Tracing plant histories: linking botanical collections, peoples, and illustrations in seventeenth century Dutch Brazil

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Chapter 2

Plant knowledge in the *Historia Naturalis Brasiliae* (1648): Retentions of seventeenth century plant use in Brazil

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Abstract

The *Historia Naturalis Brasiliae* (HNB, 1648) is a systematic treatise on Brazilian flora and fauna created in the seventeenth century. Scientists Marcgrave and Piso depicted hundreds of plants and described uses, vernacular names, and diseases in Dutch Brazil. We aimed to verify whether these plants are still used similarly, using herbarium vouchers and taxonomic literature to identify the species described in the HNB and reviewing historical and modern ethnobotanical literature to analyze whether the HNB documented specific plants and uses for the northeast region. We highlighted species of African origin, as they indicate plant introduction before and during the trans-Atlantic slave trade and exchange of African ethnobotanical knowledge. Of the 378 species found in the HNB, 256 (68%) were useful, mostly used for healing and food in a similar way (80%) both in the seventeenth century and in modern Brazil. Only one species (*Swartzia pickelii* Killip) is endemic to northeast Brazil, while the others are more widely distributed. The HNB includes one of the first reports on African crops in Brazil, such as sesame, okra, and spider plant. This study brings insights into

Indigenous and African plant knowledge retentions since the creation of the HNB and acknowledges its non-European contributors.

2.1 Introduction

The Dutch West India Company (WIC) occupied northeastern Brazil from 1630 to 1654 in search of economic profits from the exploitation of Brazil wood (*Paubrasilia echinata* (Lam.) Gagnon, H.C.Lima & G.P.Lewis) and sugarcane (*Saccharum officinarum* L.) (Mors et al., 2000). The captaincy, the modern-day state of Pernambuco, constituted the central point of the Dutch colony in the seventeenth century and was then the greatest sugar producer worldwide (Santos et al., 2010). Dutch Brazil was governed from 1637 to 1644 by Count Johan Maurits of Nassau-Siegen, who assembled a group of scholars and painters to depict the local geography, biodiversity, Indigenous population, tropical diseases, and traditional medicine. This group included German naturalist and astronomer Georg Marcggrafe, Dutch physician Willem Pies (also known as Marcgrave and Piso), and Dutch painters Frans Post and Albert Eckhout (Souza, 2006), among others whose names are still unknown. Marcgrave explored northeastern Brazil (particularly Pernambuco, Paraíba, and Rio Grande do Norte), where he studied the flora, fauna, geography, meteorology, and astronomy of the territory. At the same time, Piso focused more on medicinal plants and local diseases. Dutch artist Frans Post painted Brazilian landscapes, while Albert Eckhout worked on portraits of people in Dutch Brazil and paintings of the fauna and flora of the region. Marcgrave confided to Nassau some dried plant specimens and several manuscripts about Brazilian natural history before leaving for Luanda (Angola) between 1643 and 1644 (Whitehead, 1979). Johannes de Laet, (geographer and WIC board member) received Margrave's plant specimens and manuscripts and transcribed, edited, and published them in 1648, together with Piso’s writings, in one of the most influential treatises on Brazilian botany, zoology, and medicine:

Historia Naturalis Brasiliae (HNB). Marcgrave and Piso's legacy also comprises a second version of the book published by Piso alone, two Portuguese translations, and Marcgrave's bound herbarium, among other artistic and botanical materials (Whitehead & Boeseman, 1989). The HNB has two sections: the first part, *De Medicina Brasiliensi*, written by Piso and subdivided into four chapters, provides an account of local diseases and Brazilian medicine (Piso, 1648). Medicinal plants used by the inhabitants of seventeenth century Brazil, generally from Pernambuco, are depicted in the last chapter. The second part, *Historia Rerum Naturalium*, is devoted to Marcgrave's natural history studies (Marcgrave, 1648). This part is divided into eight chapters: the first three on plants, the next four chapters on fauna, and the last one on ethnology. In addition, four plant drawings are displayed at the end of the book. The plant chapters present descriptions and numerous woodcut images, separated into three subchapters: herbs, plants with fruits, and shrubs and trees. Johannes de Laet discovered that woodcuts were missing for some plants, so he produced new ones based on the dried specimens collected by Marcgrave or from dried specimens sent to him by his colleagues in Brazil (Gudger, 1912). He published the book with many comments, especially about plants (Françoso, 2010), and also added several annotations from the works of the Spanish monk and apothecary Francisco Ximenez (Hernández, 1615) and the Spanish physician Nicolas Monardes (1574). Ximenez published a treatise about the nature and herbal medicine of Mexico, based on the expeditions by the physician Francisco Hernández in 1570 and his own experience (Piñero & Tomás, 1996), while Monardes studied medicinal plants brought to him from the Spanish colonies in the Americas and cultivated in Seville. De Laet compared the plants described by Marcgrave with the ones described by Ximenez and Monardes and by early modern naturalists, such as Carolus Clusius, Rembert Dodoens, and Garcia da Orta; religious chroniclers, such as Jean de Léry and André Thevet; and explorers, such as Gabriel Soares de Souza (Pickel, 2008). The HNB was the earliest and most extensive intellectual

product of Natural History that came from the Dutch colonies in the Americas, and despite covering a region in the northeast of Brazil, this was interpreted by Europeans as an encyclopedia that represented the flora, fauna, and population of the whole country (Françoso, 2010). Marcgrave's chapters in the HNB were translated for the first time from Latin into Portuguese and edited by José Procópio de Magalhães in 1942 (Marcgrave, 1942). Piso's chapters were translated into Portuguese and edited by Alexandre Correia in 1948 (Piso, 1948). Correia extended Piso's section with a biography of him and Marcgrave and several reviews of their work by Brazilian historian Affonso de E. Taunay. In the original and translated editions of the HNB, specimens of plants and animals are organized in an index by vernacular names. In the Portuguese edition of 1948, Correia included the comments of the Brazilian botanist Alberto J. de Sampaio, who added a scientific classification of the plants reported by Marcgrave with local names (*História Natural do Brasil*, pp. XLVIII–LI). He based this classification mainly on the work of the German botanist Carl Friedrich Philipp von Martius, who studied Marcgrave's herbarium and published, between 1840 and 1906, the *Flora Brasiliensis* (see in Flora brasiliensis, CRIA, accessed 23.10.22). The second version of the HNB, entitled *De Indiae Utriusque Re Naturali et Medica* (IURNM), was published by Piso in 1658. He incorporated Marcgrave's figures and descriptions in his own text but made some botanical mistakes (Andrade-Lima et al., 1977). The 1658 book, organized in three parts and 14 chapters, covers both the Southeast Asian and Northeast Brazilian colonies explored in the seventeenth century by the Dutch. The first part corresponds to Piso's observations and is a review and enlargement of the first version. The second part includes two chapters, which include Marcgrave's annotations on topography and meteorology with his comments about Brazilian customs and languages. The further chapters are taken from the work published in 1642 by Jacob Bontius, a Dutch physician who worked for 4 years in the Dutch colony of Batavia, modern-day Jakarta (Bontius, 1642). Marcgrave's botanical

collections and notes were sent to the Netherlands in 1646, presumably by the Count of Nassau to De Laet, who published the HNB in 1648 but kept the herbarium containing Marcgrave's specimens (Andrade-Lima et al., 1977).The herbarium was of interest to Ole Worm, a Danish antiquarian and physician at the court of king Frederik III of Denmark, and acquaintance of De Laet. Both scholars shared correspondence about plant material and knowledge that circulated in the Netherlands during the Dutch enterprise in Brazil. Through the son of Worm, living in the Netherlands, the herbarium was bound and sent to Denmark in 1653, and eventually acquired by Frederik III after Worm's death in 1654, probably because of their shared interest in natural history collections (Romero-Reverón & Arráez-Aybar, 2015). Finally, Marcgrave's herbarium was transferred to the Botanical Museum of the University of Copenhagen at the end of the eighteenth century. In the late 1970s, botanists identified 137 species out of the 146 taxa preserved in the book herbarium, 90 of which are also described in the HNB (Andrade-Lima et al., 1977). This extensive record of Brazilian flora and medicinal plants greatly impacted the European scientific community, being used as a reference for many scholars, from taxonomists to naturalists or chroniclers working in the tropics (Safier, 2014). The Swedish naturalist Carl Linnaeus based part of his taxonomy on the species described in the HNB because he considered the scientific descriptions and illustrations high quality (Whitehead & Boeseman, 1989). Linnaeus included many species of Piso and especially Marcgrave in the 10th edition of his *Systema Naturae* (Linnaeus, 1758), all validated for scientific purposes with binomial Latin names (Boeseman, 1994). Marcgrave and Piso's work was even considered to be one of the most important contributions to the science of Natural History since Aristotle and Pliny the Elder by Gudger (1912). Moreover, the HNB provided a rich source of plant knowledge of native Brazilians, especially of Indigenous peoples from the Tupi macro linguistic family, which promoted the introduction of useful plants to Europe. Examples are ipecacuanha root (*Carapichea ipecacuahna* (Brot.)

L.Andersson) and copaiba oil (*Copaifera officinalis* L.), which are still used for medicinal purposes in Brazil and Europe (Lorenzi & Matos, 2008). Several botanists have attempted to identify the specimens depicted in the HNB and the IURNM, such as Alberto José de Sampaio (Piso, 1948), and especially Bento José Pickel (2008), but these identifications are often incomplete or outdated according to the new nomenclature system. Medeiros and Albuquerque (2014) compared the seventeenth century food plants in the HNB with present-day uses. However, no detailed overview exists of all the documented useful plants in the HNB. In this paper, we present new identifications of all useful plant species described in the original Latin HNB and IURNM, as well as the specimens in Marcgrave's herbarium. We compared the seventeenth century plant uses with modern Brazilian uses from recent ethnobotanical literature. We further compare the historical uses (compiled in northeastern Brazil) to plant uses in the rest of the country to analyze whether the HNB included plants and uses specific for the northeast region or represented a more general Brazilian plant use in the 1640s. Since colonization, the natural environment in Brazil has changed due to sugarcane monocultures, deforestation, industrialization, and urbanization (Freyre, 1989; Rogers, 2010). Indigenous peoples who survived slavery, European diseases, and genocide, have often migrated to other areas and merged with other groups in complex processes of transformation, resistance, and ethnogenesis (Langfur, 2014; Monteiro, 1999; Rodrigues, 1994). Therefore, we expect that many plant uses may have changed. Likewise, we anticipate substantial changes in plant use over time because perceptions about health and diseases, plant-based diet, and recipes in the seventeenth century were likely much different from today. We also expect to find species of African origin in the HNB, as a result of the trans-Atlantic slave trade that started in Pernambuco from circa 1560 by the Portuguese (Eltis & Richardson, 2010). To test these hypotheses, we addressed the following questions: Which useful plants are listed in the *Historia Naturalis Brasiliae* and in *De India Utriusque Re*

Naturali et Medica? Are these plants used in a similar way in recent ethnobotanical literature? Which species described in the HNB are of African origin? Through this study, we bring insights on the retentions of Indigenous and African plant knowledge since colonial Dutch Brazil.

2.2 Materials and Methods

2.2.1 Source material

We used several types of source material to identify the useful plant species described by Marcgrave and Piso (Table 2.1).

Table 2.1. Source material consulted to identify plants and their uses reported in Dutch Brazil by Marcgrave and Piso.

Title	*Authors and date*	*Source Material*	*Location*
Historia Naturalis Brasiliae [HNB]	George Marcgrave & Willem Piso, 1648	Original Latin book. Digital copy	Naturalis Library, Leiden https://archive.org/details/marcgrave
De Indiae Utriusque re Naturali et Medica [P.2]	Willem Piso, 1658	Digital copy of Latin book	Library Nederlands Tijdschrift voor Geneeskunde, Amsterdam https://archive.org/details/mobot31753002909064
Historia Rerum Naturalium	José Procópio de Magalhães, 1942	Portuguese translation of Marcgrave's chapters (1648)	Naturalis Library, Leiden
De Medicina Brasiliensi	Alexandre Correia, 1948	Portuguese translation of Piso's chapters 1648	Naturalis Library, Leiden

Title	*Authors and date*	*Source Material*	*Location*
Marcgrave's Herbarium	Georg Marcgrave, collected 1638 to 1643	Original bound herbarium and digital images	Botanical Garden of the University of Copenhagen, Denmark
Flora do Nordeste do Brasil segundo Piso e Marcgrave no século XVII	D. Bento José Pickel, 1937-1949	Commemorative edition by Vasconcellos de Almeida (Pickel, 2008)	http://www.ufrpe.br/download.php?endArquivo=noticias/4543_florafinal.pdf
Marcgrave's Brazilian Herbarium, collected 1638-44	Andrade-Lima et al. 1977	Article published in Botanisk Tidsskrift	Botanical library Naturalis, Leiden

We consulted the original Latin edition of the HNB (Marcgrave & Piso, 1648) to check the watercolor woodcuts and the original Latin edition of IURNM (Piso, 1658a) to check for illustrations that do not appear in the 1648 edition but correspond to plant species described in this first book. We also consulted the Portuguese editions of HNB (Marcgrave, 1942; Piso, 1948) to study the plant descriptions. We identified all useful plant specimens by verifying Pickel's 1949 identifications (edited by Almeida in 2008) with Brazilian and other South American collections at the herbarium of Naturalis Biodiversity Center (L) in Leiden, the Netherlands, botanical literature (Lorenzi, 1998; Lorenzi & Matos, 2008), and the online checklist Flora do Brasil 2020 (http://floradobrasil.jbrj.gov.br/) for species distributions and vegetation types. We asked several botanists at the Naturalis herbarium to verify our identifications. We checked the latest taxonomic status of each species by using The Plant List (http://www.theplantlist.org/). We identified all specimens in Marcgrave's bound herbarium collections using the South American collections in the herbarium of Copenhagen (C) and the floristic literature. We made digital images of all Marcgrave's original collections and deposited them with the curator, Prof. Dr. Ib Friis. In addition, we studied the plants

depicted in the paintings of Albert Eckhout and Frans Post in the National Museum of Denmark in Copenhagen and at the Rijksmuseum in Amsterdam.

2.2.2 Data analysis

We organized our data with information on the author and date of the consulted source, page number, taxonomical identification of the plant (genus, species, and family), vernacular names (in original spelling), geographic distribution, cultivation state, vegetation type, biomes, and seventeenth century uses (Electronic Supplementary Material – ESM 1). Subsequently, we searched for modern plant uses for these species in the extensive work of Pio Corrêa (1926–1978), Mors et al. (2000), Schoof (2012), and Lorenzi (1998), Lorenzi and Matos (2008) and additional queries in Google Scholar on specific plant use in Brazil. We did not limit this study to northeast Brazil, where Marcgrave and Piso worked, because the landscape, flora, and inhabitants have changed drastically since the seventeenth century. Many species have disappeared from Pernambuco due to deforestation and land conversion to agriculture, but these plants live in other parts of their distribution range. More importantly, most species in the HNB are commonly found in regions outside the northeast, such as weeds throughout Brazil, or are widely cultivated by people of different ethnic origins.

We searched for the distribution data of the useful species described in the HNB and their vegetation type in the online Flora do Brasil 2020 (http://floradobrasil.jbrj.gov.br/) unless there were obvious errors or misinterpretations in these data. In this case, we used the Bioportal Naturalis (https://bioportal.naturalis.nl/), Catalogue of Life: 2008 Annual Checklist (https://www.catalogueoflife.org/annual-checklist/2008/search.php), Tropicos (https://www.tropicos.org/), Species Link (https://specieslink.net/), and CNC Flora (http://cncflora.jbrj.gov.br/portal) to look for distribution patterns of herbarium specimens.

We categorized traditional and modern uses in food (including spices and drinks), medicine (including cosmetics), construction, technology (including fibers, ink, paper, illumination, fish poisoning, tanning, and insecticides), and others (e.g., ornamental, fuel, living fences, shadow plants, erosion control, fodder, and rituals) (Prance et al., 1987). Based on the plant uses in the HNB, we divided medicinal uses into 11 frequently occurring categories. These corresponded to plants that act as antidotes, febrifuges, diuretics, emmenagogues (i.e., to stimulate the menstrual flow), antiparasitic, purgatives and emetics; and plants used to heal: sexually transmitted diseases (STDs), diarrhea, wounds, skin affections and dropsy (i.e., edema or accumulation of liquid in the body). After extracting the matching uses from the literature, we added the historical and modern plant use data into an MS Word file (ESM 2).

2.3 Results

2.3.1 Comparing HNB uses to modern plant uses in Brazil

We encountered 391 plant entries in Marcgrave and Piso's books (1648, 1658) and Margrave's herbarium. We identified 378 different species, as some species were described several times. Plant entries often included local names and descriptions of plant use but not always illustrations. A total of 267 plant entries corresponded to plants used by the native population, enslaved Africans, or European colonizers in seventeenth century Brazil, while 124 included plants with no use, according to the HNB. The 267 entries of useful species sometimes had plants cited twice or more times. They referred to a total of 256 unique, useful species validated by the Plant List and the Flora do Brasil 2020 (ESM 1), representing 68% of the total number of species in Marcgrave and Piso's books (1648, 1658). The most species-rich families were Fabaceae (43 species), followed by Arecaceae, Solanaceae, and Myrtaceae (each 11 spp.), and Malvaceae, Asteraceae, Annonaceae, and Cucurbitaceae (each

eight spp.). When comparing the historic uses with modern plant uses, we found that 204 species (80% of the total useful species) had similar uses in the recent literature to those reported by Marcgrave and Piso in the seventeenth century (ESM 2). We could not find any uses in modern-day Brazil for 15 of the 256 useful plant species in the HNB: *Aniseia cernua* Moric., *Campomanesia dichotoma* (O.Berg) Mattos, *Clidemia biserrata* DC., *C. octona* (Bonpl.) L.O. Williams, *Dioclea marginata* Benth., *Gnaphalium* cf. *polycaulon* Pers., *Lundia virginalis* DC., *Matelea ganglinosa* (Vell.) Rapini, *Ouratea caudata* Engl., *Piper phytolaccifolium* Opiz, *Rhizophora racemosa* G.Mey., *Scleria gaertneri* Raddi, *Tanaecium cyrtanthum* (Mart. ex DC.) Bureau & K.Schum., *T. pyramidatum* (Rich.) L.G.Lohmann, and *Vitex rufescens* A.Juss. The number of useful plant reports per use category in modern Brazil is higher than in the seventeenth century. We observed more species in medicine, construction, technology, and others. On the contrary, we detected a slight decline in the food category, where 12 species listed as edible in the HNB are no longer used for nutritional purposes (Fig 2.1).

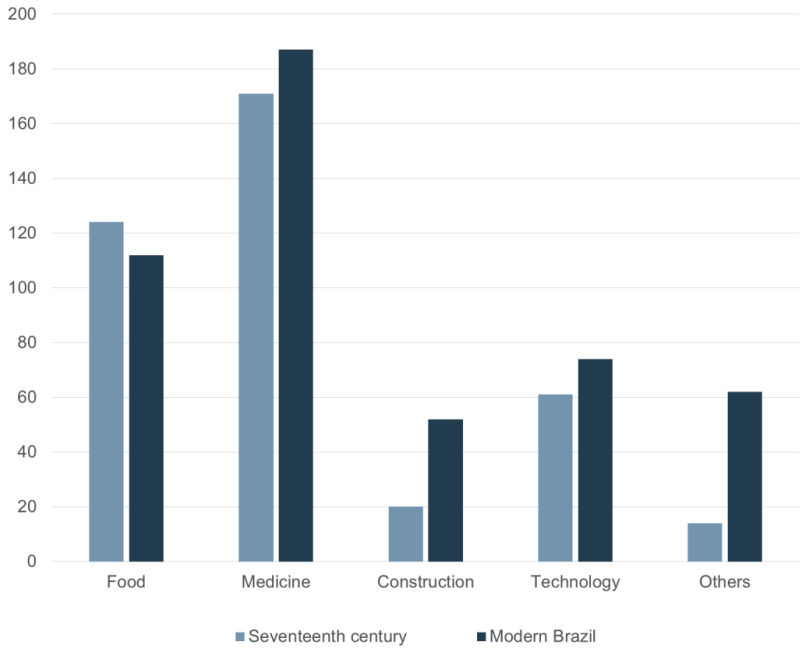

Fig 2.1 **Number of species listed by Marcgrave and Piso (1648, 1658) per use category and current uses for these species in Brazil.**

Of the 256 useful species, most plants were used as medicine in the seventeenth century (171 species, 67%) and in modern Brazil (187 spp., 73%). However, 22 medicinal species documented in 1648 seem to have lost their therapeutic use. For example, we did not find any medicinal use for *Albizia saman* (Jacq.) Merr. modern literature, although Piso described it as an 'astringent and diuretic plant, which root is used to treat kidney and bladder affections, gonorrhea, syphilis, and dropsy…to treat eye inflammation' (Piso, 1648: 80). On the other hand, the HNB did not document the medicinal use of 44 species which are now used therapeutically. For instance, Marcgrave mentioned that the fruit of *Chrysobalanus icaco* L. was edible (Marcgrave, 1648: 77) without reporting any other use, while this plant was used

in the 1980s as an astringent agent to combat diarrhea, gonorrhea, and leucorrhea (Corrêa, 1931). Notably, 84 medicinal species documented by Marcgrave and Piso had at least one specific therapeutic application in common with the twentieth or twenty-first century; however, how plants are used has changed substantially over time (Fig 2.2).

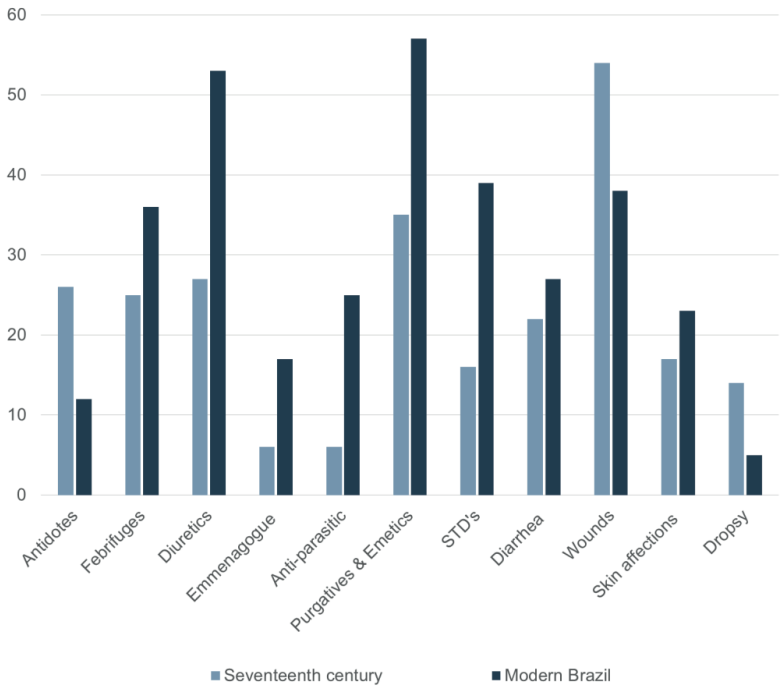

Fig 2.2 **Number of plant species in medicinal use categories in the seventeenth century and modern Brazil.**

In the seventeenth century, most medicinal species were used to heal ulcers, wounds, and abscesses. Modern Brazilians, however, use most of these species as purgative or emetic agents. Other common modern use is diuretics, treatments against STDs, and aphrodisiacs, which were less prevalent in the past. Purgatives, emetics, emmenagogues, and plants to treat fever, intestinal worms, and skin infections are also more reported today than in the past.

However, using plants as anti poisons or against dropsy is less common at present. In addition to our medicinal use categories (Fig 2.2), several other affections, such as stomachache, bladder and kidney obstructions, and rheumatism, were mentioned in the HNB. Margrave and Piso described 228 combinations of plant species and health affections, while we recorded 413 of such combinations for modern Brazil for the same species. Several useful plants we identified in the HNB are now used to treat other ailments, such as jaundice, arthritis, or neuralgia.

2.3.2 Marcgrave's herbarium

Botanical specialists incorporated glued identification slips on some of the pages in Marcgrave's herbarium. For example, John J. Wurdack, curator of botany at the Smithsonian Institution, identified *Clidemia biserrata* in 1969 (p. 25). Other specimens, like *Vismia guianensis* (Aubl.) Pers. (p. 157) have labels or notes with an identification, the page number corresponding to the HNB (Marcgrave, 1648: 96), and the local name (*Caa-opia*), but the authors of these labels are missing or unreadable. The bound herbarium contains 173 pages with 177 plant specimens (Fig 2.3).

Fig 2.3 **Marcgrave's herbarium**. The author shows the specimen of *Crescentia cujete* L. on page 50 (C, Copenhagen, July 2014. Photo by T. Van Andel).

Four pages contain mixed collections, such as page 18 with a specimen of *Zollernia latifolia* Benth. with the epiphytic orchid *Trigonidium acuminatum* Bateman ex Lindl. On page 61, fruits of *Physalis pubescens* L. are combined with a twig of *Rivina humilis* L. In total, 32 species were collected more than once (e.g., *Eichhornia paniculata* (Spreng.) Solms: 26 and 27). We identified 146 taxa, 141 at the species level, and five at the genus level (ESM 3). In addition, we encountered 37 species that were not mentioned in the published works (e.g., *Abrus precatorius* L.). We found 11 species of African origin and 114 species in the herbarium that correlated with Marcgrave and Piso's published work (1648, 1658), of which 76 (52%) were reported as useful. Although only names and no plant uses are written on the

herbarium sheets, most of the herbarium specimens described in the HNB are medicinal (76%), edible (41%), or used for technology (28%), such as *Jatropha curcas* L., or *Ricinus communis* L. The seed oil of the latter was used as a lamp fuel by Portuguese and Dutch settlers and as a medicinal oil by Indigenous peoples.

2.3.3 Useful species of African origin in the HNB

The HNB also provides several examples of plant knowledge exchange between Europeans, Indigenous peoples, and the enslaved Africans brought to Pernambuco at the beginning of the 1560s as forced labor in the sugar fields (Fausto, 2014). When Piso attended to the diseases of the enslaved and the native population and European colonists, he noticed useful herbs that had been introduced from Africa (Voeks, 2013). Both Marcgrave and Piso cited African vernacular plant names, medicinal practices, and weeds and crops that were part of the diet of African peoples. Indigenous peoples, Portuguese, and Dutch settlers used some of these plant species within the complex exchange in plant knowledge that occurred in the colonial context.

Marcgrave and Piso (1648, 1658) reported twenty-nine species of African origin (see ESM 2). Examples are sesame (*Sesamum indicum* L.), named Gangila by the 'Congo people' (the term used in the HNB is 'congensibus') and, according to Marcgrave (1648: 21), introduced from Africa by Portuguese colonizers. Other examples are the African eggplant, *Solanum macrocarpon* L., (which can also be *S. aethiopicum* L.) named Macumba by Congolese and Tongu by the 'Angolese' (Marcgrave 1648: 24) and okra (*Abelmoschus esculentus* (L.) Moench), known as Quillobo (Marcgrave 1648: 31). Some of the plants introduced from Africa were edible weeds, such as the spider plant (*Cleome gynandra* L.), while others were crops brought by the European settlers from Africa and planted in Brazil's similar tropical

environment, such as banana and plantain (*Musa* spp.), which were initially introduced from Asia to Africa centuries before the slave trade (Kury et al., 2013).

2.3.4 Paintings of Dutch Brazil

Some species that figure in the paintings by Albert Eckhout and Frans Post, such as the African weed *Abrus precatorius*, are missing in the HNB but present in Marcgrave's herbarium. Therefore, we consider them representative of the seventeenth century flora of NE Brazil. Other useful species that figure in the paintings are native crops such as cassava (*Manihot esculenta* Crantz) and *Casabanana* (*Sicana odorifera* (Vell.) Naudin) and plants that were brought from Africa like the coconut (*Cocos nucifera* L.) and banana (*Musa* sp.). In addition, European species introduced by the Portuguese, such as kale (*Brassica oleracea* L.) and turnip (*Brassica napus* L.), also appear in these paintings.

2.3.5 Phytogeographical distribution of the HNB species

Only one species (*Swartzia pickelii* Ducke) occurs exclusively in northeastern Brazil (Pernambuco) according to the literature (Ferreira et al., 2016) and the consulted virtual databases (CNC Flora and Flora do Brasil 2020). Five species (*Dioclea marginata*, *Encholirium spectabile* Mart. ex Schult. & Schult.f., *Eugenia luschnathiana* (O.Berg) Klotzsch ex B.D.Jacks., *Moquilea tomentosa* Benth., and *Pouteria grandiflora* (A.DC.) Baehni) were indicated as endemic to the northeast by some sources but had wider distribution ranges according to others (ESM 1). According to the online flora of Brazil, *D. marginata* is indicated as endemic to northeast Brazil, although it is also found in Paraná, south of Brazil (http://www.splink.org.br/index?lang=en). The seeds of other *Dioclea* species are used elsewhere in Brazil to obtain flour to prepare arepas (Maxwell, 2011), a flat bread

usually made of maize, originating in Venezuela and Colombia but also eaten in Brazil. Although Marcgrave reported *D. marginata* as an edible plant 'prepared like cassava' (they probably ground the seeds to make flour), we are not sure which species of *Dioclea* are ground into flour in Brazil today. *E. spectabile* is mentioned as endemic to northeast Brazil by the online flora, but it is also found in Minas Gerais (southeast) (http://www.tropicos.org/Specimen/3003066). *E. luschnathiana* used to be endemic to northeast Brazil, but it has been recently introduced and naturalized in Florida (Lucena et al. 2014). Ferreira et al. (2019) indicated that *L. tomentosa* is endemic to northeast Brazil. Still, this species is found in other regions of the country according to the online flora and the Species Link online database. *P. grandiflora* was listed by the online flora as endemic to the northeast. In Tropicos, botanists collected most specimens in Bahia and Sergipe (northeast), but some in Espírito Santo (southeast) and the Darien gap in Panamá. *Swartzia pickelii* is the only useful species described in the HNB that is considered endemic to northeast Brazil by all consulted sources. Piso reported its fruit pulp as edible when cooked (ESM 1). Today, people use the wood of this tree in Pernambuco for fuel and construction and the stem to make brooms (Silva, 2009), although the fruit is no longer consumed.

2.4 Discussion

2.4.1 *Historia Naturalis Septentrionalis* or *Brasiliae*?

Although compiled in northeast Brazil, the HNB was presented as an encyclopedia of Natural History of the entire country and also perceived as such by European scholars of the Early Modern period. But to what extent does the HNB represent the specific situation in the country's northeastern part? Our ethnobotanical analysis shows that concerning useful plants, the HNB is far more representative of the entire country than one might expect. From all the

useful species described in the HNB, only *Swartzia pickelii* is endemic to the Caatinga or Atlantic Rainforest biomes where Marcgrave and Piso conducted their expeditions (Gardner, 1846). Most of the plants are much more widespread, encompassing the diverse biomes of Brazil. Many species of useful plants documented in the HNB (e.g., cashew, cassava, *Bixa orellana* L., *Xanthosoma sagittifolium* (L.) Schott) were, and are used similarly by many Indigenous groups throughout Brazil (Corrêa 1926–1975; Schoof, 2012). In addition, there is evidence of great migration patterns of the Tupi-speaking peoples before and increasingly after the Dutch colonization of Brazil (Monteiro, 1999; Neves et al., 2011). Over time, the plant knowledge recorded in the HNB could have been preserved in different locations by the descendants of Indigenous peoples who migrated out of northeast Brazil in the past centuries. The origin and transmission of ethnobotanical knowledge across the regions of Brazil have not been studied extensively. Unlike Leonti (2011), who traced the transmission of ancient Greek and Roman herbals in modern Europe, we cannot trace back the direct influence of the HNB in local Brazilian pharmacopeias. Back then, this book was only accessible to the European elite (including doctors, scholars, and religious people). It became widely available in Brazil in the twentieth century when it was translated into Portuguese. Hence, it is very dubious that it ever influenced the Indigenous Tupi-speakers and African descendants, even though they were the main actors of the ecological knowledge in the HNB. The oral transmission of plant selection and botanical knowledge between ethnic groups likely influenced Brazilian pharmacopeias over time rather than the HNB. In any case, plant uses described in the HNB are now representative of larger territories in Brazil.

2.4.2 Retention of seventeenth century plant use in modern Brazil

Most useful flora reported in the two versions of the HNB were employed for medicine and food. Medicinal species were the largest category in both the seventeenth century and today,

increasing in importance over time. On the other hand, food was the second largest category in 1648, but the number of reported edible species is reduced today. We still found more edible species than Medeiros and Albuquerque (2014). They missed 32 edible species documented by Marcgrave (1648) (e.g., *Cereus fernambucensis* Lem., *Ficus gomelleira* Kunth & C.D.Bouché) and another 16 food species from Piso (1658), such as *Lagenaria siceraria* (Molina) Standl. and *Macoubea guianensis* Aubl. Marcgrave's original herbarium proved very relevant in identifying several species described in the HNB. For 22 food species, we obtained different taxonomical identifications than Medeiros and Albuquerque (2014), of which at least four edible species (*Cecropia pachystachya* Trécul, *Spondias mombin* L., *Physalis pubescens*, and *Clidemia biserrata*) were included in Marcgrave's herbarium. We also encountered 24 more plant species in the herbarium that correlated with the work of Marcgrave and Piso (1648, 1658) than Andrade-Lima et al. (1977), who reported only 90 overlapping species. There was a slight difference in the percentage of edible species between the HNB and modern Brazil (48 vs. 44%), in which 28 of the 124 edible species from the HNB are no longer consumed in Brazil today (according to scientific literature), such as *Copernicia prunifera* (Mill.) H.E.Moore and *Ficus gomelleira*. On the other hand, some species Macgrave and Piso described as medicinal in the past are now part of the Brazilian diet, such as *Piper marginatum* Jacq. or *Senna occidentalis* (L.) Link. Over time, the decrease in edible plants can be related to changes in perceptions about food and recipes since the seventeenth century and to demographic changes in the population who consumed these food resources, mostly Tupi-speaking Indigenous peoples. As Indigenous peoples migrated to other areas, they must have adjusted their plant-based diet to the new environment. According to Medeiros and Albuquerque (2014), the number of food plants in seventeenth century Brazil was higher than today due to modern cultural taboos that consider these ancient food resources as a sign of poverty. However, there are some exceptions.

Neither Marcgrave nor Piso reported *Senna occidentalis* as an edible plant. Still, its seeds are roasted as coffee by Brazilians in the northeastern region of Ceará (Lombardo et al., 2009) and other parts of Brazil (Lorenzi & Matos, 2008). *Montrichardia* cf. *arborescens* (L.) Schott (which could also be *Montrichardia linifera* (Arruda) Schott) was an 'edible fruit in case of need' (Marcgrave, 1648: 106), and its fruits are still sporadically eaten today (Schoof, 2012). This trend was also reported for eighteenth century food plants in Suriname, where the enslaved runaway population consumed *M. arborescens* without other food sources. However, Surinamese only used it as fish bait today (Van Andel et al., 2012). The species *Ananas comosus* (L.) Merr., *Bixa orellana*, *Canna glauca* L., *Carica papaya* L., *Syagrus coronata* (Mart.) Becc., and *Xylopia frutescens* Aubl. were not categorized as food in modern Brazil (M. F. T. Medeiros & Albuquerque, 2014). Nevertheless, they are still commonly consumed (*A. comosus*, *B. orellana*, and *C. papaya*) or occasionally eaten in Brazil (*C. glauca*, *S. coronata*, and *X. frutescens*) (Mors et al., 2000). On one hand, our comparison shows the continuation, to some extent, of vegetable food resources over time. On the other hand, some commonly eaten plants in the past, such as *Spondias tuberosa* Arruda and *Amaranthus viridis* L. had already turned into 'emergency food' in the 1920s (Corrêa, 1926), as was also reported for eighteenth century food plants in Suriname (Van Andel et al., 2012).

2.4.3 Transformations in medicinal plant use over time

The input of knowledge acquired from native Brazilians strongly influenced European colonial pharmacopeia (Carneiro, 2011). Food plants and several medicinal species were incorporated into European Materia Medica, such as *Anacardium occidentale* L. (Albuquerque et al., 2007) and *Passiflora edulis* Sims (Cartaxo et al., 2010). Indigenous peoples had a good reputation as healers through the use of wild and cultivated plants (Mors et al., 2000). However, many more species are recorded in Brazil today for their therapeutic

properties than the 171 medicinal species documented in the HNB. In Brazil, medicinal plants have been traded between Europeans since the Portuguese Jesuits started exchanging them in the sixteenth century (Walker, 2013), promoting the diffusion of botanical knowledge not only towards Portugal but also to diverse regions of the country and the Portuguese Empire. Nowadays, a wide variety of medicinal plants is used in Brazil in urban and rural areas (Rates, 2001). Taking into account that our literature review covered a larger region than the territories explored by Marcgrave and Piso, the higher number of medicinal plants could be related to the increase in the last decades in ethnobotanical studies (Albuquerque et al., 2007; Bieski et al., 2012; Cartaxo et al., 2010; Coelho-Ferreira, 2009; Lorenzi, 1998; Lorenzi & Matos, 2008) or the recent phytomedicinal development promoted by Brazil's great floristic diversity and potential for natural drug production (Calixto, 2005). On the other hand, local pharmacopeias have changed, and synthetic products have replaced some traditional medicines while other uses may have been forgotten. Most plant species documented by Marcgrave and Piso kept their function, and their use was often extended to different categories. *Cascabela thevetia* (L.) Lippold was 'powdered and mixed with tobacco or food to produce its highly toxic effects' (Piso, 1648: 49), while in the twentieth century, it was still considered a paralyzing poison but mainly planted as an ornamental (Corrêa, 1978b). Other medicinal plants from the HNB treat different ailments today than in the past. The resin and oil squeezed from *Schinus terebinthifolia* Raddi were used as a poultice for cold affections: 'The tree's astringent and warm leaves are used in baths, both to heal the body and to obtain pleasure' (Piso, 1648: 64). Piso based his terminology on the hot-cold Hippocratic humoral theory, prescribing warm plants to heal cold diseases and vice versa. *S. terebinthifolia* oil was later indicated for corneal diseases and tumors arising from arthritis or syphilis, while leaves were used against rheum, ulcers, and wounds (Corrêa, 1978b). Plants that were once used to heal skin ulcers and wounds have now been replaced by antibiotics

and antiseptic creams. Brazilians also use fewer plants as anti-poison today, despite the high occurrence of snakebites, a severe public health issue, especially in rural areas (Feitosa et al., 2015). The observed transformations in medicinal use can result from changes in health perception and illness since the development of modern medicine and the introduction of new terms for diseases (Van Andel et al., 2012). Still, some ideas on human health and diseases have persisted over time. In the nineteenth century, naturalists and physicians Piotr Czerniewicz, George Gardner, and Auguste de Saint-Hilaire depicted several plants to heal human ailments based on their expeditions to Brazil (Chernoviz, 1897; Gardner, 1846; Saint-Hilaire, 1824). The analysis of their manuscripts showed that diuretic, purgative, and febrifuge plants were, two centuries later, the most common ones in Brazil (Brandão et al., 2012; Fagg et al., 2015; Ricardo et al., 2017). More recently, purgative and diuretic plants have become very popular among modern Brazilians, acting as blood purifiers and intestinal cleansings (Bieski et al., 2012; Coelho-Ferreira, 2009). The retention of these particular uses may be related to attempts to achieve modern beauty standards and weight loss with purgatives, a common practice among young Brazilians (Kakeshita et al., 2013; Nunes et al., 2003).

Despite the observed trends in plant use over time, Marcgrave and Piso may not have adequately documented all plant species and local diseases in Dutch Brazil. In addition, access to specific areas was undoubtedly challenging for these two scholars, not exempt from hostile encounters, water supply limitations, and other difficulties in the tropical territory (Van den Boogaart & Brienen, 2002). Moreover, Western scholars probably did not consider or value Indigenous peoples' cosmologies and cosmovisions. Finally, the personal bias of Marcgrave and Piso likely influenced their work, as the background of both authors and their editor (Johannes de Laet) developed within a particular European context, highly influenced by the dominant political and religious scene at the time (Furtado, 2007).

During his inquiries, Piso explicitly expressed both rejection and praise of Indigenous practices that did not fall into the medical mainstream: ‘How among such crass barbarism many gross or corrupt practices, unworthy of Hippocratic art, are encountered, so that not a few very useful ones, which smell of antiquity, can be observed, and that foreign doctors who are well versed in art submit to discipline’ (Piso, 1648: 15).

In Early Modern Europe, it was common to eliminate evidence of abortive and ritual plant uses documented by European scholars due to religious beliefs, gender attitudes, and social constraints in Western society (Schiebinger, 2009). Although European scientists incorporated a significant corpus of Indigenous knowledge to create the HNB, they must have missed or deliberately omitted specific plant uses. In addition, native peoples or enslaved Africans who were compelled, to a greater or lesser degree, to give complete information on their plant resources to European colonists could have been reluctant to do so and therefore have chosen to conceal information.

Overall, the great number of useful plants encountered in our modern literature survey is a result of the large percentage of Brazil that is now covered by ethnobotanical research, compared to the small northeastern region that was explored in the seventeenth century by Marcgrave and Piso. Therefore, further ethnobotanical field research in Brazil in cooperation with Tupi-speaking Indigenous peoples and other ethnic groups would be valuable. This way, we could jointly bring new insights into plant knowledge retention over time and co-produce data, ideas, and methods that will benefit all the stakeholders.

2.5 Conclusions

Marcgrave and Piso depicted the rich flora and its many uses by the different ethnic groups who coexisted in northeastern Brazil in 1648 in their influential work of early modern science, the *Historia Naturalis Brasiliae*. According to the Western scholars, the Indigenous

population, European settlers, and enslaved Africans used most species documented in the HNB (68%). In comparison, Brazilians use 80% of these useful species similarly as they did in the seventeenth century (or as Marcgrave and Piso documented in the HNB). A substantial number of African plants, introduced during the trans-Atlantic slave trade, were used by enslaved Africans, Indigenous peoples, and Europeans. The HNB provides evidence for early plant dispersal by the Portuguese and the Dutch via the Middle Passage and the exchange of African ethnobotanical knowledge with other inhabitants in seventeenth century Brazil. Contemporary literature shows higher numbers of Brazilian medicinal plant uses, used for a broader spectrum of diseases, than the HNB. This trend is probably due to the development of ethnobotanical surveys in the country in the past century, compared to the small northeastern region Marcgrave and Piso surveyed in the seventeenth century. Our analysis shows that only a few useful plants documented in the HNB are endemic to the northeast. Most species occur in other regions of the country, and the uses described in the HNB represent larger parts of Brazil. We found fewer edible plants in modern sources than in 1648, which could result from changes in diet and health perceptions over time. These differences could also result from the editing process and the research methodology used by the authors of the HNB. By comparing the *Historia Naturalis Brasiliae* with current plant uses in Brazil, we reveal the preservation of Indigenous and African plant knowledge over time. This local knowledge influenced the works of scholars over the past 370 years. Now, however, is time to critically look into its content and enhance awareness of the crucial role of its non-European contributors.