# Species synonyms: How important are they for the retrieval of ethnobotanical information?

Oscar Perdomo and Rodrigo B. Singer

## Reviews


## Abstract

*Background:* The synonyms of the currently accepted scientific names are binomial names used to designate the same taxon, now in disuse due to the nomenclatural rules. We explore the evolution of the synonymy in the useful palm genus *Euterpe* to investigate if the inclusion of the synonyms affects the recovery of information on the uses and vernacular names.

*Materials and Methods:* We used three search engines (Google Scholar, Scopus and Web of Science) to recover papers associated with the currently accepted scientific names of the *Euterpe* palms and the forty associated synonyms. Then we examined the information recovered on the uses and vernacular names to compare the outcomes.

*Results:* Our results evidence the increase in the recovery of ethnobotanical information (11.1%) and vernacular names (17.8%) when the synonyms are used. Recently described species had less synonyms than their early-described counterparts. In addition, our results revealed that the more useful *Euterpe* species had more vernacular names.

*Conclusions:* The accurate identification of the synonyms for accepted species facilitates and improves the recovery of information by increasing the amount of material retrieved from the web. As expected, most useful palms have more vernacular names. Google Scholar has shown the better performance using synonyms, but the outcomes for the currently accepted scientific names were similar for the three search engines.


Keywords: Açaí, Asaí, *Euterpe,* Google Scholar, scientific names, Scopus, synonyms, uses, vernacular names, Web of Science


## Resumen

*Antecedentes*: Los sinónimos de los nombres científicos actualmente aceptados son nombres binomiales utilizados para designar la misma especie, hoy en desuso debido a las reglas de nomenclatura. Exploramos la evolución de la sinonimia en el útil género de palmas *Euterpe* para investigar si la inclusión de los sinónimos afecta la recuperación de información sobre los usos y nombres vernáculos.



## Correspondence

**Oscar Perdomo[1,2,*], Rodrigo B. Singer[1]**

[1]Laboratório de Sistemática de Plantas Vasculares, Departamento de Botânica, Instituto de Biociências, Universidade Federal do Rio Grande do Sul, 91501-970, Porto Alegre, RS, Brazil.
[2]Grupo de Investigación en Agroecosistemas y Conservación en Bosques Amazónicos, Facultad de Ingeniería, Universidad de la Amazonia, 180 002, Florencia, Caquetá, Colombia.

[*]Corresponding Author:
oscarperdomobaez@gmail.com


**Ethnobotany Research & Applications**
**20:28 (2020)**

*Materiales y métodos*: Utilizamos tres motores de búsqueda (Google Scholar, Scopus y Web of Science) para recuperar artículos científicos asociados con los nombres científicos actualmente aceptados de las palmas *Euterpe* y los cuarenta sinónimos asociados a ellas. Luego examinamos la información recuperada sobre los usos y los nombres vernáculos para comparar los resultados.

*Resultados*: Nuestros resultados muestran el incremento en la información etnobotánica recuperada sobre los usos (11.1%) y nombres

Manuscript received: 30/05/2020 - Revised manuscript received: 30/09/2020 - Published: 07/10/2020

http://dx.doi.org/10.32859/era.20.28.1-18

vernáculos (17.8%) cuando se usan los sinónimos. Especies descritas recientemente tienen menos sinónimos que sus contrapartes descritas con anterioridad. Adicionalmente, nuestros resultados revelaron que las especies de *Euterpe* más útiles tienen más nombres vernáculos.

*Conclusiones*: La correcta identificación de los sinónimos de las especies aceptadas facilita y mejora la recuperación de información al aumentar la cantidad de material recuperado de la web. Como esperado, las palmas com más usos tienen más nombres vernáculos. Google Scholar ha mostrado un mejor rendimiento usando los sinónimos, pero los resultados con los nombres científicos actualmente aceptados fueron similares para los tres motores de búsqueda.

Palabras clave: Açaí, Asaí, *Euterpe*, Google Scholar, nombres científicos, nombres vernáculos, Scopus, sinónimos, usos, Web of Science.

## Background

Species names are based on the Linnaean binomial system and are governed by formalized rules of nomenclature (Patterson *et al*. 2010, Remsen 2016, Tuominen *et al*. 2011). These rules determine that only one name must be used to label a particular taxon. However, in a historical context, multiple names may appear associated with one taxon (at generic, specific levels, or both). In such cases the first validly published name is kept and the others are synonymized, remaining available in the scientific literature but unused in taxonomy (Remsen 2016, Rivera *et al*. 2014). Additionally, the taxa may be known by the vernacular or common names, attributed by the local population to designate one or various species. These names vary geographically and historically. Thus, the same species may be known by multiple common names, and one common name may be used to designate different species.

The number of synonyms associated with species-names becomes a fundamental problem in taxonomy, affecting especially studies in comparative biology and biodiversity (Dayrat 2005). These complications led to the creation of engines such as the TNRS - Taxonomic Name Resolution Service - (Boyle et al. 2013) and Plantminer (Carvalho et al. 2010) and online tools to standardize plant names, websites such as IPNI -International Plant Name Index- and Tropicos, R packages as "*taxonstand*" (Cayuela *et al*. 2012), "*taxize*" (Chamberlain & Szöcs 2013) or "*taxa*" (Foster et al. 2018) as well as other similar services and tools to search and manage taxonomic information, helping the researchers in the corroboration and correction of scientific names. These tools are of particular interest in the revision of the scientific literature that aims to collect the most relevant information about any taxonomic entity, because the synonyms may link to information not recovered by the species name in current use.

In the revision of traditional botanical knowledge, also called ethnobotanical knowledge, the information about uses and vernacular names is of great interest because it is the result of the relation of human populations and their environment. Thus, ethnobotanical knowledge represents the historical record of this interaction between human societies and plants. In this scenario, the inclusion of the synonyms appears as a tool to improve the retrieval of information about any taxon, by incorporating its historical background. The use of the vernacular and scientific names on the internet is similar and highly correlated. The use of both remains constant across the internet pages standing out their relevance to link to the information contained in the web (Correia et al. 2017). The retrieval of information from the web concerning the uses, vernacular names and other kind of topics in ethnobotany, allows to establish the relevance of any species for a human community. The recovered information reflects the ethnobotanical importance of a particular taxon, as well as the human perception of the plant species, helping to improve our knowledge and understanding of this narrow relationship. By gathering this information, we can have an overview of the relevance and use perspectives of the species, recovering and saving this ancient knowledge. In turn, this could ultimately promote the elaboration of strategies dealing with a sustainable use of resources on socially acceptable and culturally fair grounds.

Palm species are key components in ecosystems networks and play an important role as the origin of many resources for human communities (Bernal *et al*. 2011, Macía *et al*. 2011, Moraes 2020, Tomlinson 2006). Some of the palm species in the genus *Euterpe* Mart. are currently used for the extraction of fruits and palm heart ("palmito" or "palmetto") for a growing industry based on these resources (Bernal *et al*. 2011, Brokamp *et al*. 2011). But these palms are also used by the local communities for medicine, construction, handicraft, and many other uses (Brokamp *et al*. 2011, Mesa & Galeano 2013, Paniagua-Zambrana *et al*. 2017, Paniagua-Zambrana *et al*. 2020). The type species of the genus is *E. oleracea* Mart., described in 1823 (Martius 1823). The most recently described species is *Euterpe luminosa* A.J.Hend., Galeano & Meza, in 1991 (Meza *et al*. 1991). Thus, we considered the genus *Euterpe* an adequate taxonomic group to

explore their synonymy and usefulness. This contribution aims to address the following questions; **i**) can the inclusion of the synonyms affect the recovery of information on the uses and vernacular names of the palm species?, We hypothesize that the papers linked to synonyms contain some information not included in the papers linked exclusively to currently accepted names; **ii**) in which way the number of uses and vernacular names are correlated? We hypothesize that the more useful species are known by more vernacular names, as expected for this correlation, evincing the representativeness of the sample used in the analysis. **iii**) can the chosen search engine influence the recovery of scientific information? We hypothesize that there may occur differences in the information recovered by the different search engines.

## Materials and Methods

***Group of study***

For this review we used all the palm species of the genus *Euterpe* Mart. This genus was originally described in 1823 by Karl Friedrich Philipp von Martius and currently comprises seven species used in different ways by Indigenous People and South American farmers (Henderson & Galeano 1996, Paniagua-Zambrana *et al*. 2020). We used this group of palms because their ecologic importance, the economic, social and cultural relevance for the local communities, and the perspectives for their use in a sustainable exploitation, agroecosystems design and implementation, as well as for ecological restoration.

***Searching synonyms, uses and vernacular names***

We used the package "taxize" (Chamberlain & Szöcs 2013) in Rstudio (RStudio Team 2018) to get the list of species names and varieties of the genus *Euterpe* Mart. and its synonyms from the site Tropicos.org. Then, we used Google Scholar (GS), Scopus (Sc) and Web of Science (WoS), three widely-used search engines, to search scientific papers reporting uses or vernacular names for all the species names and synonyms retrieved. The term "uses" is herein used in the sense of Ledezma-Rentería & Galeano (2014). We configured the search engines without time restriction, ordered the results by relevance, employing quotation marks and search commands to exact matches. Then, we developed individual searches for each scientific name in its complete form (e.g. "*Euterpe luminosa"*).

For every search outcome we recorded the number of results obtained by the search engines. For the study we included up to the first 20 scientific papers of the outcomes. The criteria to select the informative papers were the report of vernacular names or information concerning the uses of the *Euterpe* species. The uses and vernacular names found for the species names and the synonyms were individually recorded and lumped under the accepted species. We included papers with primary or secondary information sources and used only documents that reported new data for the scientific name studied, avoiding repetitions. When two papers containing the same information were found, we used for the analysis the first one recovered by the searches (*i.e.* the most relevant). We developed the searches from March to May 2019, the data collected from the informative papers included: year of publication, title, author(s), DOI or URL, uses and vernacular names reported.

***Data analysis***

To analyse the recovery of information associated with the studied species, the uses and vernacular names recovered were classified into three groups: 1) exclusive for species names, 2) exclusive for synonyms and 3) shared. These groups were used to calculate the proportions in Table 1 employed to determine the proportion of uses and vernacular names associated exclusively with synonyms or scientific names, and to answer the first question of the review.

To answer the second question, we used the package "*ggplot2*" (Wickham 2016) in RStudio (RStudio Team 2018) to perform a linear correlation to evaluate the association between the uses and vernacular names recovered for the studied species and to determine if the sample was representative of the ethnobotanical knowledge about it. The normality of the data (required to use Pearson´s correlation) was tested using a Lilliefors test from the package "*nortest*" (Gross *et al*. 2015). When necessary, the data were transformed by Log to accomplish the normal distribution of the observations. Applying the same methodology, we performed an additional linear correlation for the number of synonyms and the years from the publication of the accepted species to observe the evolution in time of the taxonomy for the genus *Euterpe*.

The indicator 1 of the Table 2 revealed the proportion of useful papers recovered by each search engine and answer the third question of the review. The indicator 2 evaluated the effectivity of the papers retrieved by the search engines to recover the information of interest. Finally, we compared the search engines retrieval of useful papers by species names using Levene´s Test from the package "*car*" (Fox & Weisberg 2011) in RStudio (RStudio Team 2018). The data for synonyms were not sufficient to

develop a statistical analysis, and then we present a descriptive analysis instead.

## Results

We found 40 synonyms for the seven species of the genus *Euterpe*, 5.7 on average (Supplementary Table 1), varying from 20 for *E. precatoria* to zero for *E. luminosa*. 11.1% of the information regarding uses and 17.8% of the vernacular names were exclusively associated with the synonyms (Table 1), confirming our hypothesis for the first question. We found 94 informative papers (Supplementary Table 2) for uses and vernacular names, 25% of them being recovered through the synonyms. We retrieved useful papers for 100% of the currently accepted names and 35% of the synonyms. For the genus *Euterpe* as a whole, 107 vernacular names and 63 uses were recovered. *E. precatoria* was the species with more uses and vernacular names (Table 1). The use of the heart of palm (palmetto) was recorded for five of the seven species of the genus, and the name "açai" was the most widespread in the studied species (Supplementary Table 3). We recovered uses for six species (85.7%) and seven synonyms (17.5%), vernacular names for 7 species (100%) and 14 synonyms (35%), and the percentage of uses and vernacular names recovered by the accepted names were higher than the recovered by synonyms, but the shared ones were very similar (Table 1).

.

Table 1. Synonyms (Syn), Uses and Vernacular Names recovered from Scientific names (SN) and synonyms (Syn), and the shared ones (Sh), for the *Euterpe* Mart. species studied.

| | **Syn** | **Uses** | | | | **Vernacular names** | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Total | SN | Syn | Sh | Total | SN | Syn | Sh |
| *E. broadwayi* Becc. ex Broadway | 4 | 7 | 1 | 2 | 4 | 10 | 2 | 3 | 5 |
| *E. catinga* Wallace | 10 | 6 | 5 | 0 | 1 | 16 | 13 | 4 | 1 |
| *E. edulis* Mart. | 3 | 14 | 11 | 4 | 1 | 14 | 10 | 2 | 2 |
| *E. longibracteata* Barb. Rodr. | 1 | 0 | 0 | 0 | 0 | 3 | 2 | 0 | 1 |
| *E. luminosa* A.J. Hend., Galeano & E. Meza | 0 | 1 | 1 | 0 | 0 | 2 | 2 | 0 | 0 |
| *E. oleracea* Mart. | 4 | 24 | 20 | 1 | 3 | 14 | 10 | 4 | 0 |
| *E. precatoria* Mart. | 20 | 32 | 29 | 2 | 1 | 55 | 45 | 7 | 3 |
| Summation | 42 | 84 | 67 | 9 | 10 | 114 | 84 | 20 | 12 |
| Consolidated | 40 | 63 | 55 | 7 | 1 | 107 | 79 | 19 | 9 |
| Proportion (%) | -- | 100 | 87.3 | 11.1 | 1.6 | 100 | 73.8 | 17.8 | 8.4 |

Table 2. Indicators and values used to analyse the recovery of information about uses and vernacular names associated with the *Euterpe* Mart. species.

| # | Indicator | Formula | Value (%) | Components |
|---|---|---|---|---|
| **1** | Percentage of useful papers recovered by each search engine | $\%P_{useful} = (P_{info} / P_{recov}) * 100$ | **0,23 (GS)**<br>**0,62 (Sc)**<br>**2,95 (WoS)** | $P_{info}$ = number of informative papers. $P_{recov}$ = papers recovered from the search engine |
| **2** | Utility of the papers to recover uses and vernacular names | $I_{Up} = Utotal / P_{info}$<br>$I_{VNp} = P_{info} / VN_{Total}$ | **0,71**<br>**0,76** | $P_{info}$ = number of informative papers. $U_{total}$ = total uses recovered. $VN_{total}$ = total vernacular names recovered. |

Our results revealed a positive correlation ($R^2$=0.707) for the uses and vernacular names of *Euterpe* species (Fig. 1B); this is, more vernacular names were recovered for species with more uses. The species with more uses and vernacular names was *E. precatoria* followed by *E. oleracea*, whilst E. *luminosa* and *E. longibracteata* were the less diverse in both items. When the four varieties (two of *E. precatoria* and two of *E. catinga*) were added to the analysis, the correlation of the uses and vernacular names slightly decreases ($R^2$=0.657) (Supplementary Figure 1) as a consequence of the new elements added that modify the correlation as a whole. This high correlation shown the representativeness of the data sample confirming our hypothesis for the second question, and validated the methodology used to recover the papers and the information.

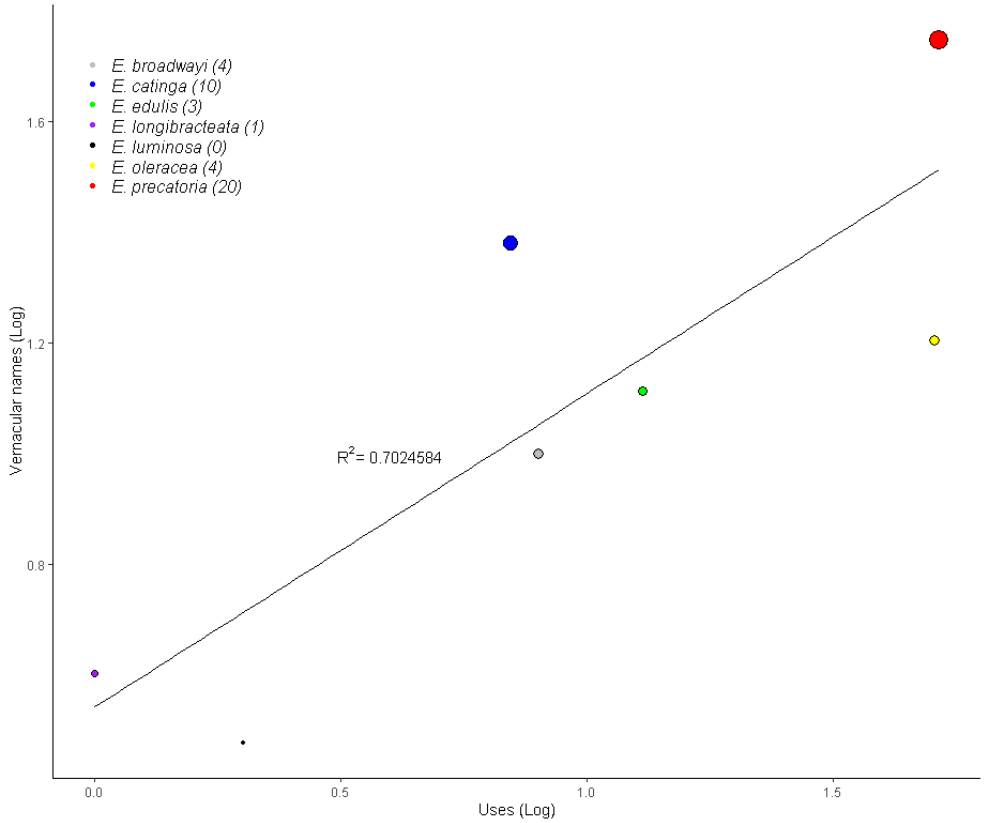



Figure 1. **A**. Correlation of uses and vernacular names (data normalized by Log) recovered for the palm species of the genus *Euterpe* Mart.

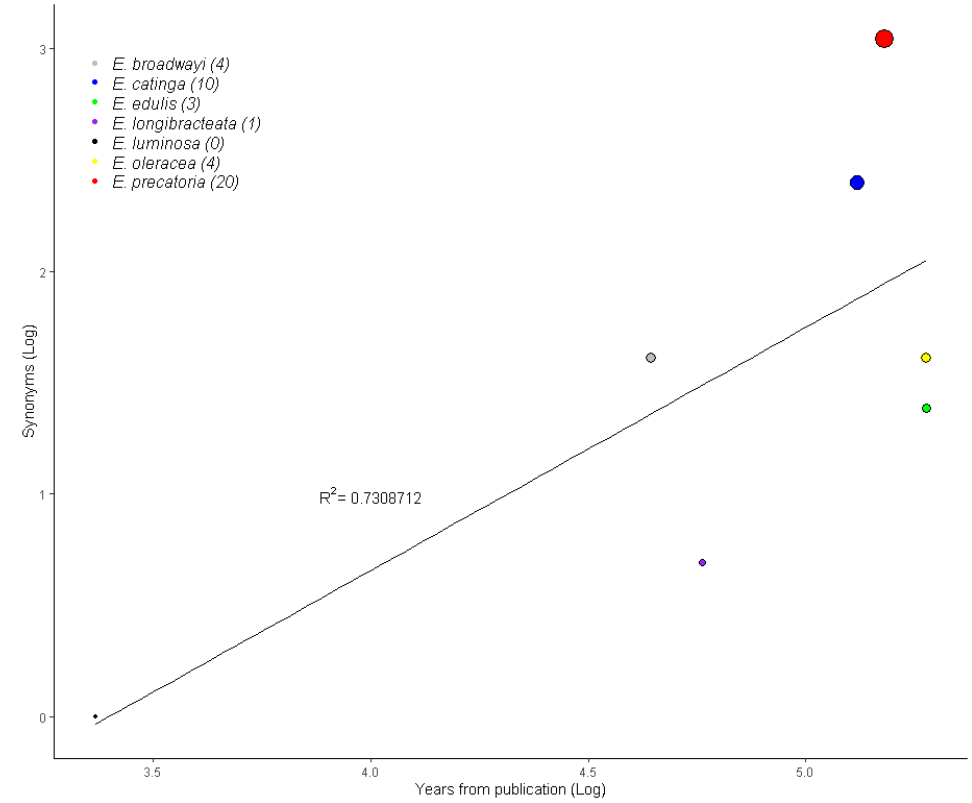



Figure 1 **B**. Correlation of the number of synonyms and years from publication (data normalized by Log) for the species of the genus *Euterpe* Mart. The size of the dots in each graphic indicates the number of synonyms of the species (data below the species name).

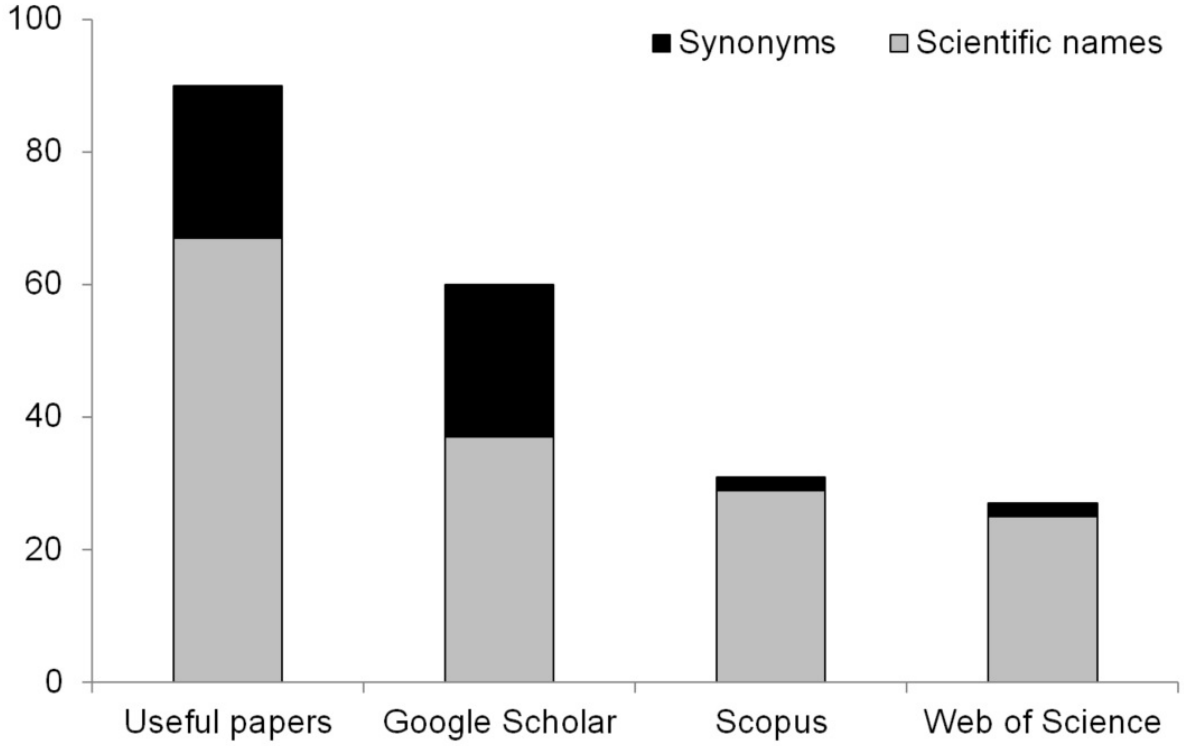



Figure 2. Useful papers recovered for the species and synonyms of the genus *Euterpe* Mart. in the used search engines.

We recovered 55% of the useful papers associated with the species names in Google Scholar, 43% in Scopus and 37% in Web of Science (Fig. 2). Nevertheless, each search engine recovered unique papers (i.e. only recovered by this engine). The search engines used in this research did not differ statistically in the retrieval of the total number of useful papers, nor by the species names ($F_{(2, 117)}$=2.7322, p = 0.06923). In the Figure 2 is clear that Google Scholar retrieved most of the useful papers when the synonyms or the species-names were used as a search term. Indeed, 100% of useful papers retrieved by the synonyms were found in Google Scholar, 8.7 % in Scopus and 8.7% in Web of Science. When considering the synonyms, no articles were unique for Scopus or Web of Science, and 85% were retrieved only in Google Scholar. Web of Science had a superior performance retrieving useful papers from the total recovered in the search. All these results confirm our hypothesis for the third question about the differences in the information retrieved by each search engine.

The papers recovered by uses and vernacular names presented a similar utility to retrieve information. The percentage of useful papers from the total recovered was higher in WoS than Sc and GS (Table 2), but the number of papers recovered by SN and Syn was superior in GS (25874/724) followed by Sc (4936/81) and WoS (901/13). Additionally, in GS we recovered information for the 7 currently accepted *Euterpe* species and 14 of the 40 synonyms. In Sc and WoS for 5 species and only 2 synonyms. We found that 25% (10) of the synonyms were published before 1900, 53% (25) between 1900 and 1950. After 1950, eight synonyms were published; the last one was *E. espiritosantensis* H.Q.B. Fernandes, in 1989 (Fernandes 1989). We found a positive correlation ($R^2$= 0.73) between the years from the description of the species and the number of synonyms recorded (Fig. 1A) showing a decrease in the number of synonyms for the species described more recently. In other words, more recently described species have less synonyms than more early-described taxa. This fact highlights the importance of including the synonyms in the researches and reviews, especially for species described long ago.

## Discussion

The recognition of sibling species and synonyms as well as the need for funding for primary taxonomic research are enormous (Godfray 2002, Regan *et al*. 2001). In papers published between 2000 and 2003, the reference of 1,015,000 binominals registered at the Index Kewensis were used to estimate the number of accepted seed plant species and the results have shown that the rates of synonymy varied from 58 to 78% (Scotland & Wortley 2003). The number of published binomial names, accepted names and synonyms were used to estimate the number of species of flowering plants, seed plants, vascular plants and land plants and compared with the estimates presented in papers published from

2000 to 2016. The results showed a high variability in the number of accepted names and synonyms used in calculations (Lughadha *et al*. 2016). The high number of perceived synonyms points out their relevance for the search of scientific literature searching, especially for revision purposes.
The importance of synonyms in literature searching has been demonstrated in other cases such as the relevance of botanical nomenclature and plant taxonomy in biomedical research (Bennett & Balick 2014), the recovery of citations for species recorded in ITIS (Guala 2016) and the retrieval of webpages linked to the scientific names and synonyms of bird species in a culturomic assessment (Correia *et al*. 2018). These researches were developed extracting information of a high number of species from the Web. In contrast we used a small taxonomic group, composed of seven species and 40 synonyms, to extract information from the scientific papers linked to these names. In this way we were able to develop the comparisons of the retrieval of uses and vernacular names for species names and synonyms, the relation of the uses and vernacular names and the performance of the search engines.

For the genus *Euterpe* we found that the number of synonyms of the currently accepted species increases in time, being lower in the most recently described and higher in those described a long time ago. Even though the scientific name of any organism is a stable entity permanently linked to its type; the specimen of reference standard for a taxon (*i.e.* the voucher, biologic collection or exsiccate) used for the first description of the species (Winston 1990), the synonymy is an inevitable phenomenon in taxonomy. This phenomenon derives from human fallibility in the recognition of already described taxa, deficient sampling and/or the lack of accessibility to the species protologues to compare with the material suspected to be a new species (Eastop & Blackman 2005, Winston 1990). These facts entail to the description and publication of information about already known species but linked to a new name posteriorly synonymized. Hence, the number of synonyms identified for any taxon and the date of their publication becomes a clear signal of the existence of information associated with them.

The proportions included in Table 1 support the inclusion of the synonyms in the searches as a factor that increases the number of recovered uses and vernacular names retrieved by the search engines. In this research we recovered 11.1% of uses and 17.8% of vernacular names linked exclusively to the synonyms and found that the relevance of synonyms is higher for species described long ago, that have more synonyms. This fact highlights that the inclusion of the synonyms in literature revisions is a factor that improves the recovery of relevant scientific information (Guala 2016). Consequently, we recommend the identification of the synonyms for the studied species as a tool to understand the taxonomy of the studied group, and as a resource to recover scientific information that may be hidden after the synonymization.

The species whit more synonyms generally are the most useful and known by more vernacular names, a strong correlation that highlights the importance of these palms for the human populations, and the relevance of the synonyms for the recovery of information about ethnobotanic or any other topic of research. Whereas many studies deal with the uses and vernacular names of some plant species (Bjorå *et al*. 2015, Cedano & Villaseñor 2004, Fernández 1992, Kunwar & Adhikari 2005, Kunwar & Bussmann 2006, Macía 2004), to the best of our knowledge, none of them addresses the interrelationship of these two kinds of ethnobotanical information. The pattern we observed for this group of palm-trees seems logic: a plant widely used is known by many vernacular names derived from the different groups of people that use it. Further studies reviewing this kind of information may detect this pattern in other groups of plants and animals.

Additionally, the values of the indicator for the utility of the papers (Table 2) evidence the number of papers needed to obtain a single useful record. In the present contribution, the values for uses (0.71) and vernacular names (0.76) indicate that a similar effort is needed to retrieve the information, and quantitatively similar information may be found in papers about both topics.

The 51 binomial names associated with the genus *Euterpe* (*i.e.* species, varieties and synonyms) were published between 1824- year of description of *E. oleracea* (Martius 1824)- and 1996, when the varieties were recognized in the revision of the genus (Henderson & Galeano 1996). We found that 79% of the synonyms were published before 1950 and some of them were published in the same year. This is the case of *Catis martiana* OF Cook and *E. badiocarpa* Barb.Rodr., synonyms of *E. oleracea*, described in 1901, and *E. petiolata* Burret and *E. subruminata* Burret synonyms of *E. precatoria* described in 1940. In consequence, many papers about the *Euterpe* species were published in this time-lapse and contain information linked to these synonyms.

The strong correlation between the number of synonyms with the number of years from the species description reflects the improved understanding of the taxonomy, the advances in the species delimitation for the species of the genus *Euterpe*,

and the enhanced access to the scientific information derived from the development of the telecommunications. Today the telecommunication technology allows to access a great part of the herbaria collections, the papers and books with the description of the species, and instantaneous communication with other researchers, reducing the probability of misidentification of specimens and parallel descriptions of species. But the latter phenomena still happen, new species are described every year and the revision of taxonomic entities continuously highlights new synonyms, increasing the number of papers that reference synonyms as species and, consequently, the information about the biology, distribution, traditional knowledge or other kinds of research topics that may be overlooked (Patterson *et al*. 2010).

We obtained the best outcomes of useful papers for the synonyms using Google Scholar, retrieving higher number of useful papers than Scopus and Web of Science. Nevertheless, for the currently accepted scientific names, all search engines presented similar performances. Although we limited our review to the first 20 scientific papers in the outcomes, only five species names, two varieties and six synonyms exceed this limit for the Google Scholar results. The same happened with three species and a synonym for Scopus, and three species for Web of Science. This limit reduced the number of papers reviewed and retrieved a good amount of information represented in the uses and vernacular names recovered by species names and synonyms.

Some researchers have criticized the use of Google Scholar to retrieve scientific information arguing that it offers results of inconsistent accuracy, problems regarding citation information (Falagas *et al*. 2007, Wadhwa *et al*. 2020), as well as the lack of a history function and tools to optimize the queries or to export a large number of citations (Boeker *et al*. 2013). We don't disagree; Google Scholar has fewer options to filter the results and tools to manage the outcomes and requires more time to manually select the papers from the outcomes. Nevertheless, Google Scholar is considered the most comprehensive academic search engine (Gusenbauer 2019) and our results showed its better performance to retrieve information about synonyms.

The selection of the searches engine and its performance to recover scientific information depend on the scope of the research and the papers of interest (Bakkalbasi et al. 2006). For the synonyms, the amplitude in time of the Google Scholar searches (not revealed by the site but considered unlimited) plays an important role in the retrieval of information because most of the synonyms for the genus *Euterpe* were published between 1900 and 1950, a period not covered in Scopus, and partially covered in Web of Science (from 1945 to present / only for science). Therefore, we recommend the use of Google Scholar for searches linked to plant synonyms. Google Scholar is thus an efficient free-access tool to recover useful papers and retrieves scientific information from a wide lapse of time and a great number of sources.

## Conclusions

The identification of the synonyms for accepted species leads to the recovery of the taxonomical history of the studied group and facilitates the retrieval of information that otherwise could be ignored or overlooked. For the genus *Euterpe* the most useful species have more vernacular names; a relation that points out the strong relation of some palms with the human populations. This confirms the hypothesis we formulated. Google Scholar presented a better performance than Scopus and Web of Science for the recovery of information about synonyms supporting our hypothesis, but the outcomes for the currently accepted scientific names were similar for the three search engines. The time from the description of a species is a factor that increases the number of synonyms and the information linked to them. As expected, the inclusion of synonyms improved the recovery of information for the species by increasing the amount of information retrieved from the web. So, researchers planning ethnobotanical research have to seriously consider the inclusion of the pertinent synonyms in order to maximise the recovery of relevant information.

## Declarations

**List of abbreviations**: SN: Scientific name, Syn: Synonyms, GS: Google Scholar, Sc: Scopus, WoS: Web of Science.

**Ethics approval and consent to participate**: Not applicable.

**Consent for publication**: Not applicable.

**Conflict of interests**: The authors declare that they have no conflict of interests.

**Competing financial interests**: The authors declare that they have no competing financial interest.

**Funding**: This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001.

**Author contributions**: OP designed the study, OP and RBS conducted the review; analysed the data; wrote, read, corrected and approved the manuscript.

## Acknowledgments

We thank to Prof. Dra. Mara Rejane Ritter for the revision of the earlier version of the text, as well as Dra. Mónica Moraes, Dr. Henrik Balslev and Dr. Rodrigo Bernal for the revision and comments on the manuscript. This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior – Brasil (CAPES) – Finance Code 001.

## Literature Cited

Bakkalbasi N, Bauer K, Glover J, Wang L. 2006. Three Options for Citation Tracking: Google Scholar, Scopus and Web of Science. Biomedical Digital Libraries 3:1-8.

Bennett BC, Balick MJ. 2014. Does the Name Really Matter? The Importance of Botanical Nomenclature and Plant Taxonomy in Biomedical Research. Journal of Ethnopharmacology 152:387-392.

Bernal R, Torres C, García N, *et al*. 2011. Palm Management in South America. Botanical Review 77:607-646.

Bjorå CS, Wabuyele E, Grace OM, Nordal I, Newton LE. 2015. The Uses of Kenyan Aloes: An Analysis of Implications for Names, Distribution and Conservation. Journal of Ethnobiology and Ethnomedicine 42:140-152.

Boeker M, Vach W, Motschall E. 2013. Google Scholar as Replacement for Systematic Literature Searches: Good Relative Recall and Precision Are Not Enough. BMC Medical Research Methodology 13:1-12.

Boyle B, Hopkins N, Lu Z, Garai JA, Mozzherin D, Rees T, Matasci N, Navarro ML, Piel WH, Mackay SJ, Lowry S, Freeland C, Peet RK, Enquist BJ. 2013. The Taxonomic Name Resolution Service: An Online Tool for Automated Standardization of Plant Names. BMC Bioinformatics 14:1-14.

Brokamp G, Valderrama N, Mittelbach M, Grandez CA, Barfod AS, Weigend M. 2011. Trade in Palm Products in North-Western South America. Botanical Review 77:571-606.

Carvalho GH, Cianciaruso MV, Batalha MA. 2010. Plantminer: A Web Tool for Checking and Gathering Plant Species Taxonomic Information. Environmental Modelling and Software 25:815-816.

Cayuela L, Granzow-de la Cerda Í, Albuquerque FS, Golicher DJ. 2012. Taxonstand: An r Package for Species Names Standardisation in Vegetation Databases. Methods in Ecology and Evolution 3:1078-1083.

Cedano M, Villaseñor L. 2004. Usos y Nombres Comunes de Las Especies de Cochlospermaceae en México. Etnobiología 4:73-88.

Chamberlain SA, Szöcs E. 2013. Taxize: Taxonomic Search and Retrieval in R. F1000Research 2: 1-28.

Correia RA, Jarić I, JepsonP, Malhado ACM, Alves JA, Ladle RJ. 2018. Nomenclature Instability in Species Culturomic Assessments: Why Synonyms Matter. Ecological Indicators 90:74-78.

Correia RA, Jepson P, Malhado ACM, Ladle RJ. 2017. Internet Scientific Name Frequency as an Indicator of Cultural Salience of Biodiversity. Ecological Indicators 78:549-555.

Dayrat B. 2005. Towards Integrative Taxonomy. Biological Journal of the Linnean Society 85:407-415.

Eastop V, Blackman R. 2005. Some New Synonyms in Aphididae (Hemiptera: Sternorrhyncha). Zootaxa 1089:1-36.

Falagas ME, Pitsouni EI, Malietzis GA, Pappas G. 2007. Comparison of PubMed, Scopus, Web of Science, and Google Scholar: Strengths and Weaknesses. The FASEB Journal 22:338-342.

Fernandes H. 1989. Uma Nova Espécie de *Euterpe* (Palmae - Arecoideae - Areceae) Do Brasil. Acta Botanica Brasilica 3:43-49.

Fernández N. 1992. Nombres Comunes, Usos y Distribución Geográfica Del Género *Karwinskia* (Rhamnaceae) En México. Anales Instituto de Biololgia Univ.Nac.Autón.México, Serie Botánica 63:1-23.

Foster ZSL, Chamberlain S, Grünwald NJ. 2018. Taxa: An R Package Implementing Data Standards and Methods for Taxonomic Data. F1000Research 7:272.

Fox J, Weisberg S. 2011. An R Companion to Applied Regression: Appendices. 2nd Edition. Sage, Thousand Oaks, USA.

Godfray H. 2002. Challenges for taxonomy. Nature 417:17-19.

Gross J, Ligges U, Ligges M. 2015. Package 'Nortest', version 1.04. Available at: https://cran.r-project.org/web/packages/nortest/index.html

Guala GF. 2016. The Importance of Species Name Synonyms in Literature Searches. PLoS ONE 11:1-7.

Henderson A, Galeano G. 1996. *Euterpe*, *Prestoea*, and *Neonicholsonia* (Palmae). Flora Neotropica 72:1-89.

Jiménez-Escobar N D, Rangel-Ch JO. 2012. La Abundancia, La Dominancia y Sus Relaciones Con El Uso de La Vegetación Arbórea En La Bahía de Cispatá, Caribe Colombiano. Caldasia 34:347-366.

Kunwar RM, Adhikari N. 2005. Ethnomedicine of Dolpa District, Nepal: The Plants, Their Vernacular Names and Uses. Lyonia 8:43-49.

Kunwar RM, Bussmann RW. 2006. *Ficus* (Fig) Species in Nepal : A Review of Diversity and

Indigenous Uses. Lyonia 11: 85-97.

Ledezma-Rentería E, Galeano G. 2014. Usos de las palmas en las tierras bajas del Pacífico Colombiano. Caldasia 36:71-84.

Lughadha EN, Govaerts R, Belyaeva I, *et al*. 2016. Counting Counts: Revised Estimates of Numbers of Accepted Species of Flowering Plants, Seed Plants, Vascular Plants and Land Plants with a Review of Other Recent Estimates. Phytotaxa 272:82-88.

Macía M. 2004. Multiplicity in Palm Uses by the Huaorani of Amazonian Ecuador. Botanical Journal of the Linnean Society 144:149-159.

Macía M, Armesilla PJ, Cámara-Leret R, *et al*. 2011. Palm Uses in Northwestern South America: A Quantitative Review. Botanical Review 77:462-570.

Martius CF. 1823. Historia Naturalis Palmarum Vol.2 Genera et Species. Leipzig, Germany.

Mesa L, Galeano G. 2013. Usos De Las Palmas En La Amazonia Colombiana. Caldasia 35:351-369.

Meza E, Galeano G, Henderson A. 1991. A New Species of Euterpe (Palmae) from Peru. Brittonia 43:178-180.

Moraes M. 2020. Palmeras y usos: Especies de Bolivia y la región. Herbario Nacional de Bolivia, Instituto de Ecología, Universidad Mayor de San Andrés, Plural editores, La Paz, Bolivia.

Paniagua-Zambrana N, Peña-Claros M, Moraes M, Montúfar R. 2020. Euterpe o palmeras asaí, un género neotropical de importancia para las poblaciones humanas americanas. In Palmeras y usos: Especies de Bolivia y la región. Edited by M Moraes. Herbario Nacional de Bolivia, Instituto de Ecología, Universidad Mayor de San Andrés, Plural editores, La Paz, Bolivia, Pp. 47-58.

Paniagua-Zambrana N, Bussmann RW, Macía MJ. 2017. The Socioeconomic Context of the Use of *Euterpe precatoria* Mart. and *E. oleracea* Mart. in Bolivia and Peru. Journal of Ethnobiology and Ethnomedicine 13: 1-17.

Patterson DJ, Cooper J, Kirk PM, Pyle RL, Remsen DP. 2010. Names Are Key to the Big New Biology. Trends in Ecology and Evolution 25:686-691.

Regan HM, Lupia R, Drinnan AN, Burgman MA. 2001. The Currency and Tempo of Extinction. American Naturalist 157: 1-10.

Remsen D. 2016. The Use and Limits of Scientific Names in Biological Informatics. ZooKeys 550:207-223.

Rivera D, Allkin R, Obón C, Alcaraz F, Verpoorte R, Heinrich M. 2014. What Is in a Name? The Need for Accurate Scientific Nomenclature for Plants. Journal of Ethnopharmacology 152:393-402.

RStudio Team. 2018. RStudio: Integrated Development for R. RStudio, Inc. Boston, USA.
Scotland RW, Wortley AH. 2003. How Many Species of Seed Plants Are There? Taxon 52:101-104.

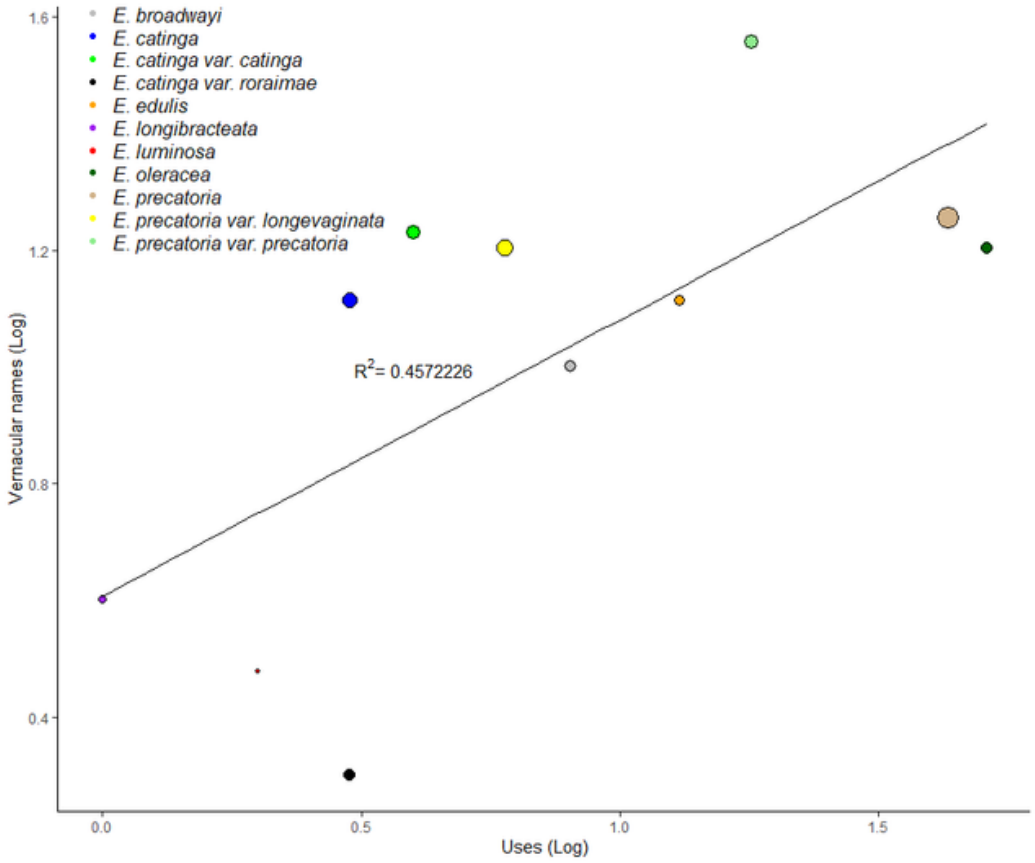
Tomlinson PB. 2006. The Uniqueness of Palms. Botanical Journal of the Linnean Society 151:5-14.

Tuominen J, Laurenne N, Hyvönen E. 2011. Biological Names and Taxonomies on the Semantic Web - Managing the Change in Scientific Conception. In Proceedings of the Extended Semantic Web Conference, Springer, Berlin, Germany. Pp. 255-269.

Wadhwa V, Vilanilam G, Chick J. 2020. Disparities in Citation Metrics Amongst Web of Science, Scopus, and Google Scholar for Interventional Radiology Journals. Cardiovascular and Interventional Radiology. Letter to the editor.

Wickham H. 2016. Ggplot2: Elegant Graphics for Data Analysis. Springer-Verlag, New York, USA.

Winston J. 1990. Describing Species: Practical Taxonomic Procedure for Biologists. Columbia University Press, New York, USA.




Supplementary Figure 1. Correlation of the uses and vernacular names (data normalized by Log) recovered for the palm species and varieties of the genus *Euterpe* Mart.

Table S1. Scientific Names (SN) (ID upper case), Synonyms (Syn) (ID numbers), varieties (ID lower case), Year (of publication), Uses (U), Vernacular Names (VN) and Usefull Papers (UP) for all the *Euterpe* species studied, The results –number of papers– (-r) for each search engines (GS = Google Scholar, SC = Scopus, WS = Web of Science), and the search engine of precedence of the useful papers (-p). Scientific names with an asterisk (*) are shown in the list. The numbers in parenthesis indicate the total of U and VN recovered for the species (SN + Syn).

| SN / Syn | Year | U | VN | GS-r | SC-r | WS-r | UP | GS-p | SC-p | WS-p |
|---|---|---|---|---|---|---|---|---|---|---|
| ***E. broadwayi*** | 1916 | 2(7) | 4(9) | 15 | 1 | 1 | 3 | 3 | 0 | 0 |
| *E. broadwayana* | 1920 | 0 | 1 | 13 | 0 | 0 | 1 | 1 | 0 | 0 |
| *E. dominicana* | 1940 | 6 | 6 | 16 | 0 | 0 | 4 | 4 | 0 | 0 |
| *E. grenadana* | 1979 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. hagleyi* | 1944 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| ***E. catinga*** | 1853 | 6(13) | 15(23) | 207 | 2 | 4 | 4 | 4 | 1 | 1 |
| *E. aurantiaca* | 1969 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. caatinga* | 1875 | 0 | 3 | 21 | 0 | 0 | 2 | 2 | 0 | 0 |
| var. *aurantiaca* | 1882 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. concinna* | 1929 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. controversa* | 1882 | 0 | 4 | 10 | 0 | 0 | 2 | 2 | 0 | 0 |
| *E. mollissima* | 1871 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. montis-duida* | 1931 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. roraimae* | 1915 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| **var. *catinga*** | 1996 | 4 | 10 | 8 | 0 | 0 | 1 | 1 | 0 | 0 |
| *E. aurantiaca** | 1969 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| var. *aurantiaca** | 1882 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. caatinga** | 1875 | 0 | 3 | 21 | 0 | 0 | 2 | 2 | 0 | 0 |
| *E. concinna** | 1929 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. controversa** | 1882 | 0 | 4 | 11 | 0 | 0 | 2 | 2 | 0 | 0 |
| *E. mollissima** | 1871 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. montis-duida** | 1931 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| **var. *roraimae*** | 1996 | 2 | 1 | 8 | 0 | 0 | 1 | 1 | 0 | 0 |
| *E. erubescens* | 1969 | 1 | 1 | 5 | 0 | 0 | 1 | 1 | 0 | 0 |
| *E. montis-duida** | 1931 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| *E. ptariana* | 1951 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. roraimae** | 1915 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| ***E. edulis Mart.*** | 1824 | 7(12) | 7(12) | 9320 | 1546 | 371 | 22 | 8 | 10 | 7 |
| var. *clausa* | 1977 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. egusquizae* | 1919 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. espiritosantensis* | 1989 | 1 | 2 | 320 | 78 | 6 | 2 | 2 | 1 | 1 |
| ***E. longibracteata*** | 1875 | 0(0) | 0(3) | 33 | 0 | 0 | 1 | 1 | 0 | 0 |
| *E. longispathacea* | 1910 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| ***E. luminosa*** | 1991 | 0(1) | 0(/2) | 19 | 1 | 1 | 1 | 1 | 1 | 1 |
| ***E. oleracea*** | 1824 | 42(50) | 12(15) | 12500 | 2989 | 422 | 23 | 10 | 10 | 8 |
| *Catis martiana* | 1901 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. badiocarpa* | 1901 | 1 | 1 | 27 | 1 | 0 | 1 | 1 | 0 | 0 |
| *E. beardii* | 1947 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. cuatrecasasiana* | 1951 | 0 | 1 | 58 | 0 | 0 | 1 | 1 | 0 | 0 |
| ***E. precatoria*** | *1842* | 42(51) | 17(55) | 3780 | 397 | 102 | 13 | 10 | 7 | 8 |
| *E. andicola* | *1842* | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. confertiflora* | *1947* | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. haenkeana* | *1842* | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. jatapuensis* | *1901* | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. kalbreyeri* | *1929* | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. karsteniana* | *1865* | 0 | 1 | 11 | 0 | 0 | 1 | 1 | 0 | 0 |
| *E. langloisii* | *1936* | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. leucospadix.* | *1885* | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. longivaginata* | *1842* | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. macrospadix* | *1859* | 1 | 2 | 82 | 2 | 7 | 3 | 3 | 1 | 1 |
| *E. microcarpa* | *1929* | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. montis-duida** | *1931* | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. panamensis* | *1933* | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. petiolata* | *1940* | 0 | 1 | 7 | 0 | 0 | 1 | 1 | 0 | 0 |
| *E. ptariana** | *1951* | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. rhodoxyla* | *1951* | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. stenophylla* | *1884* | 3 | 1 | 14 | 0 | 0 | 2 | 2 | 0 | 0 |
| *E. subruminata* | *1940* | 1 | 2 | 6 | 0 | 0 | 1 | 1 | 0 | 0 |
| *Plectis oweniana* | *1904* | 0 | 2 | 6 | 0 | 0 | 1 | 1 | 0 | 0 |
| *R. frankliniana* | *1939* | 0 | 0 | 9 | 0 | 0 | 0 | 0 | 0 | 0 |
| ***var. precatoria*** | *1995* | 17 | 35 | 41 | 0 | 2 | 4 | 4 | 0 | 1 |
| *E. confertiflora** | *1947* | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. jatapuensis** | *1901* | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. langloisii** | *1936* | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. petiolata** | *1940* | 0 | 1 | 7 | 0 | 0 | 1 | 1 | 0 | 0 |
| *E. stenophylla** | *1884* | 3 | 1 | 14 | 0 | 0 | 2 | 2 | 0 | 0 |
| *E. subruminata** | *1940* | 1 | 2 | 6 | 0 | 0 | 1 | 1 | 0 | 0 |
| ***var. longevaginata*** | *1995* | 5 | 15 | 41 | 1 | 2 | 4 | 4 | 0 | 0 |
| *E. kalbreyeri** | *1929* | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. karsteniana** | *1865* | 0 | 1 | 11 | 0 | 0 | 1 | 1 | 0 | 0 |
| *E. leucospadix** | *1885* | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. longivaginata** | *1842* | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. macrospadix** | *1859* | 1 | 2 | 82 | 2 | 7 | 3 | 3 | 1 | 1 |
| *E. microcarpa** | *1929* | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. panamensis** | *1933* | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 |
| *E. rhodoxyla** | *1951* | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Plectis oweniana** | *1904* | 1 | 2 | 6 | 0 | 0 | 1 | 1 | 0 | 0 |
| *R. frankliniana** | *1939* | 0 | 2 | 6 | 0 | 0 | 1 | 1 | 0 | 0 |

Table S2. List of scientific articles (in chronological order) used in the review of uses and vernacular names of the *Euterpe* species studied.

| YEAR | ARTICLE TITLE |
|---|---|
| 1904 | The nomenclature of the royal palms |
| 1940 | Palmae neogeae XII |
| 1940 | Palmas de Colombia |
| 1940 | Palmen von A. C. Smith aus Brit. Guayana |
| 1943 | The Vegetation of Dominica |
| 1944 | The Natural Vegetation of the Island of Tobago, British West Indies |
| 1947 | Les reliques végétales de la Réserve Caraïbe de la Dominique (Antilles Anglaises) |
| 1949 | Glossary of Arawak Names in Natural History |
| 1957 | The Ethnobotany of the Island Caribs of Dominica |
| 1967 | Flora del Auyan-Tepui |
| 1972 | Inventario florestal do distrito agropecuario da Zona Franca de Manaus |
| 1981 | Palmeiras que Crescem no Estado do Rio De Janeiro |
| 1984 | Medicinal uses of South American palms |
| 1990 | Heat Inactivation and Kinetics of Polyphenoloxidase from Palmito (*Euterpe edulis*) |
| 1991 | A New Species of *Euterpe* (Palmae) from Peru |
| 1993 | A Flórula Da Reserva Ducke, I: Palmae (ARECACEAE) |
| 1994 | Palm Ethnoecology in the Saripiqui Region of Costa Rica |
| 1994 | The foliar fungal endophytes of the Amazonian palm *Euterpe oleracea* |
| 1995 | Edaphic and Human Effects on Landscape-Scale Distributions of Tropical Rain Forest Palms |
| 1996 | *Euterpe, Prestoea* and *Neonicholsonia* |
| 1996 | Flowering, pollination, nectar standing crop, and nectaries of *Euterpe precatoria* (Arecaceae), an Amazonian rain forest palm |
| 1997 | Comportamento de armazenamento - de sementes de palmiteiro (*Euterpe edulis* mart.) |
| 1998 | Esgotamento das reservas na semente de *Euterpe edulis* mart. e efeito da nutrição mineral nas plântulas |
| 1999 | Sucesión y fisionomía de los manglares de Colombia |
| 1999 | Tolerância à dessecação de sementes de palmito-vermelho (*Euterpe espiritosantensis* Fernandes) |
| 2000 | Edible Palms and their uses |
| 2000 | Genetic differentiation of *Euterpe edulis* Mart. populations estimated by AFLP analysis |
| 2000 | Management and Conservation of Natural Populations in Atlantic Rain Forest: The Case Study of Palm Heart (*Euterpe edulis* Martius) |
| 2001 | El cerdo cimarrón (*Sus scrofa*, Suidae) en la Isla del Coco, Costa Rica: |
| 2001 | Una aproximación fitosociológica sobre los varillales húmedos de la Amazonía peruana |
| 2002 | An Antiplasmodial Lignan from *Euterpe precatoria* |

| | |
|---|---|
| 2002 | Ecotourism: its potential role in forest resource conservation in the Commonwealth of Dominica, West Indies |
| 2002 | Palms as rainforest resources: how evenly are they distributed in Peruvian Amazonia? |
| 2003 | Genetic diversity and recruitment of the tropical palm, *Euterpe edulis* Mart., in a natural population from the Brazilian Atlantic Forest |
| 2003 | Morfo-anatomia da semente de *Euterpe precatoria* Mart. (Palmae) 1 |
| 2003 | Polyphenolic Constituents of Fruit Pulp of *Euterpe oleracea* Mart. (Ac¸ai palm) |
| 2003 | The Native Palms of Dominica. |
| 2003 | Wild foods from southern Ecuador |
| 2004 | Phytochemical Composition and Pigment Stability of Ac¸ai (*Euterpe oleracea* Mart.) |
| 2004 | Potencial ecológico para o manejo de frutos de açaizeiro (*Euterpe precatoria* Mart.) em áreas extrativistas no Acre, Brasil. |
| 2005 | Constituintes químicos da raiz e do talo da folha do açaí (*Euterpe precatoria* Mart., Arecaceae) |
| 2005 | *Euterpe oleracea* juice as a functional pigment for yogurt |
| 2007 | Estudos comparativos do léxico da fauna e flora Aruák |
| 2007 | Forest structure and productivity of palmiteiro (*Euterpe edulis* Martius) in the Brazilian Mata Atlântica |
| 2008 | Antioxidant And Cytotoxic Activities Of 'Açaí' (*Euterpe precatoria* Mart.) |
| 2008 | Chemical Composition, Antioxidant Properties, and Thermal Stability of a Phytochemical Enriched Oil from Açai (*Euterpe oleracea* Mart.) |
| 2008 | Densidad de individuos adultos y producción de frutos del asaí (*Euterpe precatoria*, Arecaceae) en Riberalta, Bolivia |
| 2008 | *Euterpe oleracea* Mart. extract prevents vascular remodeling and endothelial dysfunction in spontaneously hypertensive rats |
| 2008 | Lignans and Other Constituents of the Fruits of *Euterpe oleracea* (Açai) with Antioxidant and Cytoprotective Activities |
| 2008 | Palmas (Arecaceae) útiles en los alrededores de Iquitos, Amazonía Peruana |
| 2009 | Accumulation of raphides crystals in *Euterpe oler*acea mart embryo |
| 2009 | Phytochemical composition and thermal stability of two commercial açai species, Euterpe oleracea and *Euterpe precatoria* |
| 2009 | Solar constituents of *Euterpe precatoria* roots and their plant growth activity |
| 2009 | Storage lipids and proteins of *Euterpe edulis* seeds |
| 2010 | Armazenamento de Sementes de Palmiteiro sob atmosfera modificada |
| 2010 | Berries from South America: A Comprehensive Review on Chemistry, Health Potential, and Commercialization |
| 2010 | Etnoecologia e etnobotânica da palmeira juçara (*Euterpe edulis* Martius) em comunidades quilombolas do Vale do Ribeira, São Paulo |
| 2010 | Growth of *Euterpe edulis* Mart. (Arecaceae) under forest and agroforestry in southern Brazil |
| 2010 | Temperaturas e substratos para germinação e vigor de sementes de *Euterpe oleracea* Mart. |
| 2010 | The rainbow hurts my skin: Medicinal concepts and plants uses among the Yanesha (Amuesha), an Amazonian Peruvian ethnic group |
| 2011 | Açai (*Euterpe oleracea* Mart.)—A phytochemical and pharmacological assessment of the species' health claims |
| 2011 | Anti-infl ammatory and antinociceptive activities of *Euterpe oleracea* oil |
| 2011 | Chemical characterization, bioactive compounds, and antioxidant capacity of jussara (*Euterpe edulis*) fruit from the Atlantic Forest in southern Brazil |
| 2011 | Effects of Açai (*Euterpe oleracea* Mart.) berry preparation on metabolic parameters in a healthy overweight population: A pilot study |
| 2011 | *Euterpe oleracea* (açai) Modifies sterol metabolism and Attenuates experimentally-induced atherosclerosis |

| | |
|---|---|
| 2011 | Flavonoids from acai (*Euterpe oleracea* Mart.) pulp and their antioxidant and anti-inflammatory activities |
| 2011 | Isoenzimas no monitoramento da deterioração de sementes de *Euterpe espiritosantensis* Fernandes |
| 2011 | População caiçara, Mata Atlântica e situação atual do palmito-juçara (*Euterpe edulis* mart.) na região do rio una da aldeia (Iguape - SP) |
| 2011 | Sobrevivência e crescimento inicial de plântulas de *Euterpe edulis* mart. transplantadas para clareiras e sub-bosque em uma floresta estacional semidecidual, |
| 2012 | Bioactivities of açaí (*Euterpe precatoria* Mart.) fruit pulp, superior antioxidant and anti-inflammatory properties to *Euterpe oleracea* Mart |
| 2012 | Caracterização físico-química do suco de açaí de *Euterpe precatoria* Mart. oriundo de diferentes ecossistemas amazônicos |
| 2012 | Conteúdo polifenólico e atividade antioxidante dos frutos da palmeira Juçara (*Euterpe edulis* Martius) |
| 2012 | Facing global markets – usage changes in Western Amazonian plants: the example of *Euterpe precatoria* Mart. and *E. oleracea* Mart. |
| 2013 | Bioactive compounds and health benefits of exotic tropical red–black berries |
| 2013 | Etnoentomología Baniwa |
| 2013 | Protective effect of *Euterpe edulis* M. on Vero cell culture and antioxidant evaluation based on phenolic composition using HPLC−ESI-MS/MS |
| 2013 | Total anthocyanin content determination in intact açaí *(Euterpe oleracea* Mart.) and palmitero-juçara (*Euterpe edulis* Mart.) fruit using near infrared spectroscopy (NIR) and multivariate calibration |
| 2014 | Anthocyanins, Phenolic Acids and Antioxidant Properties of Juçara Fruits (*Euterpe edulis* M.) Along the On-tree Ripening Process |
| 2015 | Allometric Equations for Estimating Biomass of *Euterpe precatoria*, the Most Abundant Palm Species in the Amazon |
| 2015 | Diversidad y Estado Poblacional de la familia Arecaceae en los Bosques Montanos de la Región del Cusco – Perú |
| 2016 | Antimalarial plants used by indigenous people of the Upper Rio Negro in Amazonas, Brazil |
| 2016 | Bryoflora and landscapes of the eastern Andes of central Peru: i. Liverworts of the el sira communal reserve |
| 2016 | Chemical Composition and Antioxidant Activity of Roots and Leaflets |
| 2016 | Grasping the Nettle: Handling Flora Entries in Dictionaries |
| 2016 | Neuroprotective Effects of Açaí (Euterpe oleracea Mart.) against *Euterpe oleracea* Rotenone In Vitro Exposure |
| 2017 | Effect of *Euterpe oleracea* Mart. (Açaí)Oil on Dyslipidemia Caused by *Cocos nucifera* L. Saturated Fat in Wistar Rats |
| 2017 | Ethnobotanical study of antimalarial plants in the middle region of the Negro River, Amazonas, Brazil |
| 2017 | Etnobotánica cuantitativa de la comunidad nativa Infierno, Madre de Dios - Perú |
| 2017 | Produção científica e prospecção tecnológica da *Euterpe oleracea* (Açaí) associada a síndrome metabólica |
| 2017 | Thermal degradation kinetics of anthocyanins extracted from juçara (*Euterpe edulis* Martius) and ‘‘Italia” grapes (*Vitis vinifera* L.), and the effect of heating on the antioxidant capacity |
| 2018 | *Euterpe oleracea* pulp extract: Chemical analyses, antibiofilm activity against Staphylococcus aureus, cytotoxicity and interference on the activity of antimicrobial drugs |
| 2018 | Physicochemical Characterization of a Crude Anthocyanin Extract from the Fruits of Jussara (*Euterpe edulis* Martius): Potential for Food and Pharmaceutical Applications |
| 2019 | Anthocyanins from jussara (*Euterpe edulis* Martius) extract carried by calcium alginate beads pre-prepared using ionic gelation |
| 2019 | Chemical composition and biological activities of Juçara (*Euterpe edulis* Martius) fruit by-products, a promising underexploited source of high-added value compounds |

**Table S3.** Uses and Vernacular Names found for the *Euterpe* species studied, retrieved from scientific names and synonyms, and the shared ones (Shared).

**USES**

| From Scientific Names | From Synonyms | Shared |
|---|---|---|
| Fruit (unripe) for treatment of diarrhea | White, edible, fat scarab larvae from rotten trunks | Heart of palm |
| Fruit and roots for gastrointestinal problems | Leaflets from young individuals, for thatch | |
| Fruit antioxidants | Palm wine from the trunk | |
| Fruit eaten raw | Roots for basketry "carry-all" | |
| Fruit extract food colorants | Roots to treat asthma | |
| Fruit extract for food flavoring | Roots to treat coughs | |
| Fruit for "vinho" | Ridge caps made from trunks | |
| Fruit for animal ration | | |
| Fruit for anthocyanins | | |
| Fruit for antibacterial | | |
| Fruit for anticarcinogenic substances | | |
| Fruit for antimicrobian compounds | | |
| Fruit for cardiovascular diseases | | |
| Fruit for control of atherosclerosis | | |
| Fruit for control of inflammatory processes | | |
| Fruit for control of metabolic syndrome | | |
| Fruit for control of oxidative stress | | |
| Fruit for desserts | | |
| Fruit for digestive disorders | | |
| Fruit for energetic snack beverages | | |
| Fruit for flavonoids extraction | | |
| Fruit for functional food | | |
| Fruit for icecream | | |
| Fruit for juice for ‘‘cassava meal’’ | | |
| Fruit for liqueur | | |
| Fruit for marmalade | | |
| Fruit for neuroprotective compounds | | |
| Fruit for oil | | |
| Fruit for parasitic infections | | |
| Fruit for phenolic acids | | |
| Fruit for pulp | | |
| Fruit for syrup | | |
| Fruit juice to prevent flu symptoms (fever and pain) | | |
| Fruit rind grated for skin ulcers | | |
| Fruit to control levels of insulin | | |
| Fruit to reduce levels of plasma glucose | | |
| Fruit to reduce levels of total cholesterol | | |
| Heart of palm | | |
| Leaflets for antioxidant | | |
| Leaflets for brooms | | |
| Leaves crushed for coagulant | | |
| Leaves for animal foraging | | |
| Leaves for thatch | | |
| Leaves for thatching temporary shelters | | |
| Palm as agroforestry component | | |
| Palm as forest component | | |
| Roots for antimalarial | | |
| Roots for antioxidant | | |
| Sap as an astringent | | |
| Seed oil for anti-conceptive | | |
| Seed oil for antidiarrheic | | |
| Seed oil for anti-inflammatory | | |
| Seed oil for phenolic and antioxidant compounds | | |
| seeds for fever (infusion of toasted crushed seeds) | | |
| Trunks in house construction | | |

**VERNACULAR NAMES**

| From Scientific Names | From Synonyms | Shared |
|---|---|---|
| Acai | Açaí pardo | Açaí chumbo |
| Açaí | Açaí-da-caatinga | Manaca |
| Açaí chumbinho | Assari Mirim | Manicol |
| Açaí da mata | Black-bearded palm | Manicole (inglés) |
| Açaí da terra | Halaute (Kekchi) | Maquenque |
| Açaí-branco | Hupér (Iñapari) | Mountain cabbage |
| Açai-caatinga | Manicole (inglés) | Palmiste |
| Açaí-da-catinga(P) | Naidí | Palmito |
| Açaí-de-terra-firme | Palmiste franc | Wabo-yaka (Wapisiana) |
| Açaí-do-amazonas, | Palmiste montagne | |
| Açai-do-pará | Palmistes manicols | |
| Açaí-preto | Palmito de mantequilla | |
| Açaí-solitário | Palmito vermelho | |
| Açaizeiro | Porámo | |
| Acaizinho | Reho | |
| Anku (Panare) | Speri (Piro) | |
| Aqai | Ternera | |
| Arimkwe | Tsaperiki ~tsapiri (Apurinã) | |
| Asaí de catinga | Uése (Caribs) | |
| Asaí de sabana | | |
| Asai palm | | |
| Asai paso | | |
| Assai chumbinho | | |
| Assai cubinha | | |
| Assai de caatinga | | |
| Assay da terra firme | | |
| Azaí | | |
| Cabbage palm | | |
| Cañaa lucia | | |
| Caruto | | |
| Chontilla | | |
| Guajo (Yekuana), | | |
| Guasai | | |
| Guasai pequeño | | |
| Guayaquil | | |
| Guypani | | |
| Heart-of-palm | | |
| Hicara | | |
| Huasai | | |
| Huasai de varillal | | |
| Iça-iça | | |
| ini-bue (Siona) | | |
| Jiçara | | |
| Juçara | | |
| Jussara | | |
| Maizpépe | | |
| Manac | | |
| Manaca | | |
| Manaca palm | | |
| Ma-na-cay (Guahibo) | | |
| Mapora | | |
| Mihpi- tahtaboakasé (Tukano) | | |

| | | |
|---|---|---|
| Mountain cabbage | | |
| Ne-e-da (Huitoto) | | |
| Nenea | | |
| Nomkie muruku pina, | | |
| Palanca | | |
| Palmbil | | |
| Palmicho | | |
| Palmist | | |
| Palmita | | |
| Palmiteiro | | |
| Palmiteiro-juçara | | |
| Palmito | | |
| Palmito branco | | |
| Palmito doce | | |
| Palmito manaca | | |
| Palmito verde | | |
| Palmo real | | |
| Pamiwa | | |
| Panabi (Chdcobo) | | |
| Prasara | | |
| Rayhoo | | |
| Ripeira | | |
| Sadke (Shuar) | | |
| Sech | | |
| Tunci sake | | |
| White-Açaí | | |
| Yisa (Esse Eja) | | |