distributional Areas’, *Biodiversity Informatics*, 2(1), pp. 1-10. DOI: 10.17161/bi.v2i0.4.

Soderstrom, T.R. & Young, S.M. (1983) ‘A Guide to Collecting Bamboo’, *Annals of the Missouri Botanical Garden*, 70(1), pp. 128-136. DOI: 10.2307/2399010.

Soderstrom, T. R., Judziewicz, E. J. & Clark, L. (1988) ‘Distribution Patterns of Neotropical Bamboos’, in Vanzolini, P.E. & Heyer, W.R. (eds.) *Proceedings Of A Workshop On Neotropical Distribution Patterns*. Rio de Janeiro: Academia Brasileira De Ciências, pp. 121-127.

Soini, K. & Birkeland, I. (2014) ‘Exploring the Scientific Discourse on Cultural Sustainability’, *Geoforum*, 51, pp. 213-223. DOI: 10.1016/j.geoforum.2013.12.001.

Solomon, T.J. (1997) *Mountain of Songs: Musical Construction of Ecology, Place, and Identity in the Bolivian Andes*. PhD Thesis, University of Texas at Austin, Austin, United States.

_____ (2012) ‘Where is the Postcolonial in Ethnomusicology?’, in Nannyonga-Tamusuza, S. & Solomon, T. (eds.) *Ethnomusicology in East Africa; Perspectives from Uganda and Beyond*. Kampala: Fountain Publishers, pp. 216-251.

Spedding, E. (2005) *Sueños, Kharisiris y Curanderos: Dinámicas Sociales de las Creencias en los Andes Contemporáneos.* La Paz: Editorial Mama Huaco.

Stapleton, C.M.A. (1997) ‘Morphology of Woody Bamboos’, in Chapman, G.P. (ed.) *The Bamboos*. London: Academic Press, pp: 251-267.

Starn, O. (1999) *Nightwatch: The Politics of Protest in the Andes*. Durham, NC: Duke University Press.

Steininger, M. K., Tucker, C. J., Townshend, J. R., Killeen, T. J., Desch, A., Bell V. & Ersts, P. (2001) 'Tropical Deforestation in the Bolivian Amazon', *Environmental Conservation*, 28(2), pp. 127-234. DOI: DOI: 10.1017/ S0376892901000133.

Stobart, H. (1988) *The Pinkillos of Vitichi.* Unpublished Document to Accompany Instrument Collection. Horniman Museum, London.

_____ (1996a) 'The Llama's Flute: Musical Misunderstandings in the Andes', *Early Music*, 24(3), pp. 470-483.

_____ (1996b) 'Tara and Q´iwa: Worlds of Sound and Meaning', in Baumann, M.P. (ed.) *Cosmología y Música en los Andes*. Frankfurt am Main/Madrid: Verveut/Iberoamerica, pp. 67-81.

_____ (2006a) *Music and the Poetics of Production in the Bolivian Andes*. Aldershot: Ashgate.

_____ (2006b) 'Devils, Daydreams, and Desire: Siren Traditions and Musical Creation in the Central Southern Andes', in Austern, L.P. & Naroditskaya, I. (eds.) *Music of the Sirens*. Bloomington: Indiana University Press, pp. 105-139.

_____ (2013a) 'Staging Sound: Acoustic Reflections on Inca Music, Architecture, and Performance Spaces', in Stöckli, M. & Both, A.A. (eds.) *Flower World: Music Archaeology of the Americas, Vol. 2*. Berlin: Ekho, pp. 11-35.

_____ (2013b) 'Unfamiliar Sounds? Approaches to Intercultural Interaction in the World's Music', in King, E. & Daynes, H. (eds.) *Music and Familiarity: Listening, Musicology and Performance*. Aldershot: Ashgate, pp. 109-136.

_____ (2014) 'Bolivia', in Olsen, D.A. & Sheehy, D.E. (eds.) *The Garland Handbook of Latin American Music*. (2nd Ed.). London: Routledge, pp. 417-437.

_____ (2016) 'Dancing in the Fields: Imagined Landscapes and Virtual Locality in Indigenous Andean Music Videos', *TRANS-Transcultural Music Review*, 20. Available at: http://sibetrans.com/trans/public/docs/07d-trans-2016-hs2.pdf (Accessed: 8 October 2019).

_____ (2019a) 'Bolivia's Anti-Racism Law: Transforming a Culture?', in Wade, P., Scorer, J. & Aguiló, I. (eds.) *Cultures of Anti-Racism in Latin America and the Caribbean.* London: The University of London Press, pp. 191-212.

_____ (2019b) 'Más allá del Batimiento: Reflexiones sobre las Sonoridades Andinas', Paper presented at IX Simposio de Historia y Arte: Artes, Paisajes y Objetos Sonoros del Pasado, Universidad de los Andes, Bogotá, Colombia, 25-27 November 2019.

Stoichita, V.A. & Brabec de Mori, B. (2017) 'Postures of Listening: An Ontology of Sonic Percepts from an Anthropological Perspective', *Terrain*. Available at: http://journals.openedition.org/terrain/16418 (Accessed 5 December 2018).

Strathern, M. (2004) *Partial Connections*. (Updated Ed.). Walnut Creek: Altamira.

Sturtevant, C. (2016). 'An Introductory Framework for Habilito: Debt for Life', *Finance and Society*, 2(1), pp. 86-89. DOI: 10.2218/finsoc.v2i1.1665.

Sulthoni, A. (1996) 'Shooting Period of Sympodial Bamboo Species: An Important Indicator to Manage Culm Harvesting', in Ramanuja R., I.V. & Sastry, C.B. (eds.) *Bamboo, People, and the Environment, Vol 1: Propagation and Management*. New Delhi: INBAR, pp. 96-100.

Swanson, K.K. & Timothy, D.J. (2012) 'Souvenirs: Icons of Meaning, Commercialization, and Commoditization', *Tourism Management*, 33(3), pp. 489-499. DOI: 10.1016/j.tourman.2011.10.007.

Swets, J. A. (1988) 'Measuring the Accuracy of Diagnostic Systems', *Science*, 240(4857), pp. 1285-1293. DOI: 10.1126/science.3287615.

Taussig, M. (1980) *The Devil and Commodity Fetishism in South America*. Chapel Hill: The University of North Carolina Press.

Tassi, N. (2017) *The Native World-System: An Ethnography of Bolivian Aymara Traders in the Global Economy*. Oxford: Oxford University Press.

Taylor, R., Dudley, N., Stolton, S. & Shapiro, A. (2015) 'Deforestation Fronts: 11 Places where Most Forest Loss is Projected between 2010 and 2030', Paper presented at the XIV World Forestry Congress, Durban, South Africa, 7-11 September 2015.

Titon, J.T. (2009a) 'Economy, Ecology, and Music: An Introduction', *World of Music*, 51(1), pp. 5-15. DOI: 10.2307/41699860.

_____ (2009b) 'Music and Sustainability: An Ecological Viewpoint', *World of Music*, 51(1), pp. 119-137. DOI: 10.2307/41699866.

_____ (2013) 'The Nature of Ecomusicology', *Música e Cultura*, 8(1), pp. 8–18.

_____ (2015) 'Sustainability, Resilience, and Adaptive Management in Applied Ethnomusicology', in Pettan, S. & Titon, J.T. (eds.) *The Oxford Handbook of Applied Ethnomusicology*. New York: Oxford University Press, pp. 157-195.

_____ (2016) 'Orality, Commonality, Commons, Sustainability, and Resilience', *The Journal of American Folklore*, 129(514), pp. 486-497. DOI: 10.5406/jamerfolk.129.514.0486

_____ (2017) 'The Music-Culture as a World of Music', in Titon, J.T. (ed.) *Worlds of Music: An Introduction to the Music of the World's Peoples*. (6th Ed.). Belmont: Schirmer Cengage Learning, pp. 1-32.

_____ (2018) 'Afterword: Ecomusicology and the Problems in Ecology', *MUSICultures*, 45(1-2), pp. 255-264.

Tsing, A.L. (2015) *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins*. Princeton: Princeton University Press.

Tucker, J. (2016) 'The Machine of Sonorous Indigeneity: Craftsmanship and Sound Ecology in an Andean Instrument Workshop', *Ethnomusicology Forum*, 25(3), pp. 326-344. DOI: 10.1080/17411912.2016.1246973.

_____ (2019) *Making Music Indigenous. Popular Music in the Peruvian Andes*. Chicago: The University of Chicago Press.

Turino, T. (1983) 'The Charango and the "Sirena": Music, Magic, and the Power of Love', *Latin American Music Review*, 4(1), pp. 81-119. DOI: 10.2307/780281.

_____ (1988) 'The Music of Andean Migrants in Lima, Peru: Demographics, Social Power, and Style', *Latin American Music Review*, 9(2), pp. 127-150. DOI: 10.2307/780291.

_____ (1989) 'The Coherence of Social Style and Musical Creation among the Aymara in Southern Peru', *Ethnomusicology*, 33(1), pp. 1-30. DOI: 10.2307/852167.

_____ (1993) *Moving Away from Silence. Music of the Peruvian Altiplano and the Experience from Urban Migration*. Chicago: The University of Chicago Press.

_____ (2008) *Music as Social Life. The Politics of Participation*. Chicago: The University of Chicago Press.

Tyrrell, C.D. (2008) *Systematics of the Neotropical Woody Bamboo Genus Rhipidocladum (Poaceae: Bambusoideae)*. Masters Dissertation, Iowa State University, Ames, United States.

Tyrrell, C.D. & Clark, L.G. (2013) 'Three new Species of Rhipidocladum (Poaceae: Bambusoideae: Arthrostylidiinae) from South America', *Phytotaxa*, 98(2), pp. 55-64. DOI: 10.11646/phytotaxa.98.2.3.

United Nations Educational, Scientific, and Cultural Organisation (UNESCO) (2003) *Convention for the Safeguarding of the Intangible Cultural Heritage*. Paris: UNESCO.

United Nations Office on Drugs and Crime (UNODC) (2017) *Estado Plurinacional de Bolivia: Monitoreo de Cultivos de Coca 2016*. La Paz: UNODC.

_____ (2020) *Estado Plurinacional de Bolivia: Monitoreo de Cultivos de Coca 2019*. La Paz: UNODC.

United Nations Development Programme (UNDP) (2013) *El Impacto del Cambio Climático en la Biodiversidad (Bolivia)*. La Paz: UNDP.

Urioste E., A. (2010) *Deforestación en Bolivia: Una Amenaza Mayor al Cambio Climático*. La Paz: Fundación Friedrich Ebert.

Urioste, M. & Pacheco, D. (2001) *Las Tierras Bajas de Bolivia a Fines del Siglo XX*. La Paz: PIEB.

Van Proosdij, A.S.J., Sosef, M.S.M., Wieringa, J.J. & Raes, N. (2016) 'Minimum Required Number of Specimen Records to Develop Accurate Species Distribution Models', *Ecography*, 39(6), pp. 542-552. DOI: 10.1111/ecog.01509.

Velez-Liendo, X. & García-Rangel, S. (2017) *Tremarctos ornatus* (errata version published in 2018). *The IUCN Red List of Threatened Species* 2017: e.T22066A123792952. Available at: https://dx.doi.org/10.2305/IUCN.UK.2017-3.RLTS.T22066A45034047.en (Accessed: 05 August 2020).

Veller, C., Nowak, M.A. & Davis, C.C. (2015) 'Extended Flowering Intervals of Bamboos evolved by Discrete Multiplication', *Ecology Letter*, 18(7), pp. 653-659. DOI: 10.1111/ele.12442.

Villavicencio, X., Rúgolo, Z.E. & Renvoize, S.A. (2014) 'Poaceae', in Jørgensen, P.M., Nee, M.H. & Beck, S.G. (eds.) *Catálogo de las Plantas Vasculares de Bolivia*. St. Louis: Missouri Botanical Garden Press, pp. 1035-1104.

Von Stosch, K. (2014) *Indígenas y Campesinos en Alto Beni: Diferentes Visiones en Torno a Tierra, Territorio y Recursos Naturales*. La Paz: Fundación Tierra.

Wachtel, N. (1971) *Los Vencidos: Los Indios del Perú frente a la Conquista Española (1530-1570)*. Madrid: Alianza.

Walker, B. & Salt, D. (2006) *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*. Washington: Island Press.

Wallis, R. & Malm, K. (1984) *Big Sounds from Small Peoples: The Music Industry in Small Countries. New York: Pendragon Press.*

Wassenaar, T., Gerber, P., Verburg, P.H., Rosales, M., Ibrahim, M. & Steinfeld, H. (2007) 'Projecting Land Use Changes in the Neotropics: The Geography of Pasture Expansion into Forest', *Global Environmental Change*, 17(1), pp. 86-104. DOI: 10.1016/j.gloenvcha.2006.03.007.

Wegst, U. (2008) 'Bamboo and Wood in Musical Instruments', *Annual Review of Materials Research*, 38(1), pp. 323-349. DOI: 10.1146/annurev.matsci.38.060407.132459.

Wilken, G.C. (1970) 'The Ecology of Gathering in a Mexican Farming Region', *Economic Botany*, 24(3), pp. 286-295. DOI: 10.1007/BF02860664.

Yano, H., Furuta, Y. & Nakagawa, H. (1997) 'Materials for Guitar Back Plates made from sustainable Forest Resources', *The Journal of the Acoustical Society of America*, 101(2). DOI: 10.1121/1.418016.

Yujra Mamani, C. (2005) *Los Grandes Pensamientos de Nuestros Antepasados: Laq'a Achachilanakan Jach'a Tayka Aymuyt'äwinakapa*. La Paz: C&C Editores.

_____ (2009) *El Camino de la Descolonización*. La Paz: Editorial All Press.

_____ (2021) 'Un Ensayo sobre las Músicas y Fiestas Autóctonas', *Contrapunto. Revista de Musicología*, tbc.

Zoomers, A. (2012) 'Migration as a Failure to Adapt? How Andean People Cope with Environmental Restrictions and Climate Variability', *Global Environment*, 5(9), pp. 104-129. DOI: 10.3197/ge.2012.050905.