People and Plants Through Generations of Polish Descendants in Brazil

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Exploring the dynamics of knowledge through generations of immigrants and their descendants can elucidate different variables that contribute to the transformation of traditional ecological knowledge. In this study, we present a quantitative investigation of intergenerational plant knowledge among Polish descendants in Brazil. We seek to answer the following questions: 1) Would plant knowledge vary with age? 2) Does the composition of species vary in accordance with the descendant's generation? 3) Does the strengthening of identity act as a homogenizer of plant knowledge? We interviewed 150 Brazilian descendants of Polish immigrants from three generational groups (second, third, and fourth generations). We classified them into two groups based on their participation in cultural associations. We found that the fourth generational group cited significantly fewer plants than the second and third groups. However, the composition of plant knowledge was similar throughout the generations. The involvement in cultural associations did not play a role in homogenizing plant knowledge. We discuss and reflect on the differences in knowledge between generations and groups that do and do not participate in cultural organizations.

Explorar a dinâmica de conhecimento através das gerações de imigrantes e seus descendentes pode ajudar a expandir nossa visão sobre diferentes variáveis que contribuem para a transformação do conhecimento ecológico tradicional. Neste artigo apresentamos uma perspectiva do conhecimento intergeracional sobre plantas entre descendentes poloneses no Brasil. Nós objetivamos responder as seguintes perguntas: 1) O conhecimento das plantas varia com a idade? 2) A composição das espécies varia de acordo com a geração dos descendentes? 3) O fortalecimento da identidade atua como homogeneizador do conhecimento das plantas? Entrevistamos 150 descendentes de imigrantes poloneses, divididos em grupos geracionais (segunda, terceira e quarta gerações), e em grupos de pessoas que participam de associações culturais ou não. Encontramos que a quarta geração cita menos plantas que a segunda e terceira. Entretanto, a composição do conhecimento sobre plantas foi similar entre todas as gerações. Organizações sociais como as associações culturais não foram consideradas como fator de homogeneização do conhecimento sobre plantas. Nós discutimos e trazemos algumas reflexões a respeito das diferenças entre os conhecimentos de cada geração assim como das associações culturais.

Keywords: Traveling knowledge, migrant ethnobotany, diaspora, dynamics of plant knowledge.

Palavras-Chave: Conhecimento viajante, imigração, dinâmica do conhecimento de plantas, etnobotânica.

Introduction

Migration is a part of human nature due to the impulse of seeking new opportunities and a better quality of life (Marcella and Ring 2003). However,

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when arriving in a place with a novel biological context, migration challenges people to learn about local diversity from scratch. The changes in plant knowledge among migrants make the study of human movements fundamental to understanding the dynamics of plant knowledge (Albuquerque et al. 2019; Ceuterick et al. 2008).

In the last decade, studies on migrants and ethnobotany have raised questions, including: What changes occur in the repertoire of traditional plant knowledge? How do people adapt their knowledge and practices to a new flora? Can knowledge decrease and eventually be lost in the migration process? (Aswani et al. 2018; Ceuterick et al. 2008; Palanisamy et al. 2011; Vandebroek and Balick 2012). Examining the dynamics in this knowledge across generations of descendants is critical to understanding the biocultural dynamics of migrants through time. Studies on intergenerational patterns have tended to ask the following questions: How is biocultural knowledge acquired, and how does plant knowledge change and become lost across generations? (Bussmann et al. 2018; Kujawska et al. 2017; Medeiros et al. 2012; Pasquini et al. 2018a, b). The expected quantitative results of these inquiries may be that immigrants' knowledge increases as they add knowledge of local flora to their own prior knowledge. Meanwhile, future generations are expected to lose the knowledge that the immigrant no longer uses and tend towards more significant acquisition of knowledge of the local flora (Medeiros et al. 2012).

Research with descendants that share the same ancestral country is challenging due to the differences in generational timelines, influenced by social, economic, and cultural factors (Mathez-Stiefel and Vandebroek 2012). The influences of a timeline can provide exciting insights into the collective dynamics of knowledge (Brown 2011). Exploring dynamics through generations of immigrant communities can help to expand our views about the different variables that contribute to the transformation of knowledge. Age and generation are correlated variables that provide critical insights into data on plant knowledge (Ayantunde et al. 2008; Müller et al. 2014; Sousa et al. 2012). Members of different generations may know different plants due to the distinct way each person accesses resources (Hanazaki 2003). The reinforcement of shared identity through plants is another important variable that can help communities in the process of self-recognition of culture (Dunn 2017; Veteto and Welch 2013). However, it can also lead migrant groups to recognize and accept a limited number of characteristics as forming a part of their identity. Thus, identity reinforcement could act as a homogenizer of plant knowledge.

Brazil has been populated by several waves of non-Amerindian immigrants arriving in the last five centuries. A strong wave of immigrants came from Europe between the late 19th and early 20th centuries, and these migratory movements resulted in changes and adaptations in food habits, medicines, and livelihoods as a whole. For example, Uhle and Grivetti (1993) discussed how food patterns changed and adapted from Switzerland to Brazil after a century of isolation. The transformations of traditional knowledge of European Tyrolese migrants in Southern Brazil was studied for medicinal plants (Haselmair et al. 2014; Pirker et al. 2012) and food plants (Kuhn et al. 2018) known and used. As a way to keep rooted to their original countries, in several places these European identities are partially reinforced by cultural associations, which organize cultural activities and meetings of local populations. The distance from homeland often leads people to recreate traditional practices as a form of cultural reinforcement (Brown 2011). Nevertheless, the willingness to learn from culturally different individuals, and the reinforcement of a cultural identity (cultural conservatism), can play an important role not only in social but in a biological domain (Erten et al. 2018; Geck et al. 2016).

The ethnobotany of Polish migrants in South America was studied in Argentina (Kujawska et al. 2017; Kujawska and Łuczaj 2015; Kujawska and Pieroni 2015), focusing on medicinal plant diversity and intercultural interactions between migrants, wild edible plants, and food plants. However, there is no information about such adaptations of Polish migrants in Brazil, which received one of the larger migrant populations of Polish in Latin America (Pacyga 2005).

We conducted an intergenerational survey to investigate the dynamics of plant knowledge between generations of descendants of Polish immigrants in Southern Brazil. Given that the baseline of immigrants' local plant knowledge was limited when they arrived at the new continent, and that the knowledge and use of plants change rapidly over generations, we had three major questions: 1) Would plant knowledge vary with age? 2) Does the composition of species vary in accordance with the descendant's generation? 3) Does the strengthening of identity act as a homogenizer of plant knowledge? We hypothesized that, over generations, the elderly would report, on average, more plants than the younger descendants, due to the process of accumulation of knowledge. Intergenerational knowledge of plants may reflect cultural transmission and adaptation over time. Therefore, we hypothesized that a significant overlap in the composition of species cited among different generations should exist due to their common cultural heritage. Our final hypothesis stated that descendants involved in cultural associations would report fewer plants than those who are not involved in such associations, as a result of a cultural conservatism due to cultural reinforcement.

Materials and Methods

Study Area: Historical and Contemporary Aspects

We conducted surveys in São Bento do Sul, Rio Negrinho, and Itaiópolis, which are three municipalities of the northern plateau of Santa Catarina State, southern Brazil (Fig. 1). All of them consist mostly of rural and semi-urbanized areas. The region is also home to the largest settlements of Polish immigrants, as well as efforts and organizations dedicated to the maintenance of cultural traditions (Iarochinski 2009). In the study area, Polish immigration dated from 1869–1890, 1890–1894 (periods known as the "Brazilian Fever"), and 1895–1914 (Pietraszek 1974). Most of the immigrants were from the province of Galicia, which was the northeastern province of the former Austro-Hungarian Empire (1864–1918) (Ficker 1973; Pacyga 2005). While Polish immigration to Brazil also occurred during the Second World War, there was no significant influx of immigrants to the study region during this period (Rodycz 2011). For our sample, we considered a time frame of immigration from ~1890 to ~1900. This allowed us to interview three generations of descendants.

Historically, the Brazilian imperial government recognized the south of the country as an empty land, neglecting the indigenous peoples and mestizos that were already inhabiting the region (Ficker 1973). Under Emperor Pedro II (1840–1889), the government enacted measures aimed at attracting immigrants to exploit natural resources, such as wood and yerba mate, and to create a white, non-slave working class (Rodycz 2011). These actions attracted several ethnic groups who immigrated to Brazil, such as Germans, Italians, Poles, Ukrainians, and others. In Brazil, Polish immigrants arrived at

Fig. 1. Study site and municipalities where interviews were conducted

previously established German settlements, and due to the history of fights and partitioning of Poland, contributed to Polish immigrants concentrating their settlements in regions more distant to the other ethnic groups.

Study Design and Data Sampling

We selected collaborators interviewed through snowball sampling with the following criteria: (a) age 18 years or older; (b) second- to fourth-generation Polish descendant; (c) residing in the area for at least 10 years; (d) agreed to participate in this research. We conducted interviews with respondents between January 2017 and March 2018. The sample consisted of 150 Brazilians of Polish descent, with 50 interviewees per generation. In addition, we divided the 150 respondents into two groups, one with descendants who are members of or participate in cultural associations, and the other with those who do not participate in such associations (Table 1).

Cultural associations are organizations that unite people through their connection to Polish culture. These groups commonly feature language classes, traditional cooking classes, and traditional dances. Annual festivities are also common, in which the whole community is invited to celebrate the Polish culture.

The semi-structured interviews collected information on socio-organizational variables such as age, generation (correlated variables), gender, and participation in cultural associations. Data on plant knowledge were collected through free lists, where we gathered information about the known plants and the purposes of uses for each plant. We asked about the main uses of each plant species, including major use categories based on Cámara-Leret et al. (2012), such as human food, medicinal, and cultural uses.

We collected and photographed the cited plants during walk-in-the-woods touring (Alexiades 1996) in home gardens, pastures, and forests. The plants were identified through the bibliography and reviewed by plant taxonomists at the Federal University of Santa Catarina, Florianópolis, Brazil. Vouchers were deposited at the EAFM herbarium, Federal Institute of Education, Science, and Technology of Amazonas, Manaus, Brazil under the numbers 17,511–17,526. We photographed plants to check the identification of common species, identified in the field, and to help in the identification of plants with no reproductive structures available.

Data Analyses

The Spearman correlation was performed to evaluate if plant knowledge would be age-dependent, and the Kruskal-Wallis test was used to compare the averages of plants cited per generational group. Since age and generation were highly correlated (Spearman correlation p value <2.2e-16), for the other analysis we used the variable generation instead of age. Interpolation and extrapolation curves were used to explore the composition of species cited between generations and involvement in cultural associations. To assess if generations of descendants and involvement in cultural associations share common clusters of known plants, we used a non-metric multidimensional scaling (nMDS) analysis with the Jaccard matrix. To compare nMDS differences between groups, we carried out a permutational multivariate analysis of variance (PERMANOVA) and a multivariate homogeneity test of group dispersions (PERMDISP). To test differences in the average number of plants cited by those involved or not in cultural associations, we used the Mann-Whitney-Wilcoxon test. We performed all analyses in R (R Core Team 2018) using the ade4 (Dray and Dufour 2007), vegan (Oksanen et al. 2018), ape (Paradis and Schliep 2018), and iNEXT (Hsieh et al. 2018) packages.

Results

We interviewed 83 women and 67 men with ages varying between 18 to 90 years. The average ages

Table 1. Study sampling design

	2nd generation	3rd generation	4th generation	Total
Sampling	50	50	50	150
Subset of the main sampling (not considering generation)				
Involved in cultural associations	75			150
Not involved in cultural associations	75			

were 69 years (σ 11.61) for the second generation, 49 years (σ 13.97) for the third generation, and 29 years (σ 9.65) for the fourth generation. For the groups involved and not involved in cultural associations, the average age was 45 years (σ 20.55) and 53 years (σ 18.73), respectively.

We recorded a total of 443 plant citations, of which 320 were identified to the species level, and 23.93% were mentioned by just one person (idiosyncratic). Asteraceae (30 species), Lamiaceae (17 species), and Myrtaceae (11 species) were the three major families identified, and most of the cited plants are non-native (84.05%). The five most-cited plants per studied group are in Table 2.

For all groups, the most cited plants were *Aristolochia cymbifera* Mart. and *Brassica oleracea* L. All groups indicated knowledge of the most cited plants. *Aristolochia cymbifera* was cited for medicinal purposes as a detoxifier of the body, while *B. oleracea* was cited for food and medicinal purposes. The food purpose of *B. oleracea* appeared in several recipes cited, mainly related to Polish cuisine, such as sour cabbage, gołąbki (stuffed cabbage), or pierogi (a type of dumpling) filling.

Certain plants were cited with different frequencies by each generation. These include *Ipomoea batatas* (L.) Lam. and *Brugmansia suaveolens* (Humb. & Bonpl. ex Willd.) Bercht. & J.Presl for the second generation. *Ipomoea batatas* was cited for food and medicinal uses, with its leaves used to treat toothaches. *Brugmansia suaveolens* was cited as an ornamental and medicinal plant, the leaves of which were referred to as a treatment of urinary infections. *Cunninghamia lanceolata* (Lamb.) Hook. was among the most frequently cited plants by the third generation, with ornamental and religious purposes, including its use as a Christmas tree. Finally, *Salvia officinalis* L. was mostly cited by the fourth generation, used as food (as a seasoning), a medicinal plant in the form of infusions to treat various illnesses, and as a ritualistic plant to clean people and surroundings of bad energies.

Respondents involved in cultural associations identified certain plants with higher frequency than those who were not involved in such associations. *Plectranthus madagascariensis* (Pers.) Benth. and *Cyphomandra betacea* (Cav.) Sendtn were among the five most-cited plants by respondents involved

TABLE 2. LIST OF MOST CITED PLANTS. THE FIVE PLANTS MOST FREQUENTLY CITED BY EACH STUDIED GROUP ARE HIGHLIGHTED IN BOLD

Botanical family	Species	Origin	2nd generation Freq. (%)	3rd generation Freq. (%)	4th generation Freq. (%)	Involved in cultural associations Freq. (%)	Not involved in cultural associations Freq. (%)
Aristolochiaceae	*Aristolochia cymbifera* Mart.	Native	**13.97%**	**11.73%**	**15.55%**	**17.06%**	**14%**
Convolvulaceae	*Ipomoea batatas* (L.) Lam.	Native	**12.69%**	7.04%	9.33%	13.47	11.22%
Brassicaceae	*Brassica oleracea* L.	Non-native	**12.38%**	**9.67%**	**16.44%**	**16.16%**	**12.42%**
Sapindaceae	*Litchi chinensis* Sonn	Non-native	**10.47%**	8.79%	**20.88%**	**17.96%**	**11.28%**
Solanaceae	*Brugmansia suaveolens* (Humb. & Bonpl. ex Willd.) Bercht. & J.Presl	Native	**9.52%**	6.15%	8.44%	11.67%	8.44%
Lamiaceae	*Plectranthus madagascariensis* (Pers.) Benth.	Non-native	6.66%	5.27%	**19.11%**	**14.97%**	8.35%
Solanaceae	*Cyphomandra betacea* (Cav.) Sendtn	Non-native	6.03%	**11.14%**	13.33%	**14.97%**	9.66%
Apiaceae	*Anethum graveolens* L.	Non-native	10.79%	9.09%	14.22%	13.77%	**11.52%**
Lythraceae	*Punica granatum* L.	Non-native	12.69%	**9.97%**	**15.55%**	17.66%	**11.28%**
	Bidens pilosa L.	Native	6.66%	**9.38%**	**16%**	13.77%	11.22%
Cupressaceae	*Cunninghamia lanceolata* (Lamb.) Hook.	Non-native	8.25%	**9.38%**	12.88%	14.07%	10.44%
Rubiaceae	*Randia armata* (SW.) DC.	Native	7.61%	4.39%	**19.11%**	12.27%	3.65%
Lamiaceae	*Salvia officinalis* L.	Non-native	6.98%	8.79%	**16.88%**	13.77%	11.48%

in cultural groups. The use of *P. madagascariensis* was related to medicinal properties to treat foot problems, such as bad smell and fungal infections, while *C. betacea* was only cited as a food. On the other hand, the five most frequently mentioned plants by respondents not involved in cultural associations included *Anethum graveolens* L. and *Bidens pilosa* L.. *Anethum graveolens* was cited as a seasoning in various Polish dishes, including sour cucumber, pierogi, gołąbki, and salads. *Bidens pilosa* was cited as a medicinal plant; the whole plant can be used in the form of infusion to treat internal and external infections.

Distribution of Knowledge between Groups

We found differences in the estimated richness of plants cited between generations, with the fourth generation citing fewer plants than second and third generations (Fig. 2a). The average number of cited plants between generational groups was also different (Kruskal-Wallis chi-squared = 10.747, df = 2, *p* value = 0.0046).

Species richness values differed between respondents involved and not involved in cultural associations, with a little overlap in the extrapolated richness (Fig. 2b). Although the curve indicates that participants from the cultural association group cited fewer plants than the other group, there were no significant differences in the average number of plants cited between groups (W = 3106.5, *p* value = 0.2695). The composition of plant species also did not differ between groups (Fig. 3b, nMDS stress = 0.20; PERMANOVA *P* = 0.01, F = 3.0135, df = 1; PERMDISP *P* = 0.02917, F = 4.8516, df = 1).

In addition, the composition of plant species cited by each generation (Fig. 3a) did not reveal differences of knowledge between generational groups (nMDS stress = 0.20; PERMANOVA P = 0.01, F = 4.1159, df = 2; PERMDISP *P* = 0.2854, F = 1.2647, df = 2).

Discussion and Conclusions

Participants of the fourth generation exhibited significantly less plant knowledge than those in the second and third generations; this partially confirms our first hypothesis that plant knowledge would increase with age. However, those in the second generation showed less plant knowledge than those in the third one. In terms of the average numbers of plants cited, the Kruskal test confirmed differences between generational groups. The second generation was the closest to the original immigrants in this study. We, therefore, assumed that their knowledge had already adjusted to local flora while still maintaining stored plant knowledge from the ancestral country.

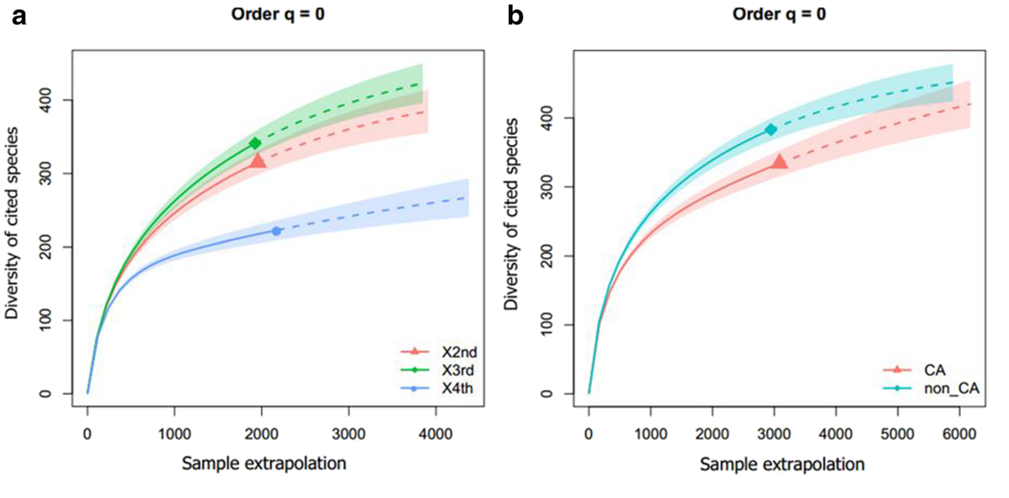

Fig. 2. Interpolation and extrapolation curves ($n = 150$) of the interviews, where q = 0 is the diversity observed; Y represents the diversity of cited species per generation; X is the sample extrapolation. **a** Diversity observed in each generational group. **b** Diversity observed in the groups involved in cultural associations (CA) and not involved in cultural associations (non_CA)

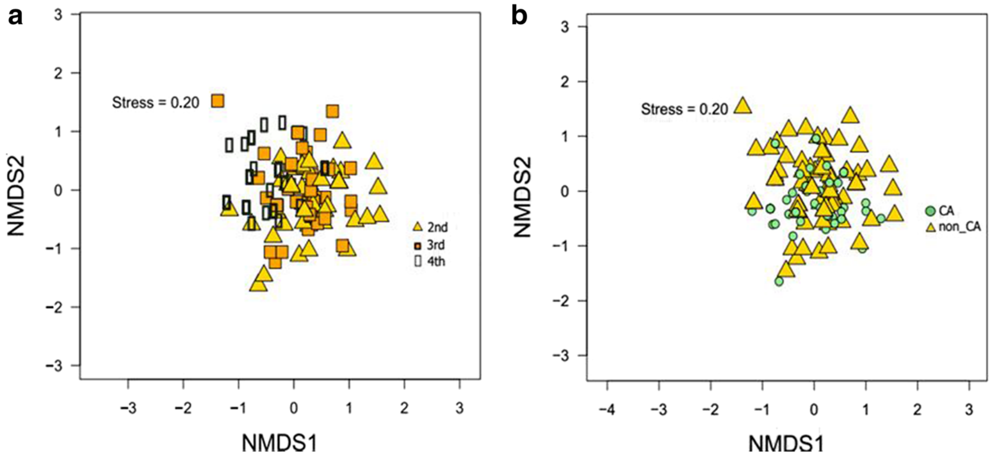

Fig. 3. nMDS of obtained interviews (n = 150). **a** Non-metric multidimensional scaling (nMDS) for generational group, STRESS = 0.20. **b** nMDS for the group involved in cultural associations (CA) and not involved in cultural associations (non_CA), STRESS = 0.20

As suggested by Medeiros et al. (2012), stored and unused knowledge of plants from the ancestral country may be lost in future generations. Following the same argument, Vandebroek and Balick (2012), in a study with Dominican descendants in New York, found no age-dependency of plant knowledge for the first generation of immigrants. Those authors discussed that changes and losses would be more pronounced in the younger generations. Our results showed that, even with knowledge adapted to the biological, social, and economic realities of Brazil, the pattern of knowledge loss in the fourth generation is prevalent, implying that adapted knowledge is being lost. Pirker et al. (2012) documented a decrease in medicinal plant knowledge between Tyroleans migrants in Australia, Brazil, and Peru. These authors pointed at urbanization and globalization as main drivers for changes in the traditional health services. Urbanization changes plant abundance, diversity, composition, and can lead to changes in people's lifestyle as well as increasing disconnection with nature (Faeth et al. 2005; Soga and Gaston 2016).

We did not find any difference in the composition of plants cited by each generation of descendants, confirming our second hypothesis of a significant overlap in the composition of known plants (Table 2). Pasquini et al. (2018a, b) noted a similar result in an intragenerational study on three Afro-descendant communities on the Caribbean coast of Colombia, in which generations knew mostly the same plant species. In the common cluster of known plants of our study, *A. cymbifera* was one of the five most-cited plants across all generations. *Aristolochia cymbifera* is a native species used medicinally, collected by forage in forests. This pattern shows a process of learning and adaptation of traditional medicine to local plants through time. Even though the fourth generation cited fewer plants than the others, the composition of species was largely similar to the second and third generations, although some plants were cited more frequently by a particular generation. This was the case, for example, of *S. officinalis*, which the fourth generation cited more frequently than the others. People from the same generation are exposed to the same process of economic and biocultural negotiations (Mathez-Stiefel and Vandebroek 2012). Therefore, even with a "core" plant knowledge, there are some plants linked to individual social, cultural, and economical experience.

A high number of non-native plants were cited in this survey, a finding that could be related to lifestyle, economic, and biological variables. For example, in the study areas, there are several plantations of food and wood monocultures, and agricultural activities in Brazil are based mostly on introduced species (Coradin et al. 2011). Even in the past, the small-scale farms of the migrants relied on introduced species such as rye, wheat, and potatoes (Dvorak 2013). The main native species used in commercial scale, throughout the history of Polish people in Brazil, are *Araucaria angustifolia* and *Ilex* *paraguariensis* (Ficker 1973; Gerhardt 2011; Kormann 1980). Although Mello and Peroni (2015) mentioned other native species frequently used in the region (not only by Polish descendants), such as *Psidium cattleianum* Afzel. ex Sabine, *Curitiba prismatica* (D.Legrand) Salywon & Landrum, and *Bromelia antiacantha* Bertol., none of these species were mentioned in this study. Cultural practices that were not adapted to native resources (Medeiros et al. 2012) could also explain our results, including other socio-economic changes such as increase in urban areas, increase in exotic crops, and the process of medicalization in case of medicinal plants, which occurred in several parts of Brazil (Moreira et al. 2016; Zank et al. 2019).

We noted a strong sense of cultural reaffirmation from participants that attended cultural associations. On the one hand, the reinforcement of a cultural identity brings recognition and respect for practices and beliefs. On the other hand, it may lead to denial of plant knowledge deemed to come from other cultures, threatening plant diversity. Despite the cultural reinforcement processes in the study area, our findings showed no significant differences between groups (involved vs. not involved in cultural associations). The potential intergenerational loss of plant understanding can be explained through the standardization process of learning, due to globalization and homogenization of knowledge through media and formal education, so that different points of view and comprehension are suppressed and/or forgotten over time (Aswani et al. 2018). We suggest that plant knowledge is strongly related to daily practices passed through parents and to observing nature, making cultural associations relatively unimportant in the intergenerational transmission and acknowledgment of plant knowledge. An insightful interpretation of the role of cultural association would be clearer if comparing with others migrants' ethnicities. Our work compared two subsets (involved in cultural associations and not involved) of the same ethnicity. The phenomenon of cultural associations reflects a collective desire to recreate ancestral memories and cultural identity through cooking, praying, and sharing stories (Brown 2011). In the study region, many descendants still live in or near the original migrant settlements, and we suggest that the sense of belonging to a familiar place can play a similar role, such as the cultural association by offering a familiar context to express their identity.

One limitation of this study was the quantitative approach, since we analyzed general plant knowledge without correlating its significance and variety of uses within the generational groups. Analytical aspects such as the number of cited plants are not necessarily an effective representation of local knowledge because, even though one generation cited fewer species than others, the overall composition of known species was shared among all generations. Moreover, we did not collect data about transmission processes and shifting drivers of plant knowledge to better understand the role of immigration, adaptation, and formation of cultural associations. Those should form the basis of next steps for further investigations.

In a nutshell, our work shows a quantitative approach to evolution of plant knowledge between generations of immigrant descendants. The plant knowledge erosion across generations corroborates with the overall patterns reported around the world. Observing within the spectrum of a multicultural society, the plant knowledge erosion across generations merits more attention since less knowledge represents a vulnerability factor in biocultural systems. The unfamiliarity with plants leads to a distancing and a change in the relationship between humans and nature and can undermine people's adaptation to dynamic biocultural systems, which often change economically and politically.

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Author's Contributions

RHL and NH designed the study; RHL conducted fieldwork and statistical analyses. All authors contributed to writing the manuscript. All authors read and approved the final version of the manuscript.

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Data Availability

Data without the collaborators interviewed are available upon request to the first author.

Compliance with Ethical Standards

Conflict of interest. The authors declare that they have no competing interests.

Consent for Publication. Collaborators were informed through prior informed consent that the results would be presented in a scientific article and gave their approval to publish them in the present format.

Ethics Approval and Consent to Participate. This study was approved by the Ethics Committee of the State University of Santa Catarina (protocol number 58283316.0.0000.0121), and the participation of the collaborators was conditional on the acceptance of the term prior to the informed consent. This study was also approved by the Brazilian System of Authorization and Information on Biodiversity (protocol number 63758) and registered at the National System of Genetic Heritage and Associated Traditional Knowledge (protocol A8129ED).

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