Extinction of New World mega-frugivores disrupts the fruit size-body size relationship in palms and mammals

Journal:	*Global Ecology and Biogeography*
Manuscript ID	Draft
Manuscript Type:	Research Papers
Date Submitted by the Author:	n/a
Complete List of Authors:	Göldel, Bastian; Aarhus University, Department of Bioscience Kissling, W.; University of Amsterdam, Institute for Biodiversity and Ecosystem Dynamics, IBED. Faurby, Søren; Museo Nacional de Ciencias Naturales, CSIC, Department of Biogeography and Global Change; University of Gothenburg, Department of Biological and Environmental Sciences Svenning, Jens-Christian; Aarhus University, Department of Bioscience
Keywords:	Arecaceae, evolutionary co-variation, functional diversity, megafauna extinction, plant-animal interaction, plant functional traits, Quaternary climate change, seed dispersal

Extinction of New World mega-frugivores disrupts the fruit size-body size relationship in palms and mammals

Bastian Göldel[1]*, W. Daniel Kissling[2], Søren Faurby[3,4] and Jens-Christian Svenning[1]

[1]Section for Ecoinformatics and Biodiversity, Department of Bioscience, Aarhus University, Ny Munkegade 114, 8000 Aarhus C, Denmark

[2]Institute for Biodiversity and Ecosystem Dynamics (IBED), University of Amsterdam, P.O. Box 94248, 1090 GE Amsterdam, The Netherlands

[3]Department of Biogeography and Global Change, Museo Nacional de Ciencias Naturales, CSIC, Calle José Gutiérrez Abascal 2, 28006 Madrid, Spain

[4]Department of Biological and Environmental Sciences, University of Gothenburg, SE 40530 Gothenburg, Sweden

E-mails: wdkissling@gmail.com (WDK); soren.faurby@bios.au.dk (SF); svenning@bios.au.dk (JCS)

***Correspondence:** Bastian Göldel; Department of Bioscience, Aarhus University, Ny Munkegade 114, 8000 Aarhus C, Denmark. E-mail: bastian.goeldel@bios.au.dk

Keywords: Arecaceae**,** evolutionary co-variation, functional diversity, megafauna extinction, plant-animal interaction, plant functional traits, Quaternary climate change, seed dispersal

Running title: Megafaunal frugivores and palms

Number of words in Abstract: 300

Number of words in main body: 5825 *(through Biosketch)*

Number of references: 50

ABSTRACT

Aim: Megafauna extinctions can have cascading consequences for food webs and plant-animal interactions, but detailed knowledge at biogeographical scales is scarce. Here, we quantify the relationship between palm (Arecaceae) fruit sizes and body sizes of frugivorous mammals while simultaneously controlling for environmental conditions, and highlight biogeographic differences in the potential impacts of lost frugivores.

Location: Global

Methods: We combined palm distributions with palm fruit sizes, and distributions of frugivorous mammals with body sizes, to quantify geographic trait variation at global and biogeographical scales. Furthermore, we added estimated range losses of present and extinct mammals during the late Quaternary. We then used structural equation models and spatial regressions to assess the relationships between average mammal body sizes and average palm fruit sizes while accounting for differences in environment (current climate, soil texture, net primary productivity, and Quaternary glacial–interglacial climate change).

Results: Positive associations between palm fruit sizes and current mammal body sizes were found globally and in the Old World, but not in the New World (i.e. the Americas including the Caribbean islands). A positive relationship between fruit size and present and extinct mammalian body sizes was found in global, Old World and New World analyses.

Main conclusions: In the New World, the spatial pattern of palm fruit size distributions has been largely preserved despite the Late Pleistocene and Holocene loss of megafaunal mammals. Hence, the current geographic co-variation in functional traits of New World palms and mammalian frugivores does not reflect any co-variation over deep time scales. We suggest that the continued presence of large-fruited palms in areas with lost megafauna could result from abiotic and biotic seed dispersal services of substitute dispersers (e.g. scatter-hoarding rodents, introduced livestock, and humans) which might allow short-distance dispersal and survival of megafauna-dependent fruit species despite the extinction of the major seed dispersers.

INTRODUCTION

Consistent with the arrival of the ancestors of the Native Americans in the New World ~10.000 years ago, a very large number of species of the Pleistocene megafauna —such as gomphotheres, giant sloths and toxodonts— were lost to extinction (Barnosky *et al.*, 2004; Bakker *et al.*, 2015). In both North and South America every member of the formerly highly diverse guild of herbivores >1000 kg went extinct even though both continents used to house even more such species than currently occur in Africa (Sandom *et al.*, 2014; Faurby & Svenning, 2015). Recent studies suggest that these megafauna extinctions might have caused strong shifts and changes in the geographic distributions of other species and ecosystems (Janzen & Martin, 1982; Guimarães *et al.*, 2008). For instance, large herbivores can control the abundance of woody plants, and their absence might therefore result in shifts of woody cover and landscape structure as well as changes in plant species composition, soil fertility and biogeochemical cycling (Bakker *et al.*, 2015; Doughty *et al.*, 2015b; Svenning *et al.*, 2015). Moreover, the loss of megafauna also represents a loss of large-bodied seed dispersers which might have strong effects on seed dispersal distances and the spatial and genetic structure of large-fruited trees (Barnosky *et al.*, 2004; Donatti *et al.*, 2007; Guimarães *et al.*, 2008; Beaune *et al.*, 2013). However, recent studies suggest that seed dispersal of megafaunal fruits might to some extent be substituted by other dispersers, including scatter-hoarding rodents and humans (Guimarães *et al.*, 2008; Jansen *et al.*, 2012). Whether these substitute dispersers can compensate for the loss of megafauna remains doubtful (Beaune *et al.*, 2013).

Vertebrate frugivory is a key plant-animal interaction, especially in tropical ecosystems (Fleming & Kress, 2013). Morphological and functional traits of both plants and frugivores play a key role in this plant-animal interaction (Guimarães *et al.*, 2008). Of particular importance is the relationship between fruit size and frugivore body size (Jordano, 2000; Lord, 2004) because only large-bodied frugivores are able to fully ingest and disperse large fruits (Guimarães *et al.*, 2008). The loss of large-bodied frugivores can therefore result in negative consequences for plant recruitment, population structure and geographic range dynamics (Guimarães *et al.*, 2008; Galetti *et al.*, 2013). In areas where large-seeded or large-fruited plants occur without present-day dispersers, the presence of large-fruited plant lineages might represent disrupted or anachronistic mutualisms with megafaunal species that have disappeared or have gone at least functionally (Janzen & Martin, 1982; Guimarães *et al.*, 2008; Galetti *et al.*, 2013; Federman *et al.*, 2016). For instance, the strong decline of elephants in Congo's tropical lowland forests has been shown to disrupt the seed dispersal of most megafauna-dispersed trees (Beaune *et al.*, 2013). Similarly, the elimination of the largest mammalian herbivores (elephants and rhinoceroses) from forests in tropical Asia has strongly reduced dispersal of megafauna-dispersed plants (Campos-Arceiz & Blake, 2011). Nevertheless, the consequences of megafauna disperser loss at large geographical scales are still little explored.

Palms (Arecaceae) are a key component of tropical and subtropical ecosystems (Henderson, 2002; Dransfield *et al.*, 2008; Kissling *et al.*, 2012b; Couvreur & Baker, 2013) and a model system for the ecology and evolution of tropical rainforests (Couvreur & Baker, 2013). They represent an important food source for a variety of frugivores (Zona & Henderson, 1989; Galetti *et al.*, 2006), especially frugivorous vertebrates such as birds and mammals (Fleming & Kress, 2013). Dispersal of palm seeds therefore almost exclusively depends on avian and mammalian frugivores (Zona & Henderson, 1989). For instance, several species of large-gaped toucans and cotingas are successful seed dispersers of the palm *Euterpe edulis* (Galetti *et al*., 2013) whereas tapirs are key dispersers of the palms *Mauritia flexuosa* (Fragoso & Huffman, 2000) and *Astrocaryum aculeatissimum* (Galetti *et al.*, 2006). Palm fruits vary widely in shape, surface texture and size (Dransfield *et al.*, 2008), but on average they are located at the upper limit of the seed and fruit size space of flowering plants (Tomlinson, 1990). Most palm species are 1-seeded (Tomlinson, 1990; Dransfield *et al.*, 2008) and fruit size can therefore be taken as a proxy for seed size (Tomlinson, 1990; Henderson, 2002). Diameters of palm fruits often vary between 0.5 and 2.5 cm, but many palms also have larger fruits that can be classified as megafaunal fruits, i.e., at least 4 cm in length (Guimarães *et al.*, 2008). Overall, the relationship between palm fruit sizes and geographic distributions of animal dispersers remains little explored (Zona & Henderson, 1989; Kissling *et al.*, 2012a).

Besides biotic interactions among frugivores and their food plants, various environmental and historical drivers are likely to have shaped the distribution of functional traits of fleshy-fruited plants across broad spatial scales (Donatti *et al.*, 2007). For instance, contemporary temperature and precipitation (Swenson & Weiser, 2010), seasonality (Göldel *et al.*, 2015) and soil conditions (Tautenhahn *et al.*, 2008) can show a strong relationship with plant trait distributions at macro-ecological scales. Such environmental effects might also be indirect (Kissling *et al.*, 2008), e.g. if present-day climate affects consumer and resource diversity via productivity and human impact (Sandom *et al.*, 2013). Moreover, historical factors such as past climate change may also affect the spatial distribution of fruit and seed sizes. For instance, Quaternary glacial-interglacial climate oscillations can explain a large proportion of the palm fruit size distributions in the New World (Göldel *et al.*, 2015). Moreover, compared to the New World the Old World tends to harbor fewer small-fruited plant species (Mack, 1993). This might be related to Cenozoic drying, as large seed masses enable seedlings to better survive hazards such as drought (Kissling *et al.*, 2012a). Alternatively, this might also be caused by differences in body sizes of frugivorous dispersers (Mack, 1993). A key challenge is therefore to disentangle the direct and indirect biotic and abiotic effects on functional trait distributions across broad spatial extents.

Here, we focus on the relationship between palm fruit sizes and body sizes of mammalian frugivores at global and biogeographic scales. We quantify this relationship and simultaneously control for present and historical environmental predictor variables, incl. current climate, soil

conditions, net primary productivity, and Quaternary glacial-interglacial climate change. Specifically, we test whether the geographic distribution of palm fruit sizes is related to the current distribution of mammal body sizes, and to what extent megafaunal extinctions and range contractions in the Late Pleistocene and early Holocene might have disrupted this relationship (Barnosky *et al.*, 2004). To our knowledge, no study has yet quantified the relationship between fruit sizes of a tropical plant lineage and current and extinct frugivores across such broad spatial extents. In detail, we test following predictions:

1) Fruit sizes of palm assemblages at a global scale are positively related to body sizes of current mammal assemblages, with large average fruit sizes coinciding with large mammal body sizes, even when accounting for contemporary and Quaternary environmental conditions.

2) Within major biogeographic realms (e.g. New World, Western Old World, Eastern World), we expect a positive relationship between palm fruit sizes and body sizes of current mammal assemblages, but only in regions where large-bodied megafauna is still abundant today (e.g. Africa).

3) When adjusting for megafauna range losses and extinctions, a positive relationship between palm fruit sizes and body sizes of mammal assemblages should be evident in all regions.

METHODS

Palm data

Presence-absence data for all palm species (n = 2467) were obtained from the world checklist of palms (Govaerts & Dransfield, 2005; downloaded May 2012). The coconut *Cocos nucifera* and the coco de mer *Lodoicea maldivica* have fruits that are not dispersed by animals (Tomlinson, 1990; Henderson, 2002) and were therefore deleted from the dataset. The presence-absence data are recorded at a spatial resolution of so-called 'botanical countries' (level 3 units) as defined by the International Working Group on Taxonomic Databases (TDWG). These TDWG units correspond mainly to political countries, but also divide large countries (e.g. Australia, Brazil, China, United States) into smaller regions. They also occasionally combine political divided areas (e.g. Borneo and New Guinea) or ignore tiny political states with minor geographic importance (e.g. Vatican City). Out of a total of 368 TDWG units, we included the 187 units in which at least one palm species occurred. We also run analyses by including only units with species richness ≥2 (n = 153), but results were qualitatively similar and we therefore present the analyses for the full dataset (n = 187 units).

Data on fruit sizes of palm species were extracted from the primary literature, monographs, species descriptions, and herbaria, including the Aarhus University Herbarium the herbarium of the Royal Botanic Gardens Kew and the e-monocot database from Royal Botanic Gardens Kew (http://e-monocot.org/). To quantify fruit size for each species, we used reported measurements of average fruit length (rather than width or diameter) as this was the most consistently recorded fruit size trait in the literature. Out of the 2467 species, a total of 1800 species had data on average fruit sizes available from the literature sources. Table S1 in Appendix S1 provides information on the literature used to record fruit size values for each of the species. In case of missing trait values, we used the mean of congeners to estimate the value for the missing species. This was done for 669 species. A detailed overview of the mean trait values per genus as well as the number of species with estimated traits in each genus is provided in Table S2 (Appendix S1). Based on all species-level fruit sizes, we computed mean fruit sizes across all species that are present in each of the 187 TDWG units (see Fig. 1). These assemblage-level means of palm fruit sizes in TDWG units were then used as response variables in the statistical analyses (see below).

Mammal data

We quantified the spatial distribution of current frugivorous mammals using the taxonomy and geographic range maps compiled by the IUCN Global Mammal Assessment 2012 (http://www.iucnredlist.org/). Diet preferences for current mammals were obtained from the MammalDiet dataset (Kissling *et al.* (2014). Out of a total of 5364 terrestrial mammal species, 1950 are frugivorous, i.e. species which have fleshy fruits as a preferred diet (Kissling *et al.*, 2014). We then

intersected the range maps of the frugivorous mammals with the TDWG level 3 units and retained the 1806 frugivorous mammals which occurred within the botanical countries where palms are present. To quantify historical mammal distributions we used the dataset from Faurby and Svenning (2015), which estimates the geographic ranges of all late Quaternary mammalian species as they would have been under present climate in the absence of past or present impacts by *Homo sapiens*. We refer to these geographic ranges as 'present-natural ranges' (following Faurby and Svenning (2015)). We acknowledge that other non-flying dispersers like tortoises and ratite birds could potentially be important functional analogous to mammalian dispersers, but data on their present-natural distribution is not available and we therefore did not include these groups. In detail, we estimated the present-natural ranges from 691 current and 93 extinct frugivorous species at the resolution of TDWG level 3 units. Combined with current frugivorous mammals, this included a total of 1899 mammal species in the dataset of the present-natural mammal distributions. For diet information of extinct mammals we assessed that the groups of herbivores and omnivores are most likely represent (palm) fruit and seed dispersers. We then added information on current and present-natural mammal body sizes (Faurby & Svenning, 2016) and calculated the mean body size over all frugivorous mammal species within each palm TDWG units (Table 1). We chose the mean over the median because the richness of extinct megafauna was rather low (Sandom *et al.*, 2013; Faurby & Svenning, 2015) and we aimed to emphasize the effect of large mammalian frugivores.

Additionally, to assess whether there are differences among all current frugivores (n = 1806), fruit specialists (n = 1578), partial frugivores (n = 194) and opportunists (n = 34) we re-did the global and biogeographical analyses for these groups separately as a sensitivity-analysis.

Environmental data

To account for environmental variation at the level of TDWG units we included data on current climate (three predictor variables), paleoclimate (two variables), soil (one variable) and net primary productivity (one variable) (Table 1). All environmental variables were calculated in ArcGIS (version 10.1, ESRI, Redlands, CA, USA).

Current climate

To represent current climate we used six climate variables from the WORLDCLIM database (version 1.4; http:// www.worldclim.org), a set of global climate layers with a spatial resolution of *c.* 1 km^2 (Hijmans *et al.*, 2005). We chose mean annual precipitation, precipitation seasonality, mean annual temperature, temperature seasonality, temperature of the coldest quarter, and precipitation of the driest quarter. These variables have been shown to be important drivers of functional trait distributions in palms and other plant families (Swenson & Weiser, 2010; Göldel *et al.*, 2015). We performed a Principal Component Analysis (PCA) to reduce collinearity among these climatic variables. PCAs were done separately for the global and the analyses of the biogeographic realms. We retained the first

three PCA axes (PC-PREC, PC-TEMP, PC-SEAS) in all analyses (Table 1), which together each time explained >90% of the variability within the data.

Soil

To quantify soil conditions, we used data from the ISRIC - World Soil Information (http://soilgrids.org/ page), a soil dataset with a resolution of 1 km (Hengl *et al.*, 2014). We chose the percentage of sand in 45 cm soil depth as a predictor variable (SOIL) because palms often form short roots (Dransfield *et al.*, 2008) and water availability strongly depends on the fraction of sand (Ritchie, 1981). We calculated the mean value for sand fraction for each TGWD unit.

Net primary productivity

As a measure of productivity, we used net primary productivity (NPP, measured in $gC/m^2/yr$) as provided by the Moderate Resolution Imaging Spectral radiometer (MODIS) data at 1-km resolution (Zhao *et al.*, 2005) and calculated mean values were calculated per TDWG.

Paleoclimate

We calculated the differences in temperature and precipitation (anomalies) between the Last Glacial Maximum (LGM; c. 21,000 years ago) and the present to represent Quaternary climate change. For temperature, these anomalies cover the full glacial-interglacial climate cycle with a geographic pattern that is consistent with these orbitally-driven climatic oscillations over at least the 10–100 thousand years (Jansson, 2003). We used mean annual temperature and annual precipitation to compute the anomaly of temperature (LGM TEMP, in °C) and the anomaly of precipitation (LGM PREC, in mm $year^{-1}$), respectively. We used two climate simulations for the LGM (the Community Climate System Model version 3, CCSM3, and the Model for Interdisciplinary Research on Climate version 3.2, MIROC3.2) from the Paleoclimate Modeling Intercomparison Project (PMIP2; http://pmip2.lsce.ipsl.fr/) to quantify these paleoclimatic changes (Braconnot *et al.*, 2007), and used the mean values across both simulations. LGM data were resampled with a bilinear interpolation from the original 2.5″ resolution to the resolution of the contemporary climate data. Higher temperature and precipitation in the past than in the present is reflected by small (temperature) or negative (precipitation) anomaly values, whereas high anomaly values represent a higher temperature and precipitation in the present than in the past.

Statistical analysis

We used Structural Equation Models (SEMs) to test our hypotheses. The procedure followed general guidelines and previous studies using SEMs (Grace *et al.*, 2012; Sandom *et al.*, 2013). In our first hypothesis, we expected fruit sizes of palm assemblages at a global scale to be positively related to current mammal body sizes, with large average fruit sizes coinciding with large mammal body sizes. We started our modeling processes with an a priori SEM which included all hypothesized pathways among all predictor variables. Hence, we examined direct and indirect effects of biotic and abiotic drivers (PC-PREC, PC-TEMP, PC-SEAS, SOIL, LGM TEMP and LGM PREC) on our three response variables (palm fruit size, mammal body size and NPP). In the next step, we evaluated model modification indices, model fits and residual correlations. We used the chi-square test, the root mean square error of approximation (RMSEA), and the comparative fit index (CFI) to measure model fit. To ensure an adequate fit of SEMs we used the following criteria: P-values of chi-square tests > 0.05, CFI > 0.90 and confidence intervals of RMSEA < 0.05 (Grace *et al.*, 2012). Missing paths within the model were identified from large residuals and high modification indices and deleted from the SEM. The path with the least statistical significance was deleted from the model. Afterwards we developed a new model without the deleted path and identified again the least statistically significant path. We repeated these steps until our final model only consisted of statistically significant pathways (at $P < 0.05$). For the first hypothesis the final SEM is shown in Fig. 2.

Based on our second hypothesis we expected a positive relationship between palm fruit sizes and current mammal body sizes in regions where large-bodied megafauna is still abundant today (e.g. Africa), but not where it is mainly extinct (e.g. New World). To test this hypothesis we built separate SEMs for each of the biogeographical realms as defined by TDWG: New World (Americas: $n = 61$ TDWG units), Eastern Old World (e.g. Australasia, Indomalay: $n = 62$) and Western Old World (Africa, Europe: $n = 64$) (see map in Appendix S2, Fig. S1). These realms are characterized by a unique species composition due to long-term geographic isolation and dispersal limitation. A finer subdivision into more biogeographic regions was not sensible because sample sizes (i.e. number of TDWG units) of several regions became too small for statistical analysis. To analyze our third hypothesis we included geographic range losses and megafauna extinctions of mammals and built SEMs on a global scale and for each biogeographical realm. We hypothesized a positive relationship between palm fruit sizes and body sizes of mammal assemblages within all biogeographical realms. For all the biogeographically divided SEMs (current and present-natural), climate PCA axes were calculated separately for each biogeographical realm. The analysis of these SEMs was performed as described above for the global SEM of current mammals.

As spatial autocorrelation can affect significance tests and coefficients estimates of statistical models (Legendre & Legendre, 1998; Kissling & Carl, 2008), we assessed the extent of spatial autocorrelation by calculating Moran's *I* values on the residuals of non-spatial multiple regression

models (ordinary least squares, OLS). As standardized coefficients from the OLS models are equivalent to the path coefficients of the SEMs, they enable a direct comparison of the spatial autocorrelation between the spatial and non-spatial models (Kissling *et al.*, 2008). We used the same variables as in the SEMs and computed correlograms of the OLS model residuals (Kissling & Carl, 2008; Kissling *et al.*, 2008). We further fitted simultaneous autoregressive (SAR) models of the error type to allow the inclusion of the residual spatial autocorrelation of OLS model (Kissling & Carl, 2008). The spatial weights matrix was defined using the minimum distance that linked each occupied TDWG unit to at least one other occupied unit (2072 km). To identify the extent of spatial autocorrelation we used correlograms and quantified the spatial autocorrelation in the raw data response variables, the residuals of the non-spatial OLS and the SAR models. The standardized coefficients from the SAR models were similar to those of the OLS models. We therefore focus on the spatial path coefficients from the SARs throughout the manuscript.

For all analyses with current and present-natural frugivores the predictor variables were checked for normal distribution, both globally and separately for each biogeographical realm. Furthermore, univariate relationships of both mean mammal body size and palm fruit size with all predictor variables were tested to check for non-linear responses. The response and predictor variables for palm fruit size, mammal body size and LGM PREC were $\log_{10}$ transformed. All statistical analyses were conducted with R version 3.0.1 (R Core Team, 2013). The SEMs were calculated using the package 'lavaan' version 0.5-18 (2015, Y. Rosseel). The correlograms were calculated using the ncf package. The spatial weight matrices of the SARs and the Moran's I values were calculated using the R package 'spdep' version 0.5-71 (2014, R. Bivand).

RESULTS

Overall, the highest assemblage-mean values for palm fruit sizes were found in Africa, while intermediate sizes were found for South America and Asia, and low values for Australasia, Northern and Central America (Fig. 1). Consistent with large fruit sizes, current mammal body sizes were highest in Africa, followed by Eastern Asia and low values within the New World and Australasia. Including the natural ranges of extinct and current mammal species ('present-natural'), the highest mammal body sizes were found in Africa, closely followed by the Americas, and lowest values in the eastern Old World.

In line with the first hypothesis, we found a global, positive relationship between palm fruit size assemblages and current mammal body sizes using SEMs (standardized path coefficient = 0.324, $P < 0.001$; Fig. 2), indicating that areas with large average fruit sizes coincide with large body sizes of mammalian frugivores. Assemblage palm fruit sizes were also related to LGM TEMP (coeff. = 0.476) and PC-SEAS (coeff. = 0.394), indicating that palm fruit sizes are on average larger in areas with strong Quaternary temperature oscillations and seasonal climates. Overall, the environmental and biotic predictor variables within our global SEM explained a rather large amount of the variation in assemblage-level mean fruit sizes of palms ($R^2 = 0.431$).

To test the second hypothesis we quantified the relationship between average palm fruit sizes and current mammal body sizes separately for the three main biogeographical realms, and found a positive relation for two of them (western Old World and eastern Old World; Fig. 3; Fig. S1 in Appendix S2). The only biogeographical realm in which we did not find any relationship between palm fruit size and body size was the New World (Fig. 3). Notably, the strongest relationship was found for the western Old World (coeff. = 0.421, $P < 0.001$), with a weaker relationship in the eastern Old World (coeff. = 0.318, $P = 0.004$). Furthermore, there were direct effects of LGM TEMP in all three biogeographical realms, and NPP (New World and western Old World), PC-SEAS (New World and eastern Old World), and SOIL (western and eastern Old World) in two of them. In contrast, PC-PREC (New World), PC-TEMP and LGM PREC (western Old World) only showed significant effects in one realm (Fig. 3, Fig.4, Fig. S1 in Appendix S2).

The third hypothesis predicted a consistent positive relationship between palm fruit sizes and mammal body sizes at a global scale as well as within all three biogeographical realms when adjusting for megafauna range losses and extinctions. This prediction was confirmed both globally (coeff. = 0.393, $P < 0.001$; Fig. S1 in Appendix S2) as well as for all three regions, including the New World (coeff. = 0.398, $P < 0.001$; Fig. 4). The strongest relationship was again found for the western Old World (coeff. = 0.432, $P < 0.001$, see Fig. S1 in Appendix S2), with the weakest now for the eastern Old World (coeff. = 0.319, $P = 0.003$, Fig. S1 in Appendix S2).

The sensitivity analysis revealed similar relationships between palm fruit sizes and mammal body sizes for current frugivores, fruit specialists, partial frugivores and opportunists, with the strongest relationship for the group of opportunists (see Fig. S2, Appendix S2).

DISCUSSION

Palms provide important food sources for frugivorous animals throughout the tropics and at the same time depend on these animals for seed dispersal (Zona & Henderson, 1989; Galetti *et al.*, 2006). Such mutualistic interactions could imply that palms and frugivores exhibit functional co-adaptations. We quantified the relationships between palm fruit sizes and body sizes of frugivorous mammals worldwide and within the major biogeographic realms. Providing strong support for a functional relationship between palms and frugivores, our analyses revealed positive associations between palm fruit sizes and current mammal body sizes globally and within the Old World. However, this relationship did not occur in the New World. The warmer, palm-inhabited parts of the New World have experienced massive megafaunal extinctions within the last 13,000–5,000 years, with much smaller losses than in Sub-Saharan Africa and South-East Asia (Barnosky *et al.*, 2004; Sandom *et al.*, 2014). Hence, current patterns in the distribution of palms and frugivores in the New World might not reflect their long-term evolutionary and functional co-variation. We found strong support for this scenario, with a clear palm-frugivore trait relationship emerging in the New World after accounting for the Late Pleistocene and Holocene megafauna extinctions and range contractions.

Previous studies at continental scales have highlighted the importance of disperser body size for the dispersal of large fruits (Lord, 2004; Guimarães *et al.*, 2008). For several large-fruited palm species (e.g. *Attalea geraensis*, *Borassus aethiopium*, *Astrocaryum aculeatissimum*), large frugivorous mammals such as elephants (*Elephas maximus*, *Loxodonta* spp.), tapirs (*Tapirus* spp.), and chimpanzees (*Pan troglodytes*) are disproportionately important for successful seed dispersal (Zona & Henderson, 1989; Fragoso & Huffman, 2000; Donatti *et al.*, 2007). Although tight co-evolutionary adaptations between individual plant and frugivore species are rare, generalized interactions of mutualistic partners driven by key functional traits such as fruit size and consumer body size are increasingly recognized in plant-frugivore mutualisms (Donatti *et al.*, 2011; Fleming & Kress, 2013). This reflects that large animals are able to swallow large seeds, and they are more likely than small animals to deposit seeds away at greater distances from the parental plant, leading to greater establishment probabilities (Guimarães *et al.*, 2008). Our results show that the geographic distribution of fruit sizes and mammal consumer body sizes are interlinked at a global scale, at least for this pantropical, fleshy-fruited keystone plant family.

In addition to consumer body sizes, our results show that current climate and Quaternary climate change, both directly as well as indirectly via mammal body size and NPP, affect the distribution of assemblage-mean palm fruit sizes at global and continental scales. Notably, we found large average fruit sizes being associated with currently warm conditions, high precipitation seasonality, and unstable Quaternary climates, especially in areas such as continental Africa and the South American Cerrado. This could be driven by large mammals being more abundant in areas with

seasonal climates, such as savannahs and open forests (Doughty *et al.*, 2015a). Notably, in unstable climates the post ice-age expansions of large frugivores might be particularly important, and hence intensify the consequences of disperser extinctions for palms. Additionally, our findings are consistent with palm fruit size patterns across the New World (Göldel *et al.*, 2015) and tropical Africa (Kissling *et al.*, 2012a). The latter region is dominated by large-fruited palms which might be at least partly driven by the long-term exposure to the strong drying during the Cenozoic (Kissling *et al.*, 2012a). The relatively large assemblage-level mean fruit sizes in areas with seasonal droughts and long-term unstable conditions may furthermore be explained by a greater sensitivity of small-seeded species to such climatic stresses (Chazdon, 1991). Phylogenetic clustering of palm assemblages is also stronger in areas with greater long-term climate instability and might reflect that large fruits are concentrated in certain clades, due to filtering by past and present harsh environmental conditions (Kissling *et al.*, 2012a).

The relationship of average palm fruit sizes and current mammal body sizes differed among the three biogeographical realms. Notably, areas in the Old World (both western and eastern parts) exhibit strong relationships between palm fruit size and body size of frugivorous mammals, while this was not evident for the New World. Present-day Africa still harbors most of its megafauna. Nevertheless, range losses in large mammals is an ongoing process in many regions (Bakker *et al.*, 2015), e.g., affecting elephants, buffalos and rhinos, which serve as major long-distance seed dispersers of large-fruited palm species (e.g. *Borassus* spp., *Elaeis guineensis*) (Zona & Henderson, 1989; Beaune *et al.*, 2013). In tropical Asia, elephants, rhinos and tapirs are important palm seed dispersers (Zona & Henderson, 1989; Campos-Arceiz & Blake, 2011). In contrast, the Americas today contain a high species richness of small-bodied frugivorous mammals, but fewer large-bodied frugivores than in the Old World, although tapirs and peccaries still serve as megafauna frugivores (Janzen & Martin, 1982; Donatti *et al.*, 2007). Although the New World harbored an even higher species richness of large mammals in the recent past than Africa (Bakker *et al.*, 2015; Faurby & Svenning, 2015), massive megafaunal extinctions occurred after the immigration of humans into the region in the latest Quaternary (Barnosky *et al.*, 2004; Sandom *et al.*, 2014). Although the ultimate causes (e.g. climate vs. humans) of these megafaunal extinctions are still debated (Hubbe *et al.*, 2013; Sandom *et al.*, 2014), the consequences for plant-animal interactions at regional and continental scales are little explored empirically.

We found strong evidence that the loss of large-bodied frugivores contributed to a missing palm-frugivore trait relationship at biogeographic scales, as a clear positive relationship emerged also for the New World after accounting for the Late Pleistocene and Holocene megafauna extinctions and range contractions. Our results support the idea proposed by Janzen and Martin (1982) that large Neotropical fruits were evolved for dispersal with the former megafauna, which may better explain the existence of Neotropical, megafaunal fruits than the existing present-day frugivores. It may seem a

mystery how large-fruited plant species adapted for megafauna dispersal still remain and have not suffered extinction after the loss of most of their megafaunal dispersers in the early Holocene (Hubbe *et al.*, 2013). However, population declines and range contractions in large-seeded trees are likely to occur at slow rates even if dispersal effectiveness is dramatically decreased, mostly because large-seeded trees often have long generation times and small animals may still provide some dispersal services (Donatti *et al.*, 2007; Guimarães *et al.*, 2008; Doughty *et al.*, 2015a). Notably, after the extinction of megafauna, other biotic and abiotic factors could allow for some amount of successful dispersal (Guimarães *et al.*, 2008). For instance, abiotic dispersal by water or gravity, or biotic substitute dispersers could act as alternative dispersal vectors (Guimarães *et al.*, 2008; Jansen *et al.*, 2012). Furthermore, humans and scatter-hoarding rodents may sometimes disperse large-fruited tree species (Jansen *et al.*, 2012). Nevertheless, large-fruited palm species, for example *Attalea rostrata*, *Acrocomia aculeata* and *Bactris major*, might be suffering range contractions or at least reduced postglacial range expansions due to the past losses of megafaunal dispersers (Janzen & Martin, 1982; Guimarães *et al.*, 2008).

Several aspects in the relationship between fruit sizes and consumer body sizes of animal-dispersed plants and their vertebrate counterparts require further scrutiny in future studies. For instance, we analyzed coarse geographic units (TWDG 'botanical countries') and could not assess the consequences of mammal range contractions for palms at finer spatial resolutions. Severe consequences have been suggested for several palm species (e.g. *Astrocaryum aculeatissimum*, *Attalea phalerata*, *Iriartea deltoidea*), suffering disperser losses due to the ongoing human-driven defaunation of tropical forests (Galetti *et al.*, 2006). The loss of large-bodied frugivores from forest fragments in Brazil have even led to rapid (<100 years) changes in fruit sizes (Galetti *et al.*, 2013). Nevertheless, model simulations suggest that effects of megafaunal extinctions on population structures of fleshy-fruited trees may take substantially longer than 10,000 years to fully unroll (Doughty *et al.*, 2015a). Another aspect is the role of birds (rather than mammals) for the seed dispersal of large-fruited palm species worldwide (Zona & Henderson, 1989; Galetti *et al.*, 2013). Since most birds are not able to chew and bite palm fruits, they rely on swallowing whole fruits. This makes them more restricted to comparably smaller fruit sizes than megafaunal mammals. This reduces the role of birds as dispersers of megafaunal fruits, with mammals playing the major role (Lord, 2004; Donatti *et al.*, 2011).

Due to the ongoing rapid defaunation of tropical forests (Dirzo *et al.*, 2014), it is crucial to understand how past extinctions have influenced current plant-animal interactions, and how such knowledge can be used to predict future changes. Our findings could help to guide efforts in 'trophic rewilding', an attempt to introduce suitable species to re-establish top-down trophic interactions (Svenning *et al.*, 2015). One key aspect of trophic rewilding is to restore ecosystem functioning by re-establishing megafaunas in regions which have experienced massive anthropogenic megafauna losses (Galetti, 2004). To our knowledge, no rewilding experiments have yet been established which focus on

restoring mammalian megafauna-dispersal of large-fruited trees. Nevertheless, 'unintentional' rewilding of exotic animals (incl. feral pigs, cattle and horses) within Neotropical savannahs have already provided first insights including their role in re-establishing former ecosystems (Galetti, 2004; Svenning *et al.*, 2015). Broad-scale spatial analyses of plant-animal distributions in relation to interaction-relevant traits combined with paleo-ecological and historical studies and experimental evidence might therefore help to shed light on possibilities for conservation and trophic rewilding.

In conclusion, at biogeographic and global scales, large palm fruit sizes spatially coincide with large body sizes of frugivorous mammals, but only emerge in the New World after accounting for the massive Late Pleistocene and Holocene megafaunal extinctions in that region. This suggests that the broad spatial distributions of palm fruit sizes have been largely preserved despite the early Holocene loss of megafauna (Hubbe *et al.*, 2013). This could result from abiotic and biotic substitute dispersal services which might allow only short-distance dispersal, but may have been enough to maintain the broad-scale, coarse-grained distribution of palms. Overall, such studies provide new insights into how plant-animal interactions shape the broad-scale distribution of biodiversity across the world.

ACKNOWLEDGEMENTS

Our research was supported by the European Research Council (grant ERC-2012-StG-310886-HISTFUNC to J.-C.S.), the Danish Council for Independent Research–Natural Sciences (grant 11-106163 to W.D.K. and #4090-00227 to S.F.), the Netherlands Organisation for Scientific Research (grant 824.15.007 to W.D.K.), and the University of Amsterdam (starting grant to W.D.K.). We further acknowledge the international modelling groups for providing the LGM data for analysis and the Laboratoire des Sciences du Climat et de l'Environnement (LSCE) for collecting and archiving them. The PMIP2/MOTIF DataArchive is supported by CEA, CNRS, the EU Project MOTIF (EVK2-CT-2002-00153) and the Programme National d'Etude de la Dynamique du Climat (PNEDC). We also thank Aarhus University, the Department of Bioscience and several people for feedback and support to this study, notably Peder K. Bøcher, Alejandro Ordonez and Henrik Balslev.

Supplementary Material

BIOSKETCH

Bastian Göldel is interested in the geography and ecology of functional traits in palms, a keystone plant lineage within tropical and subtropical ecosystems. He aims to understand how ecological traits and ecosystem functioning vary across small and large spatial extents, and how this relates to biotic and abiotic environmental factors. The team of co-authors is broadly interested in macroecology and biogeography, sharing an interest in the role of biotic interactions and historical factors that shape broad-scale ecological patterns and dynamics.

REFERENCES

Bakker, E.S., Gill, J.L., Johnson, C.N., Vera, F.W.M., Sandom, C.J., Asner, G.P. & Svenning, J.-C. (2015) Combining paleo-data and modern exclosure experiments to assess the impact of megafauna extinctions on woody vegetation. *Proceedings of the National Academy of Sciences*, **113**, 847–855.

Barnosky, A.D., Koch, P.L., Feranec, R.S., Wing, S.L. & Shabel, A.B. (2004) Assessing the causes of Late Pleistocene extinctions on the continents. *Science*, **306**, 70–75.

Beaune, D., Fruth, B., Bollache, L., Hohmann, G. & Bretagnolle, F. (2013) Doom of the elephant-dependent trees in a Congo tropical forest. *Forest Ecology and Management*, **295**, 109–117.

Braconnot, P., Otto-Bliesner, B., Harrison, S., Joussaume, S., Peterchmitt, J.Y., Abe-Ouchi, A., Crucifix, M., Driesschaert, E., Fichefet, T., Hewitt, C.D., Kageyama, M., Kitoh, A., Laine, A., Loutre, M.F., Marti, O., Merkel, U., Ramstein, G., Valdes, P., Weber, S.L., Yu, Y. & Zhao, Y. (2007) Results of PMIP2 coupled simulations of the Mid-Holocene and Last Glacial Maximum - Part 1: experiments and large-scale features. *Climate of the Past*, **3**, 261–277.

Campos-Arceiz, A. & Blake, S. (2011) Megagardeners of the forest–the role of elephants in seed dispersal. *Acta Oecologica*, **37**, 542–553.

Chazdon, R.L. (1991) Plant size and form in the understory palm genus *Geonoma*: are species variations on a theme? *American Journal of Botany*, **78**, 680–694.

Couvreur, T.L.P. & Baker, W.J. (2013) Tropical rain forest evolution: palms as a model group. *BMC biology*, **11**, 48.

Dirzo, R., Young, H.S., Galetti, M., Ceballos, G., Isaac, N.J.B. & Collen, B. (2014) Defaunation in the Anthropocene. *Science*, **345**, 401–406.

Donatti, C.I., Galetti, M., Pizo, M.A., Guimaraes Jr., P.R. & Jordano, P. (2007) *Living in the land of ghosts: fruit traits and the importance of large mammals as seed dispersers in the Pantanal, Brazil. Seed dispersal: theory and its application in a changing world*. Cabi Publishing, Cambridge.

Donatti, C.I., Guimarães, P.R., Galetti, M., Pizo, M.A., Marquitti, F. & Dirzo, R. (2011) Analysis of a hyper-diverse seed dispersal network: Modularity and underlying mechanisms. *Ecology Letters*, **14**, 773–781.

Doughty, C.E., Faurby, S. & Svenning, J.-C. (2015a) The impact of the megafauna extinctions on savanna woody cover in South America. *Ecography*, **39**, 213–222.

Doughty, C.E., Roman, J., Faurby, S., Wolf, A., Haque, A., Bakker, E.S., Malhi, Y., Dunning, J.B. & Svenning, J.-C. (2015b) Global nutrient transport in a world of giants. *Proceedings of the National Academy of Sciences*, **113**, 868–873.

Dransfield, J., Uhl, N.W., Asmussen, C.B., Baker, W.J., Harley, M.M. & Lewis, C.E. (2008) *Genera palmarum: The Evolution and Classification of Palms.* Royal Botanic Gardens, Kew.

Faurby, S. & Svenning, J.-C. (2015) Historic and prehistoric human-driven extinctions have reshaped global mammal diversity patterns. *Diversity and Distributions*, **21**, 1155–1166.

Faurby, S. & Svenning, J.-C. (2016) Resurrection of the island rule–human-driven extinctions have obscured a basic evolutionary pattern. *American Naturalist*, **187**, 812–820.

Federman, S., Dornburg, A., Daly, D.C., Downie, A., Perry, G.H., Yoder, A.D., Sargis, E.J., Richard, A.F., Donoghue, M.J. & Baden, A.L. (2016) Implications of lemuriform extinctions for the Malagasy flora. *Proceedings of the National Academy of Sciences*, **113**, 5041–5046.

Fleming, T.H. & Kress, W.J. (2013) *The ornaments of life: coevolution and conservation in the tropics*. University of Chicago Press, Chicago.

Fragoso, J.M.V. & Huffman, J.M. (2000) Seed-dispersal and seedling recruitment patterns by the last Neotropical megafaunal element in Amazonia, the tapir. *Journal of Tropical Ecology*, **16**, 369–385.

Galetti, M. (2004) Parks of the Pleistocene: recreating the Cerrado and the Pantanal with megafauna. *Natureza and Conservacao*, **2**, 93–100.

Galetti, M., Donatti, C.I., Pires, A.S., Guimaraes, P.R. & Jordano, P. (2006) Seed survival and dispersal of an endemic Atlantic forest palm: the combined effects of defaunation and forest fragmentation. *Botanical Journal of the Linnean Society*, **151**, 141–149.

Galetti, M., Guevara, R., Côrtes, M.C., Fadini, R., Von Matter, S., Leite, A.B., Labecca, F., Ribeiro, T., Carvalho, C.S., Collevatti, R.G., Pires, M.M., Guimarães Jr., P.R., Brancalion, P.H., Ribeiro, M.C. & Jordano, P. (2013) Functional extinction of birds drives rapid evolutionary changes in seed size. *Science*, **340**, 1086–1090.

Göldel, B., Kissling, W.D. & Svenning, J.C. (2015) Geographical variation and environmental correlates of functional trait distributions in palms (Arecaceae) across the New World. *Botanical Journal of the Linnean Society*, **179**, 602–617.

Govaerts, R. & Dransfield, J. (2005) *World checklist of palms*. Royal Botanic Gardens, Kew.

Grace, J.B., Schoolmaster, D.R., Guntenspergen, G.R., Little, A.M., Mitchell, B.R., Miller, K.M. & Schweiger, E.W. (2012) Guidelines for a graph-theoretic implementation of structural equation modeling. *Ecosphere*, **3**, 1–44.

Guimarães, P.R., Galetti, M. & Jordano, P. (2008) Seed dispersal anachronisms: rethinking the fruits extinct megafauna ate. *PLoS One*, **3**, e1745.

Henderson, A. (2002) *Evolution and Ecology of Palms*. New York Botanical Garden Press.

Hengl, T., de Jesus, J.M., MacMillan, R.A., Batjes, N.H., Heuvelink, G.B.M., Ribeiro, E., Samuel-Rosa, A., Kempen, B., Leenaars, J.G.B., Walsh, M.G. & Gonzalez, M.R. (2014) SoilGrids1km — global soil information based on automated mapping. *Plos One*, **9**, e105992.

Hijmans, R.J., Cameron, S.E., Parra, J.L., Jones, P.G. & Jarvis, A. (2005) Very high resolution interpolated climate surfaces for global land areas. *International Journal of Climatology*, **25**, 1965–1978.

Hubbe, A., Hubbe, M., Karmann, I., Cruz, F.W. & Neves, W.A. (2013) Insights into Holocene megafauna survival and extinction in southeastern Brazil from new AMS 14 C dates. *Quaternary Research*, **79**, 152–157.

Jansen, P.A., Hirsch, B.T., Emsens, W.-L., Zamora-Gutierrez, V., Wikelski, M. & Kays, R. (2012) Thieving rodents as substitute dispersers of megafaunal seeds. *Proceedings of the National Academy of Sciences*, **109**, 12610–12615.

Jansson, R. (2003) Global patterns in endemism explained by past climatic change. *Proceedings of the Royal Society B: Biological Sciences*, **270**, 583–590.

Janzen, D.H. & Martin, P.S. (1982) Neotropical anachronisms: the fruits the gomphotheres ate. *Science*, **215**, 19–27.

Jordano, P. (2000) Fruits and frugivory. *Seeds: the ecology of regeneration in plant communities*, CABI Publishing, Wallingford, UK.

Kissling, W.D. & Carl, G. (2008) Spatial autocorrelation and the selection of simultaneous autoregressive models. *Global Ecology and Biogeography*, **17**, 59–71.

Kissling, W.D., Field, R. & Böhning-Gaese, K. (2008) Spatial patterns of woody plant and bird diversity: functional relationships or environmental effects? *Global Ecology and Biogeography*, **17**, 327–339.

Kissling, W.D., Eiserhardt, W.L., Baker, W.J., Borchsenius, F., Couvreur, T.L.P., Balslev, H. & Svenning, J.-C. (2012a) Cenozoic imprints on the phylogenetic structure of palm species assemblages worldwide. *Proceedings of the National Academy of Sciences*, **109**, 7379–7384.

Kissling, W.D., Baker, W.J., Balslev, H., Barfod, A.S., Borchsenius, F., Dransfield, J., Govaerts, R. & Svenning, J.-C. (2012b) Quaternary and pre-Quaternary historical legacies in the global distribution of a major tropical plant lineage. *Global Ecology and Biogeography*, **21**, 909–921.

Kissling, W.D., Dalby, L., Flojgaard, C., Lenoir, J., Sandel, B., Sandom, C., Trojelsgaard, K. & Svenning, J.-C. (2014) Establishing macroecological trait datasets: digitalization, extrapolation, and validation of diet preferences in terrestrial mammals worldwide. *Ecology and Evolution*, **4**, 2913–2930.

Legendre, P. & Legendre, L. (1998) *Numerical Ecology*. Elsevier Science, Amsterdam.

Lord, J.M. (2004) Frugivore gape size and the evolution of fruit size and shape in southern hemisphere floras. *Austral Ecology*, **29**, 430–436.

Mack, A.L. (1993) The sizes of vertebrate-dispersed fruits: a Neotropical-Paleotropical comparison. *American Naturalist*, **142**, 840–856.

Ritchie, J.T. (1981) Soil-water availability. *Plant and Soil*, **58**, 327–338.

Sandom, C., Faurby, S., Sandel, B. & Svenning, J.-C. (2014) Global late Quaternary megafauna extinctions linked to humans, not climate change. *Proceedings of the Royal Society B: Biological Sciences*, **281**, 20133254.

Sandom, C., Dalby, L., Fløjgaard, C., Kissling, W.D., Lenoir, J., Sandel, B., Trøjelsgaard, K., Ejrnæs, R. & Svenning, J.-C. (2013) Mammal predator and prey species richness are strongly linked at macroscales. *Ecology*, **94**, 1112–1122.

Svenning, J.-C., Pedersen, P.B.M., Donlan, C.J., Ejrnæs, R., Faurby, S., Galetti, M., Hansen, D.M., Sandel, B., Sandom, C.J. & Terborgh, J.W. (2015) Science for a wilder Anthropocene: synthesis and future directions for trophic rewilding research. *Proceedings of the National Academy of Sciences*, **113**, 898–906.

Swenson, N.G. & Weiser, M.D. (2010) Plant geography upon the basis of functional traits: an example from eastern North American trees. *Ecology*, **91**, 2234–2241.

Tautenhahn, S., Heilmeier, H., Götzenberger, L., Klotz, S., Wirth, C. & Kühn, I. (2008) On the biogeography of seed mass in Germany — distribution patterns and environmental correlates. *Ecography*, **31**, 457–468.

Tomlinson, P.B. (1990) *The structural biology of palms*. Oxford University Press, Oxford.

Zhao, M., Heinsch, F.A., Nemani, R.R. & Running, S.W. (2005) Improvements of the MODIS terrestrial gross and net primary production global data set. *Remote Sensing of Environment*, **95**, 164–176.

Zona, S. & Henderson, A. (1989) A review of animal-mediated seed dispersal of palms. *Selbyana*, **11**, 6–21.

References to data sources of the Appendix S1.

AAU Herbarium, The Aarhus University Herbarium (AAU), Ole Worms Allé 1, 8000 Aarhus C, Denmark.

Dowe, J.L. & Ferrero, M.D. (2000) A new species of rheophytic palm from New Guinea. *Palms*, **44**, 194–197.

Dowe, J.L. & Ferrero, M.D. (2001) Revision of *Calyptrocalyx* and the New Guinea species of *Linospadix* (Linospadicinae, Arecoideae, Arecaceae). *Blumea*, **46**, 207–251.

Dowe, J.L. (2010) *Australian palms, biogeography, ecology and systematics*. CSIRO Publishing, Collingwood, Australia.

Dransfield, J.L. (1979) *A manual of the rattans of the Malay Peninsula*, Malayan Forest Records 29, Kuala Lumpur.

Dransfield, J. & Beentje, H. (1995) *Palms of Madagascar*, Royal Botanical Gardens, Kew.

Dransfield, J. (1984) *The rattans of Sabah*, Sabah forest record 13, Sabah.

Essig, F.B. (1978) A revision of the genus *Ptychosperma* Labill. (Arecaceae). *Allertonia*, **1**, 415–478.

Essig, F.B. (2008) A systematic histological study of palm fruits. VIII. Subtribe Dypsidinae (Arecaceae). *Brittonia*, **60**, 82–92.

Essig, F.B., Bussard, L. & Hernandez, N. (2001) A systematic histological study of palm fruits. IV. Subtribe Oncospermatinae (Arecaceae). *Brittonia*, **53**, 466–471.

Essig, F.B., Manka, T. J. & Bussard, L. (1999) A systematic histological study of palm fruits. III. Subtribe Iguanurinae (Arecaceae). *Brittonia*, **51**, 307–325.

Fernando, E.S. (1983) A revision of the Genus *Nenga. Principes*, **27**, 55–70.

Galeano, G. & Bernal, R. (2010) *Palmas de Colombia*, *guia de campo.*Panamericana Formas e Impresos S.A., Bogota.

Glassman, S.F. (1987) Revisions of the palm genus *Syagrus* Mart. and other selected genera in the *Cocos* alliance. Illinois Biological Monographs, **59**, 1–414.

Henderson, A. (2002) *Evolution and Ecology of Palms*. New York Botanical Garden Press, Bronx.

Henderson, A. (2009) *Palms of Southern Asia,* Princeton University Press, Princeton.

Henderson, A., Galeono, G. & Bernal, R. (1995) *Field Guide to the Palms of the America*, Princeton University Press, Princeton.

Henderson, A. (2005) A multivariate study of *Calyptrogyne* (Palmae). *Systematic Botany*, **30**, 60–83.

Hodel, D.R. (1992) *Chamaedorea palms. The International Palm Society*, Allen Press, Lawrence, Kansas.

Hodel, D.R. (1996) Two new species of *Chamaedorea* from Costa Rica. *Principes*, **40**, 212–216.

Hodel, D.R. (1998) *The palms of Thailand.* Allen Press, Lawrence, Kansas.

Hodel, D.R. (2007) A review of the Genus *Pritchardia. Palms*, **51**, S1–S52.

Hodel, D.R., Herrera, G. & Cascante, A. (1997) A remarkable new species and additional novelties of *Chamaedorea* from Costa Rica and Panama. *Palms*, **139**, 32–44.

Hodel, D.R., Mont, J.J.C. & Zuniga, R. (1995) Two new species of *Chamaedorea* from Honduras. *Principes*, **39**, 183–189.

Jones, D.L. (1995) *Palms throughout the world*. Smithsonian Institution Press, Washington, D.C.

Kew Herbarium (K), The Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AE, UK.

Leaflets of Philippine Botany (1938), **10**, 3014.

Lorenzi, H. (2010) *Brazilian Flora Arecaceae (Palms)*. Instituto Plantarum, Nova Odessa.

Mogea, J.P. (1991) *Palms for human needs in Asia, Palm utilization and Conservation in India, Indonesia, Malaysia and Philippines*, AA Belkama, Rotterdam, the Netherlands.

palmpedia (http//www.palmpedia.net/).

palmweb (http//palmweb.org/).

Principes: Journal of the International Palm Society (1969), **13**, 104.

Principes: Journal of the International Palm Society (1992), **36**, 4.

Principes: Journal of the International Palm Society (1997), **41**, 66.

Saw, L.G. (2003) Morphological diversity of the genus *Licuala* (Palmae). Telopea, **10**, 187–206.

Sunderland, T.C.H. (2007) *Field guide to the rattans of Africa*, Royal Botanic Gardens, Kew.

Tuley, P. (1995) *The palms of Africa*, The Trendrine Press, Zennor.

Webbia: Journal of Plant Taxonomy and Geography (1914), **4**, 278.

Table 1. Predictor variables to explain spatial variation in the distribution of palm fruit sizes at global and biogeographic scales. PC represents axis of the Principal Component Analysis among current climate variables. All data have been compiled and aggregated at TDWG resolution.

Abbreviation	Predictor variable (unit)	Data source
Biotic		
Current mammal body sizes	Mean body sizes (g) of mammals as they currently are distributed	Mammal distributions (Faurby & Svenning, 2015) and body sizes (Faurby & Svenning, 2016)
Present-natural mammal body sizes	Mean body sizes (g) of present and extinct mammals based on estimated late Quaternary distributions under present climate and absence of humans	Mammal distributions (Faurby & Svenning, 2015) and body sizes (Faurby & Svenning, 2016)
Current environment		
PC-PREC	High PC-PREC values mainly represent high values in annual precipitation (mm $year^{-1}$) and precipitation of the driest quarter (mm)	Worldclim dataset (Hijmans *et al.*, 2005)
PC-TEMP	High PC-TEMP values mainly represent high values in annual mean temperature (°C) and temperature of the coldest quarter (°C)	Worldclim dataset (Hijmans *et al.*, 2005)
PC-SEAS	High PC-SEAS values mainly represent high seasonality of precipitation (coefficient of variation of monthly total, mm) and seasonality of temperature (SD of monthly means, °C)	Worldclim dataset (Hijmans *et al.*, 2005)
SOIL	Mean sand fraction in the depth of 45cm (%) with resolution of 1 km in original data	ISRIC – World Soil Information (Hengl *et al.*, 2014)
NPP	Mean annual values of primary productivity (gC m^{-2} yr^{-1}) for the period from 2000 to 2006 with resolution of 1 km in original data	NPP dataset (Zhao *et al.*, 2005)
Quaternary climate change		
LGM TEMP	Anomaly in mean annual temperature between Last Glacial Maximum and present (°C)	Calculated in ArcGIS using the Worldclim and the PIMP2 dataset (Hijmans *et al.*, 2005; Braconnot *et al.*, 2007)
LGM PREC	Anomaly in annual precipitation between Last Glacial Maximum and present (mm $year^{-1}$)	Calculated in ArcGIS using the Worldclim and the PIMP2 dataset (Hijmans *et al.*, 2005; Braconnot *et al.*, 2007)

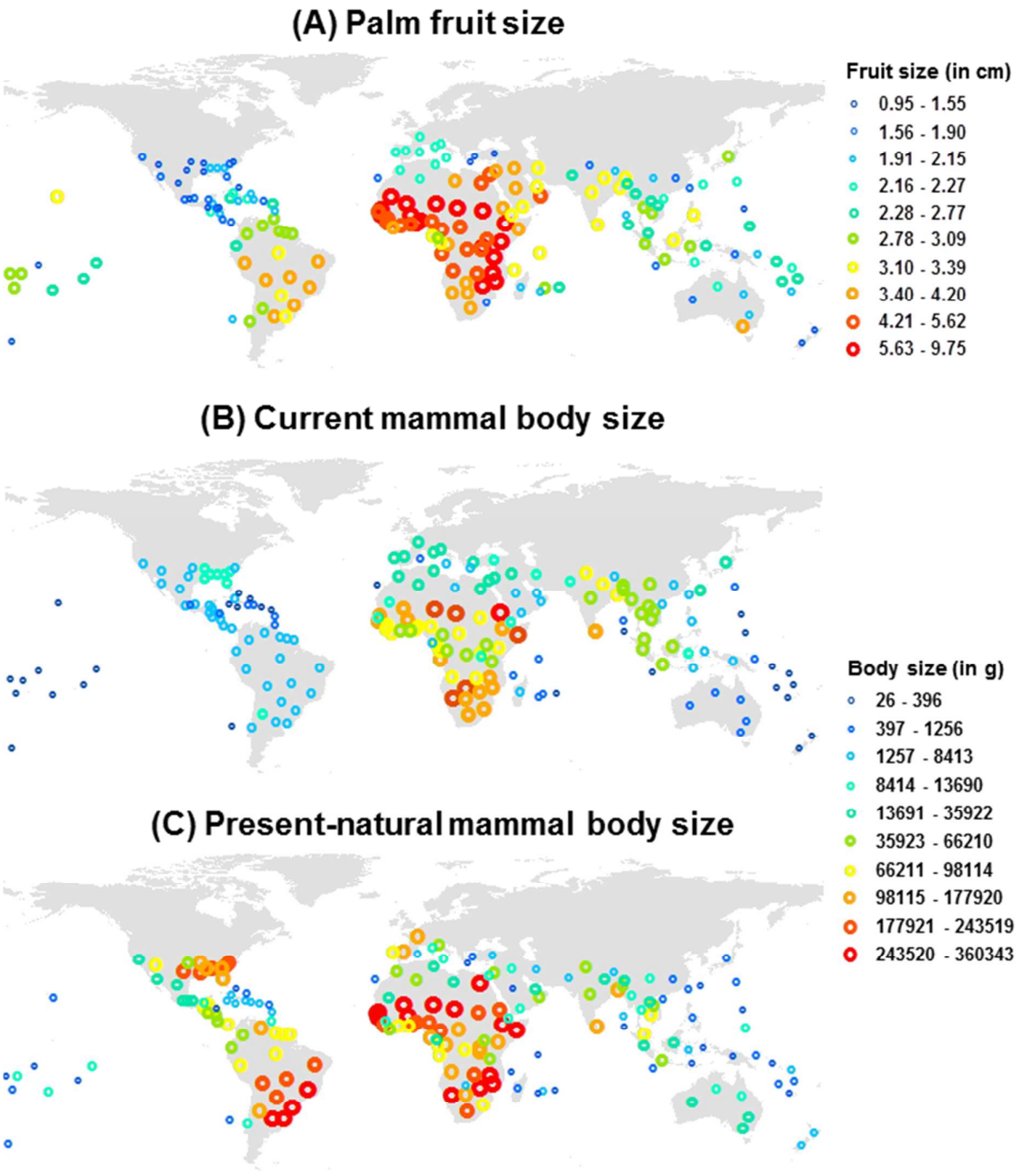
Figure 1. Global variation in (A) palm fruit sizes and in body sizes of (B) current frugivorous mammal assemblages and (C) present-natural frugivorous mammal assemblages. Illustrated are mean values across all species which occur within geographic units as defined by the International Working Group on Taxonomic Databases (centroids of TDWG level 3 units, n = 187). Only TDWG units with at least one palm and mammal species are shown. All maps are using WGS 1984 projection. Maps in (A) and (C) use quantile classification, while the map in (B) uses manual classification to ensure identical visualization of mammal body size values in maps (B) and (C).

Figure 2. Global relationship (in red) between palm fruit sizes and body sizes of current frugivorous mammals illustrated with (A) a structural equation model (SEM) and (B) a partial residuals plot. In (A), the SEM shows the fruit size-body size relationship (red arrow) and the direct and indirect effects of past and present-day environmental conditions (grey arrows). All arrows illustrate statistically significant effects, and values show standardized coefficients, with arrow thickness being proportional to effect strength. R^2–values show the explained variance of the response variable. In (B), the partial residual plot illustrates the relationship between assemblage-level mean fruit sizes of palms and current mammal body sizes when all other predictor variables in the multi-predictor model are statistically accounted for. Abbreviations of predictor and response variables can be found in Table 1.

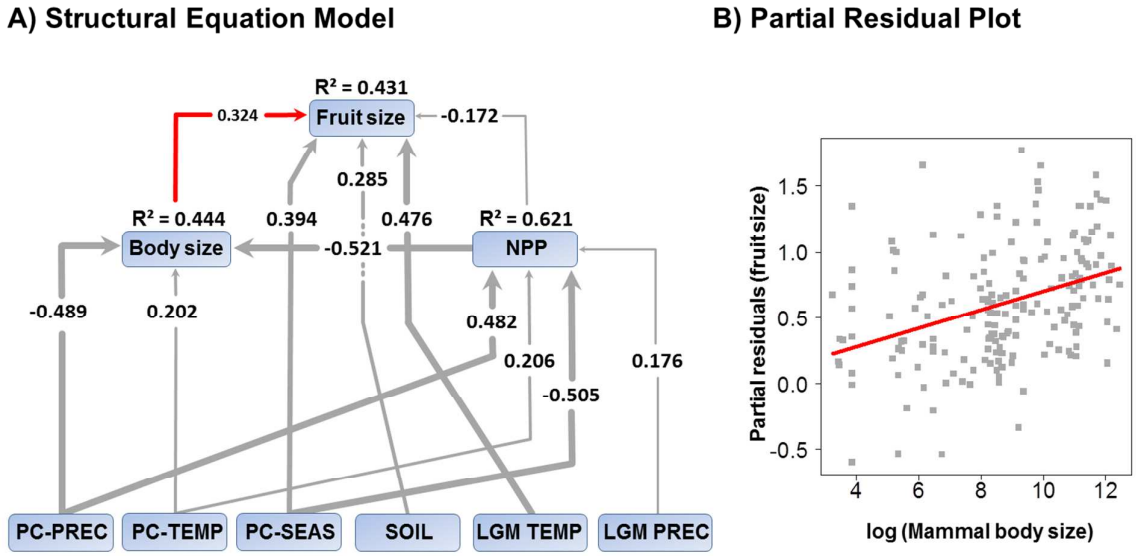
Figure 3. Barplot with the standardized coefficients from three structural equation models of each biogeographical realm (New World, Western Old World, Eastern Old World) showing the direct, positive effect of current mammal body sizes on average palm fruit sizes. The structural equation models were calculated separately for each of the three biogeographical realms, containing different sample sizes in terms of TDWG units (New World, n = 61; Eastern Old World, n = 62; Western Old World, n = 64). The corresponding structural equation models are shown in Fig. 4 (New World) and Fig. S1 in Appendix S2 (Eastern and Western Old World).

Figure 4. Structural equation models (SEMs) for (A) current and (B) present-natural frugivorous mammals within the New World showing direct and indirect impacts of biotic and abiotic drivers on palm fruit sizes, mammal body sizes and net primary productivity (NPP). Present-natural frugivorous mammals represent the late Quaternary mammalian species within the palm units. All arrows illustrate statistically significant effects and values show standardized coefficients, with arrow thickness being proportional to effect strength. R^2–values show the explained variance of the response variable. On the right partial residual plots illustrate the relationship between assemblage-level mean fruit sizes of palms and mammal body sizes with current (C) and present-natural (D) distributions when all other predictor variables in the multi-predictor model are statistically accounted for. Abbreviations of predictor and response variables can be found in Table 1.

Figure 1.

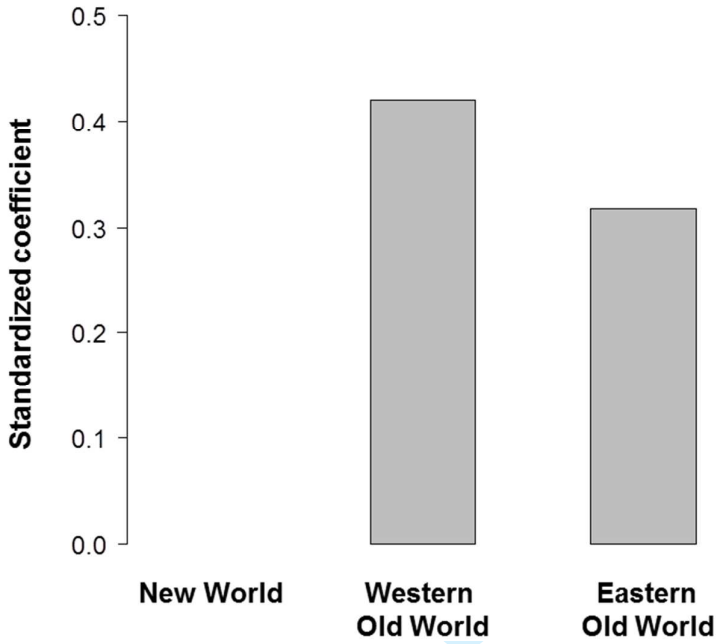

(A) Palm fruit size
Fruit size (in cm)
0.95 - 1.55
1.56 - 1.90
1.91 - 2.15
2.16 - 2.27
2.28 - 2.77
2.78 - 3.09
3.10 - 3.39
3.40 - 4.20
4.21 - 5.62
5.63 - 9.75
(B) Current mammal body size
(C) Present-natural mammal body size
Body size (in g)
26 - 396
397 - 1256
1257 - 8413
8414 - 13690
13691 - 35922
35923 - 66210
66211 - 98114
98115 - 177920
177921 - 243519
243520 - 360343

699 **Figure 2.**

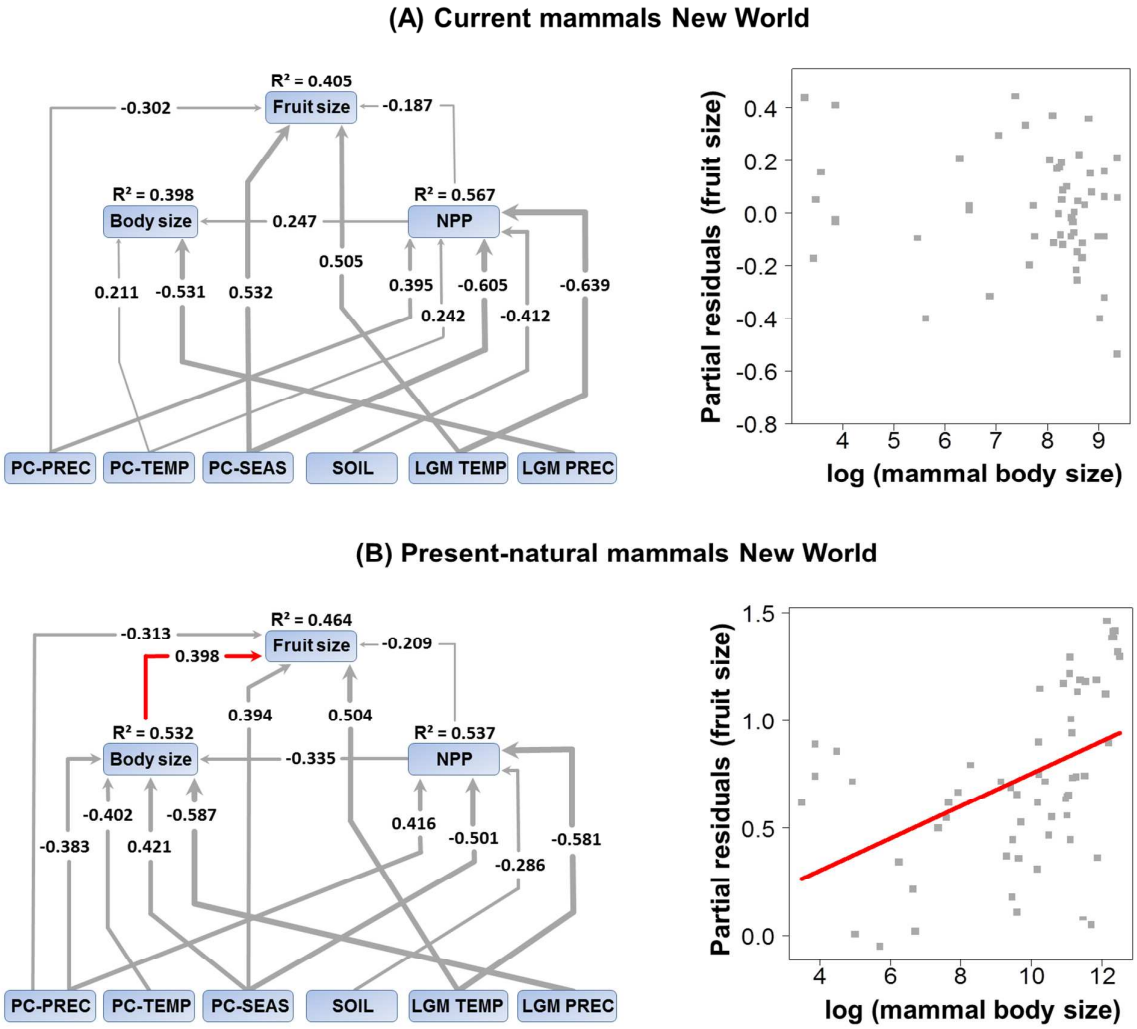


700

Figure 3.



703 **Figure 4.**



704

Appendix S1. Data sources

Table S1. The table shows all used palm species of the dataset (n = 2467) and attendant references which had been used to fulfill the values for average fruit size (length). For those species we were not able to find any literature sources (n = 669, marked with '—') we calculated the mean of congeners to estimate the value for the missing species.

Table S2. For each genus (n = 183), the number of all species, the number of species for which fruit size has been estimated, and the trait variation (mean, median and standard deviation SD) for all species with available data is given. Note that SD is not available for genera with only one species.

Table S3. Table shows the largest present-natural mammal species and their potential weight (in g) for each of the major biogeographical realms (New World, Western and Eastern Old World). Only mammal species are listed which occur in ≥5 TDWG level 3 units in which also palms occur.

Appendix S2. Supplementary methods

Figure S1. Map shows the geographic units as defined by the International Working Group on Taxonomic Databases (TDWG level 3 units) and the assignment of each TDWG level 3 unit to a major biogeographical realms (New World, n = 61 TDWG units; Western Old World, n = 62; Eastern Old World, n = 64).

Figure S2. Results of the structural equation models (SEM) of current frugivorous mammals within the Western Old World (A) and Eastern Old World (B) showing direct and indirect effects of biotic and abiotic drivers on the response variables palm fruit size, mammal body size and net primary productivity (NPP). All arrows illustrate statistically significant effects and values show standardized coefficients, with arrow thickness being proportional to effect strength. R^2–values show the explained variance of the response variable. On the right partial residual plots illustrate the relationship between assemblage-level mean fruit sizes of palms and mammal body sizes with current distributions for the Western (C) and Eastern Old World (D) when all other predictor variables in the multi-predictor model are statistically accounted for. Abbreviations of predictor and response variables can be found in Table 1.

Figure S3. Barplots showing the results of structural equation models (SEMs) focusing on the direct, positive statistically significant relationships (standardized path coefficients) between assemblage means for mammal body sizes and palm fruit sizes. Effects are illustrated for current mammal ranges on a global scale (GLO, n = 187 TDWG units), for the New World (NW, n = 61), Western Old World (OWW, n = 62) and Eastern Old World (OWE, n = 64). The barplots are shown for all frugivorous mammals (A, n = 1806 species), for fruit specialists (B, n = 1578), for partial frugivores (C, n = 194) and for opportunists (D, n = 34). Specialists represent mammals with fruits as major important diet, partial frugivores with fruits as intermediate and opportunists with fruits as minor important diet.

Figure S4. Moran's I correlograms of the raw trait data (white circles), of the residuals of the non-spatial OLS models (grey dots), and the residuals of the SAR model (black dots) for the three response variables (A, B: fruit size; C, D: body size; E, F: NPP) within the SEM models. This is illustrated for current mammal ranges (left) and present-natural mammal ranges (right).

Table S1. The table shows all used palm species of the dataset (*n*=2469) and attendant references which had been used to fulfill the values of average fruit size (length). For those species we were not able to find any literature sources (*n*=669, marked with '—') we calculated the mean of congeners to estimate the value for the missing species (see in Appendix 1, Table S2).

Species	Reference
Acanthophoenix crinita	—
Acanthophoenix rousselii	Kew Herbarium
Acanthophoenix rubra	Kew Herbarium
Acoelorrhaphe wrightii	AAU Herbarium
Acrocomia aculeata	Henderson, 2002
Acrocomia crispa	Henderson, 2002
Acrocomia hassleri	—
Acrocomia media	Kew Herbarium
Actinokentia divaricata	Henderson, 2002
Actinokentia huerlimannii	Kew Herbarium
Actinorhytis calapparia	Kew Herbarium
Adonidia merrillii	Kew Herbarium
Aiphanes acaulis	—
Aiphanes bicornis	Galeano & Bernal, 2010
Aiphanes chiribogensis	AAU Herbarium
Aiphanes deltoidea	AAU Herbarium
Aiphanes duquei	Henderson, 2002
Aiphanes eggersii	AAU Herbarium
Aiphanes erinacea	Henderson, 2002
Aiphanes gelatinosa	AAU Herbarium
Aiphanes graminifolia	—
Aiphanes grandis	AAU Herbarium
Aiphanes hirsuta	AAU Herbarium
Aiphanes horrida	AAU Herbarium
Aiphanes leiostachys	—
Aiphanes lindeniana	—
Aiphanes linearis	AAU Herbarium
Aiphanes macroloba	AAU Herbarium
Aiphanes minima	AAU Herbarium
Aiphanes parvifolia	—
Aiphanes pilaris	Galeano & Bernal, 2010
Aiphanes simplex	AAU Herbarium
Aiphanes spicata	—
Aiphanes stergiosii	AAU Herbarium
Aiphanes tricuspidata	—
Aiphanes ulei	—

Aiphanes verrucosa	AAU Herbarium
Aiphanes weberbaueri	AAU Herbarium
Allagoptera arenaria	—
Allagoptera brevicalyx	Kew Herbarium
Allagoptera campestris	Henderson, 2002
Allagoptera caudescens	Kew Herbarium
Allagoptera leucocalyx	AAU Herbarium
Ammandra decasperma	AAU Herbarium
Aphandra natalia	palmpedia
Archontophoenix alexandrae	Dowe, 2010
Archontophoenix cunninghamiana	Dowe, 2010
Archontophoenix maxima	Dowe, 2010
Archontophoenix myolensis	Dowe, 2010
Archontophoenix purpurea	Dowe, 2010
Archontophoenix tuckeri	Dowe, 2010
Areca abdulrahmanii	—
Areca ahmadii	Kew Herbarium
Areca andersonii	Kew Herbarium
Areca arundinacea	Kew Herbarium
Areca brachypoda	Kew Herbarium
Areca caliso	Kew Herbarium
Areca camarinensis	Kew Herbarium
Areca catechu	—
Areca celebica	Kew Herbarium
Areca chaiana	Kew Herbarium
Areca concinna	Kew Herbarium
Areca congesta	—
Areca costulata	Kew Herbarium
Areca dayung	Kew Herbarium
Areca furcata	Kew Herbarium
Areca guppyana	—
Areca hutchinsoniana	Kew Herbarium
Areca insignis	Kew Herbarium
Areca ipot	Kew Herbarium
Areca jobiensis	Kew Herbarium
Areca jugahpunya	—
Areca kinabaluensis	Kew Herbarium
Areca klingkangensis	Kew Herbarium
Areca laosensis	Kew Herbarium
Areca ledermanniana	Kew Herbarium
Areca macrocalyx	Kew Herbarium
Areca macrocarpa	Henderson, 2002
Areca minuta	Kew Herbarium
Areca montana	Kew Herbarium

Areca multifida	Kew Herbarium
Areca nannospadix	—
Areca nigasolu	Kew Herbarium
Areca novohibernica	—
Areca oxycarpa	Kew Herbarium
Areca parens	Kew Herbarium
Areca rechingeriana	Kew Herbarium
Areca rheophytica	Kew Herbarium
Areca ridleyana	—
Areca rostrata	Kew Herbarium
Areca salomonensis	Kew Herbarium
Areca subacaulis	—
Areca torulo	—
Areca triandra	—
Areca tunku	Kew Herbarium
Areca vestiaria	Kew Herbarium
Areca vidaliana	—
Areca warburgiana	Kew Herbarium
Areca whitfordii	Henderson, 2002
Arenga australasica	Dowe, 2010
Arenga brevipes	Kew Herbarium
Arenga caudata	AAU Herbarium
Arenga distincta	Kew Herbarium
Arenga engleri	—
Arenga hastata	Kew Herbarium
Arenga hookeriana	Kew Herbarium
Arenga listeri	Dowe, 2010
Arenga longicarpa	Henderson, 2009
Arenga longipes	Kew Herbarium
Arenga micrantha	—
Arenga microcarpa	AAU Herbarium
Arenga mindorensis	Kew Herbarium
Arenga nana	Henderson, 2009
Arenga obtusifolia	—
Arenga pinnata	AAU Herbarium
Arenga plicata	Kew Herbarium
Arenga porphyrocarpa	Jones, 1995
Arenga retroflorescens	—
Arenga ryukyuensis	—
Arenga talamauensis	Kew Herbarium
Arenga tremula	Kew Herbarium
Arenga undulatifolia	—
Arenga westerhoutii	AAU Herbarium
Arenga wightii	—

Asterogyne guianensis	Kew Herbarium
Asterogyne martiana	—
Asterogyne ramosa	Kew Herbarium
Asterogyne spicata	Kew Herbarium
Asterogyne yaracuyense	Kew Herbarium
Astrocaryum acaule	Kew Herbarium
Astrocaryum aculeatissimum	—
Astrocaryum aculeatum	AAU Herbarium
Astrocaryum alatum	Kew Herbarium
Astrocaryum campestre	Kew Herbarium
Astrocaryum carnosum	Kew Herbarium
Astrocaryum chambira	—
Astrocaryum chonta	—
Astrocaryum ciliatum	—
Astrocaryum confertum	Kew Herbarium
Astrocaryum faranae	AAU Herbarium
Astrocaryum farinosum	Lorenzi, 2010
Astrocaryum ferrugineum	Lorenzi, 2010
Astrocaryum giganteum	Lorenzi, 2010
Astrocaryum gratum	Kew Herbarium
Astrocaryum gynacanthum	AAU Herbarium
Astrocaryum huaimi	AAU Herbarium
Astrocaryum huicungo	Kew Herbarium
Astrocaryum jauari	—
Astrocaryum javarense	Kew Herbarium
Astrocaryum macrocalyx	AAU Herbarium
Astrocaryum malybo	—
Astrocaryum mexicanum	Kew Herbarium
Astrocaryum minus	Kew Herbarium
Astrocaryum murumuru	AAU Herbarium
Astrocaryum paramaca	Lorenzi, 2010
Astrocaryum perangustatum	—
Astrocaryum rodriguesii	AAU Herbarium
Astrocaryum sciophilum	Kew Herbarium
Astrocaryum scopatum	Kew Herbarium
Astrocaryum sociale	—
Astrocaryum standleyanum	—
Astrocaryum triandrum	—
Astrocaryum ulei	AAU Herbarium
Astrocaryum urostachys	Kew Herbarium
Astrocaryum vulgare	AAU Herbarium
Attalea allenii	—
Attalea amygdalina	Kew Herbarium
Attalea amylacea	—

Attalea anisitsiana	Kew Herbarium
Attalea apoda	—
Attalea attaleoides	Kew Herbarium
Attalea barreirensis	—
Attalea bassleriana	Kew Herbarium
Attalea blepharopus	Kew Herbarium
Attalea brasiliensis	Kew Herbarium
Attalea brejinhoensis	Kew Herbarium
Attalea butyracea	Kew Herbarium
Attalea camopiensis	Kew Herbarium
Attalea cephalotus	Kew Herbarium
Attalea cohune	—
Attalea colenda	Kew Herbarium
Attalea compta	Kew Herbarium
Attalea crassispatha	—
Attalea cuatrecasana	—
Attalea dahlgreniana	Kew Herbarium
Attalea degranvillei	—
Attalea dubia	Kew Herbarium
Attalea eichleri	Kew Herbarium
Attalea exigua	Kew Herbarium
Attalea fairchildensis	Kew Herbarium
Attalea funifera	Kew Herbarium
Attalea geraensis	Kew Herbarium
Attalea guacuyule	—
Attalea guianensis	Kew Herbarium
Attalea hoehnei	Kew Herbarium
Attalea huebneri	Kew Herbarium
Attalea humilis	Kew Herbarium
Attalea iguadummat	Kew Herbarium
Attalea insignis	Kew Herbarium
Attalea kewensis	Kew Herbarium
Attalea lauromuelleriana	Kew Herbarium
Attalea leandroana	Kew Herbarium
Attalea luetzelburgii	—
Attalea macrolepis	Kew Herbarium
Attalea magdalenica	—
Attalea maracaibensis	—
Attalea maripa	Kew Herbarium
Attalea maripensis	Kew Herbarium
Attalea microcarpa	Kew Herbarium
Attalea minarum	—
Attalea moorei	Kew Herbarium
Attalea nucifera	Kew Herbarium

Attalea oleifera	Kew Herbarium
Attalea osmantha	—
Attalea peruviana	Kew Herbarium
Attalea phalerata	Kew Herbarium
Attalea piassabossu	Kew Herbarium
Attalea pindobassu	—
Attalea plowmanii	Kew Herbarium
Attalea princeps	Kew Herbarium
Attalea racemosa	Kew Herbarium
Attalea rhynchocarpa	Kew Herbarium
Attalea rostrata	Kew Herbarium
Attalea salazarii	Kew Herbarium
Attalea salvadorensis	Kew Herbarium
Attalea seabrensis	—
Attalea septuagenata	Kew Herbarium
Attalea speciosa	—
Attalea spectabilis	Kew Herbarium
Attalea teixeirana	Kew Herbarium
Attalea tessmannii	Kew Herbarium
Attalea vitrivir	Kew Herbarium
Attalea voeksii	Kew Herbarium
Attalea weberbaueri	—
Attalea wesselsboeri	—
Bactris acanthocarpa	Kew Herbarium
Bactris acanthocarpoides	Kew Herbarium
Bactris ana-juliae	Kew Herbarium
Bactris aubletiana	Kew Herbarium
Bactris bahiensis	Kew Herbarium
Bactris balanophora	Kew Herbarium
Bactris barronis	Kew Herbarium
Bactris bidentula	Kew Herbarium
Bactris bifida	Kew Herbarium
Bactris brongniartii	—
Bactris campestris	Kew Herbarium
Bactris caryotifolia	—
Bactris caudata	—
Bactris charnleyae	Kew Herbarium
Bactris chaveziae	—
Bactris coloniata	Kew Herbarium
Bactris coloradonis	Kew Herbarium
Bactris concinna	—
Bactris constanciae	Kew Herbarium
Bactris corossilla	Kew Herbarium
Bactris cubensis	Kew Herbarium

Bactris cuspidata	Kew Herbarium
Bactris dianeura	Kew Herbarium
Bactris elegans	Kew Herbarium
Bactris faucium	Kew Herbarium
Bactris ferruginea	Kew Herbarium
Bactris fissifrons	—
Bactris gasipaes	—
Bactris gastoniana	Kew Herbarium
Bactris glandulosa	Kew Herbarium
Bactris glassmanii	Kew Herbarium
Bactris glaucescens	Kew Herbarium
Bactris gracilior	Kew Herbarium
Bactris grayumii	Kew Herbarium
Bactris guineensis	—
Bactris halmoorei	Kew Herbarium
Bactris hatschbachii	Kew Herbarium
Bactris herrerana	Kew Herbarium
Bactris hirta	Kew Herbarium
Bactris hondurensis	Kew Herbarium
Bactris horridispatha	—
Bactris jamaicana	Kew Herbarium
Bactris killipii	Kew Herbarium
Bactris kunorum	Kew Herbarium
Bactris longiseta	Kew Herbarium
Bactris macroacantha	—
Bactris major	Kew Herbarium
Bactris maraja	Kew Herbarium
Bactris martiana	—
Bactris mexicana	Kew Herbarium
Bactris militaris	Kew Herbarium
Bactris moorei	—
Bactris nancibaensis	Kew Herbarium
Bactris oligocarpa	Kew Herbarium
Bactris oligoclada	Kew Herbarium
Bactris panamensis	Kew Herbarium
Bactris pickelii	Kew Herbarium
Bactris pilosa	Kew Herbarium
Bactris pliniana	Kew Herbarium
Bactris plumeriana	Kew Herbarium
Bactris polystachya	—
Bactris ptariana	Kew Herbarium
Bactris rhaphidacantha	Kew Herbarium
Bactris riparia	Kew Herbarium
Bactris rostrata	Kew Herbarium

Bactris schultesii	—
Bactris setiflora	Kew Herbarium
Bactris setosa	Kew Herbarium
Bactris setulosa	—
Bactris simplicifrons	Kew Herbarium
Bactris soeiroana	—
Bactris sphaerocarpa	Kew Herbarium
Bactris syagroides	Kew Herbarium
Bactris tefensis	Kew Herbarium
Bactris timbuiensis	Kew Herbarium
Bactris tomentosa	—
Bactris turbinocarpa	Kew Herbarium
Bactris vulgaris	Kew Herbarium
Balaka brachychlamys	—
Balaka longirostris	—
Balaka macrocarpa	Kew Herbarium
Balaka microcarpa	Kew Herbarium
Balaka minuta	—
Balaka pauciflora	Kew Herbarium
Balaka samoensis	Kew Herbarium
Balaka seemannii	Kew Herbarium
Balaka streptostachys	palmweb
Balaka tahitensis	Kew Herbarium
Balaka tuasivica	Kew Herbarium
Barcella odora	palmpedia
Basselinia deplanchei	Kew Herbarium
Basselinia favieri	Kew Herbarium
Basselinia glabrata	palmweb
Basselinia gracilis	—
Basselinia humboldtiana	Kew Herbarium
Basselinia iterata	Kew Herbarium
Basselinia pancheri	Kew Herbarium
Basselinia porphynea	—
Basselinia sordida	Kew Herbarium
Basselinia tomentosa	Henderson, 2002
Basselinia velutina	Kew Herbarium
Basselinia vestita	Kew Herbarium
Beccariophoenix alfredii	Kew Herbarium
Beccariophoenix madagascariensis	AAU Herbarium
Bentinckia condapanna	Henderson, 2009
Bentinckia nicobarica	Kew Herbarium
Bismarckia nobilis	Henderson, 2002
Borassodendron borneense	Kew Herbarium
Borassodendron machadonis	AAU Herbarium

Borassus aethiopum	AAU Herbarium
Borassus akeassii	—
Borassus flabellifer	AAU Herbarium
Borassus heineanus	—
Borassus madagascariensis	—
Brahea aculeata	—
Brahea armata	Henderson, 2002
Brahea brandegeei	—
Brahea calcarea	Jones, 1995
Brahea decumbens	Henderson, 2002
Brahea dulcis	AAU Herbarium
Brahea edulis	Henderson, 2002
Brahea moorei	AAU Herbarium
Brahea pimo	Henderson, 2002
Brahea salvadorensis	Jones, 1995
Brahea sarukhanii	palmweb
Brassiophoenix drymophloeoides	Kew Herbarium
Brassiophoenix schumannii	AAU Herbarium
Burretiokentia dumasii	Kew Herbarium
Burretiokentia grandiflora	—
Burretiokentia hapala	Kew Herbarium
Burretiokentia koghiensis	Henderson, 2002
Burretiokentia vieillardii	Kew Herbarium
Butia archeri	—
Butia campicola	Kew Herbarium
Butia capitata	—
Butia eriospatha	Kew Herbarium
Butia exospadix	Lorenzi, 2010
Butia lallemantii	Lorenzi, 2010
Butia leptospatha	Lorenzi, 2010
Butia marmorii	Lorenzi, 2010
Butia microspadix	—
Butia paraguayensis	Kew Herbarium
Butia purpurascens	—
Butia stolonifera	—
Butia yatay	Kew Herbarium
Calamus acanthochlamys	—
Calamus acanthophyllus	AAU Herbarium
Calamus acanthospathus	Kew Herbarium
Calamus acaulis	—
Calamus acidus	—
Calamus acuminatus	Kew Herbarium
Calamus adspersus	AAU Herbarium
Calamus aggregatus	Kew Herbarium

Calamus aidae	—
Calamus albidus	Kew Herbarium
Calamus albus	Kew Herbarium
Calamus altiscandens	Kew Herbarium
Calamus amplijugus	Henderson, 2009
Calamus andamanicus	—
Calamus anomalus	Kew Herbarium
Calamus arborescens	Kew Herbarium
Calamus arfakianus	Henderson, 2009
Calamus aruensis	—
Calamus arugda	AAU Herbarium
Calamus ashtonii	Kew Herbarium
Calamus asperrimus	AAU Herbarium
Calamus australis	Kew Herbarium
Calamus austroguangxiensis	AAU Herbarium
Calamus axillaris	—
Calamus bacularis	—
Calamus balerensis	—
Calamus balingensis	AAU Herbarium
Calamus bankae	palmweb
Calamus banlingensis	Kew Herbarium
Calamus baratangensis	AAU Herbarium
Calamus barbatus	AAU Herbarium
Calamus basui	palmweb
Calamus batanensis	—
Calamus beccarii	—
Calamus benkulensis	palmweb
Calamus bicolor	Kew Herbarium
Calamus billitonensis	Henderson, 2009
Calamus bimaniferus	Kew Herbarium
Calamus blumei	AAU Herbarium
Calamus boniensis	Kew Herbarium
Calamus bousigonii	Henderson, 2009
Calamus brandisii	AAU Herbarium
Calamus brassii	Kew Herbarium
Calamus brevifolius	AAU Herbarium
Calamus burckianus	palmweb
Calamus burkillianus	Kew Herbarium
Calamus buroensis	Kew Herbarium
Calamus caesius	AAU Herbarium
Calamus calospathus	Dransfield, 1979
Calamus caryotoides	Kew Herbarium
Calamus castaneus	AAU Herbarium
Calamus cawa	Kew Herbarium

Calamus centralis	AAU Herbarium
Calamus ceratophorus	AAU Herbarium
Calamus ciliaris	—
Calamus cockburnii	AAU Herbarium
Calamus compsostachys	Henderson, 2009
Calamus comptus	Kew Herbarium
Calamus concinnus	Dransfield, 1979
Calamus congestiflorus	Henderson, 2009
Calamus conirostris	AAU Herbarium
Calamus conjugatus	AAU Herbarium
Calamus convallium	Dransfield, 1984
Calamus corneri	Kew Herbarium
Calamus corrugatus	AAU Herbarium
Calamus crassifolius	—
Calamus crispus	Dransfield, 1979
Calamus cumingianus	—
Calamus curag	—
Calamus cuthbertsonii	AAU Herbarium
Calamus dasyacanthus	—
Calamus deerratus	Kew Herbarium
Calamus delessertianus	Kew Herbarium
Calamus delicatulus	AAU Herbarium
Calamus densiflorus	AAU Herbarium
Calamus depauperatus	Kew Herbarium
Calamus dianbaiensis	Kew Herbarium
Calamus didymocarpus	AAU Herbarium
Calamus diepenhorstii	Kew Herbarium
Calamus digitatus	Kew Herbarium
Calamus dilaceratus	—
Calamus dimorphacanthus	—
Calamus dioicus	—
Calamus discolor	Kew Herbarium
Calamus distentus	Kew Herbarium
Calamus divaricatus	AAU Herbarium
Calamus dongnaiensis	Kew Herbarium
Calamus doriaei	AAU Herbarium
Calamus dransfieldii	AAU Herbarium
Calamus egregius	Kew Herbarium
Calamus elmerianus	Kew Herbarium
Calamus elopurensis	
Calamus endauensis	Kew Herbarium
Calamus epetiolaris	Kew Herbarium
Calamus equestris	AAU Herbarium
Calamus erectus	—

Calamus erinaceus	Kew Herbarium
Calamus erioacanthus	—
Calamus essigii	AAU Herbarium
Calamus evansii	AAU Herbarium
Calamus exilis	Kew Herbarium
Calamus eximius	Kew Herbarium
Calamus faberi	—
Calamus farinosus	Kew Herbarium
Calamus fertilis	AAU Herbarium
Calamus filipendulus	Kew Herbarium
Calamus filispadix	—
Calamus fimbriatus	AAU Herbarium
Calamus fissijugatus	Kew Herbarium
Calamus fissilis	—
Calamus flabellatus	—
Calamus flagellum	Kew Herbarium
Calamus floribundus	AAU Herbarium
Calamus formosanus	AAU Herbarium
Calamus foxworthyi	—
Calamus fuscus	AAU Herbarium
Calamus gamblei	Kew Herbarium
Calamus gibbsianus	Kew Herbarium
Calamus godefroyi	Kew Herbarium
Calamus gogolensis	Kew Herbarium
Calamus gonospermus	Kew Herbarium
Calamus gracilis	—
Calamus graminosus	Kew Herbarium
Calamus grandifolius	AAU Herbarium
Calamus gregisectus	AAU Herbarium
Calamus griseus	Kew Herbarium
Calamus guangxiensis	Kew Herbarium
Calamus guruba	Kew Herbarium
Calamus halmaherensis	Kew Herbarium
Calamus harmandii	—
Calamus hartmannii	AAU Herbarium
Calamus helferianus	—
Calamus henryanus	—
Calamus hepburnii	Kew Herbarium
Calamus heteracanthus	Kew Herbarium
Calamus heteroideus	AAU Herbarium
Calamus hispidulus	Kew Herbarium
Calamus holttumii	AAU Herbarium
Calamus hookerianus	Kew Herbarium
Calamus hoplites	—

Calamus hukaungensis	—
Calamus humboldtianus	Kew Herbarium
Calamus hypertrichosus	Kew Herbarium
Calamus hypoleucus	—
Calamus impar	AAU Herbarium
Calamus inopinatus	Kew Herbarium
Calamus inops	Kew Herbarium
Calamus insignis	
Calamus interruptus	Kew Herbarium
Calamus javensis	Kew Herbarium
Calamus jenningsianus	—
Calamus kandariensis	—
Calamus karnatakensis	AAU Herbarium
Calamus karuensis	Kew Herbarium
Calamus keyensis	Kew Herbarium
Calamus khasianus	Kew Herbarium
Calamus kiahii	Kew Herbarium
Calamus kingianus	—
Calamus kjellbergii	Kew Herbarium
Calamus klossii	AAU Herbarium
Calamus kontumensis	Kew Herbarium
Calamus koordersianus	Kew Herbarium
Calamus lacciferus	Kew Herbarium
Calamus laevigatus	—
Calamus lakshmanae	Kew Herbarium
Calamus lambirensis	Kew Herbarium
Calamus laoensis	Dransfield, 1979
Calamus lateralis	AAU Herbarium
Calamus latifolius	Kew Herbarium
Calamus latispinus	—
Calamus lauterbachii	AAU Herbarium
Calamus laxissimus	AAU Herbarium
Calamus ledermannianus	Kew Herbarium
Calamus leiocaulis	Kew Herbarium
Calamus leloi	AAU Herbarium
Calamus leptospadix	Kew Herbarium
Calamus leptostachys	—
Calamus lobbianus	Kew Herbarium
Calamus longipinna	Kew Herbarium
Calamus longisetus	Kew Herbarium
Calamus longispathus	—
Calamus luridus	—
Calamus macgregorii	AAU Herbarium
Calamus macrochlamys	Dransfield, 1979

Calamus macrorhynchus	—
Calamus macrosphaerion	—
Calamus maiadum	—
Calamus malawaliensis	Kew Herbarium
Calamus manan	AAU Herbarium
Calamus manillensis	—
Calamus marginatus	Kew Herbarium
Calamus maritimus	Dransfield, 1979
Calamus mattanensis	—
Calamus maturbongsii	AAU Herbarium
Calamus mayrii	Kew Herbarium
Calamus megaphyllus	AAU Herbarium
Calamus meghalayensis	Kew Herbarium
Calamus melanacanthus	Kew Herbarium
Calamus melanochrous	Kew Herbarium
Calamus melanoloma	Kew Herbarium
Calamus melanorhynchus	—
Calamus merrillii	—
Calamus mesilauensis	—
Calamus metzianus	—
Calamus micranthus	—
Calamus microcarpus	Kew Herbarium
Calamus microsphaerion	Kew Herbarium
Calamus minahassae	—
Calamus mindorensis	Kew Herbarium
Calamus minor	—
Calamus minutus	Kew Herbarium
Calamus mitis	Kew Herbarium
Calamus modestus	—
Calamus mogeae	Henderson, 2002
Calamus moorhousei	Kew Herbarium
Calamus moseleyanus	—
Calamus moszkowskianus	Kew Herbarium
Calamus moti	Kew Herbarium
Calamus muelleri	Kew Herbarium
Calamus multinervis	Kew Herbarium
Calamus multisetosus	—
Calamus multispicatus	—
Calamus muricatus	Kew Herbarium
Calamus myriacanthus	—
Calamus myriocarpus	—
Calamus myriocladus	—
Calamus nagbettai	AAU Herbarium
Calamus nambariensis	Kew Herbarium

Calamus nannostachys	Kew Herbarium
Calamus nanodendron	Kew Herbarium
Calamus neelagiricus	AAU Herbarium
Calamus nematospadix	Kew Herbarium
Calamus nicobaricus	Kew Herbarium
Calamus nielsenii	Kew Herbarium
Calamus nigricans	—
Calamus nuichuaensis	Kew Herbarium
Calamus obovoideus	—
Calamus occidentalis	Kew Herbarium
Calamus oligostachys	—
Calamus opacus	—
Calamus optimus	Kew Herbarium
Calamus ornatus	—
Calamus orthostachyus	—
Calamus ovoideus	—
Calamus oxleyanus	Dransfield, 1979
Calamus oxycarpus	Kew Herbarium
Calamus pachypus	—
Calamus pachystachys	Dransfield, 1979
Calamus pachystemonus	Kew Herbarium
Calamus padangensis	AAU Herbarium
Calamus palustris	Kew Herbarium
Calamus pandanosmus	Kew Herbarium
Calamus papuanus	Kew Herbarium
Calamus paspalanthus	AAU Herbarium
Calamus paucijugus	AAU Herbarium
Calamus paulii	Kew Herbarium
Calamus pedicellatus	Dransfield, 1979
Calamus penicillatus	Kew Herbarium
Calamus perakensis	—
Calamus peregrinus	Kew Herbarium
Calamus pholidostachys	—
Calamus pilosellus	Kew Herbarium
Calamus pilossisimus	Kew Herbarium
Calamus pisicarpus	Kew Herbarium
Calamus platyacanthoides	—
Calamus platyspathus	Kew Herbarium
Calamus plicatus	Kew Herbarium
Calamus poensis	Kew Herbarium
Calamus pogonacanthus	—
Calamus poilanei	Kew Herbarium
Calamus polycladus	—
Calamus polydesmus	—

Calamus polystachys	Kew Herbarium
Calamus praetermissus	Kew Herbarium
Calamus prasinus	—
Calamus prattianus	Henderson, 2002
Calamus pseudofeanus	Kew Herbarium
Calamus pseudomollis	Kew Herbarium
Calamus pseudorivalis	—
Calamus pseudotenuis	Kew Herbarium
Calamus pseudoulur	Kew Herbarium
Calamus pseudozebrinus	Kew Herbarium
Calamus psilocladus	Kew Herbarium
Calamus pulaiensis	Kew Herbarium
Calamus pulchellus	—
Calamus pulcher	—
Calamus pycnocarpus	Kew Herbarium
Calamus pygmaeus	Kew Herbarium
Calamus quinquenervius	Kew Herbarium
Calamus radiatus	—
Calamus radicalis	Kew Herbarium
Calamus radulosus	—
Calamus ramulosus	—
Calamus reinwardtii	—
Calamus reticulatus	Kew Herbarium
Calamus reyesianus	—
Calamus rhabdocladus	—
Calamus rheedei	Kew Herbarium
Calamus rhomboideus	—
Calamus rhytidomus	Kew Herbarium
Calamus ridleyanus	Kew Herbarium
Calamus rivalis	Kew Herbarium
Calamus robinsonianus	Kew Herbarium
Calamus rotang	Kew Herbarium
Calamus rudentum	Kew Herbarium
Calamus rugosus	
Calamus rumphii	Kew Herbarium
Calamus ruvidus	Kew Herbarium
Calamus sabalensis	Kew Herbarium
Calamus sabensis	Kew Herbarium
Calamus salicifolius	—
Calamus samian	Kew Herbarium
Calamus sarawakensis	Kew Herbarium
Calamus scabridulus	Kew Herbarium
Calamus scabrispathus	Kew Herbarium
Calamus schaeferianus	Kew Herbarium

Calamus schistoacanthus	Kew Herbarium
Calamus schlechterianus	—
Calamus scipionum	Kew Herbarium
Calamus scleracanthus	—
Calamus sedens	—
Calamus semierectus	Henderson, 2002
Calamus semoi	Kew Herbarium
Calamus senalingensis	Kew Herbarium
Calamus sepikensis	Kew Herbarium
Calamus serrulatus	Kew Herbarium
Calamus sessilifolius	Kew Herbarium
Calamus setulosus	—
Calamus shendurunii	Kew Herbarium
Calamus siamensis	Kew Herbarium
Calamus simplex	Kew Herbarium
Calamus simplicifolius	
Calamus siphonospathus	Kew Herbarium
Calamus solitarius	Kew Herbarium
Calamus sordidus	—
Calamus speciosissimus	Kew Herbarium
Calamus spectabilis	Kew Herbarium
Calamus spectatissimus	—
Calamus spicatus	Kew Herbarium
Calamus spinifolius	Kew Herbarium
Calamus spinulinervis	Kew Herbarium
Calamus spiralis	Kew Herbarium
Calamus stoloniferus	Kew Herbarium
Calamus suaveolens	
Calamus subinermis	Kew Herbarium
Calamus sumbawensis	Kew Herbarium
Calamus symphysipus	Kew Herbarium
Calamus tanakadatei	—
Calamus tapa	Kew Herbarium
Calamus temburongii	—
Calamus temii	—
Calamus tenompokensis	—
Calamus tenuis	Kew Herbarium
Calamus tetradactyloides	Kew Herbarium
Calamus tetradactylus	Kew Herbarium
Calamus thwaitesii	Kew Herbarium
Calamus thysanolepis	—
Calamus timorensis	Kew Herbarium
Calamus toli-toliensis	Kew Herbarium
Calamus tomentosus	Kew Herbarium

Calamus trachycoleus	Kew Herbarium
Calamus travancoricus	Kew Herbarium
Calamus trispermus	
Calamus tumidus	Kew Herbarium
Calamus ulur	Kew Herbarium
Calamus unifarius	Kew Herbarium
Calamus usitatus	—
Calamus vattayila	—
Calamus vestitus	Kew Herbarium
Calamus vidalianus	Kew Herbarium
Calamus viminalis	Kew Herbarium
Calamus vinosus	—
Calamus viridispinus	Kew Herbarium
Calamus viridissimus	Kew Herbarium
Calamus vitiensis	—
Calamus wailong	—
Calamus walkeri	—
Calamus wanggaii	Kew Herbarium
Calamus warburgii	Kew Herbarium
Calamus wari-wariensis	Kew Herbarium
Calamus whitmorei	AAU Herbarium
Calamus wightii	—
Calamus winklerianus	Kew Herbarium
Calamus wuliangshanensis	—
Calamus yuangchunensis	Kew Herbarium
Calamus zebrinus	—
Calamus zeylanicus	Kew Herbarium
Calamus zollingeri	Kew Herbarium
Calamus zonatus	—
Calyptrocalyx albertisianus	—
Calyptrocalyx amoenus	Kew Herbarium
Calyptrocalyx arfakianus	—
Calyptrocalyx awa	Dowe & Ferrero, 2001
Calyptrocalyx caudiculatus	Dowe & Ferrero, 2001
Calyptrocalyx doxanthus	AAU Herbarium
Calyptrocalyx elegans	—
Calyptrocalyx flabellatus	Dowe & Ferrero, 2001
Calyptrocalyx forbesii	—
Calyptrocalyx geonomiformis	Kew Herbarium
Calyptrocalyx hollrungii	Kew Herbarium
Calyptrocalyx julianettii	—
Calyptrocalyx lauterbachianus	Dowe & Ferrero, 2001
Calyptrocalyx laxiflorus	—
Calyptrocalyx lepidotus	—

Calyptrocalyx leptostachys	Dowe & Ferrero, 2001
Calyptrocalyx merrillianus	Kew Herbarium
Calyptrocalyx micholitzii	—
Calyptrocalyx multifidus	—
Calyptrocalyx pachystachys	—
Calyptrocalyx pauciflorus	—
Calyptrocalyx polyphyllus	Dowe & Ferrero, 2001
Calyptrocalyx pusillus	—
Calyptrocalyx sessiliflorus	—
Calyptrocalyx spicatus	Dowe & Ferrero, 2001
Calyptrocalyx yamutumene	—
Calyptrogyne allenii	—
Calyptrogyne anomala	Kew Herbarium
Calyptrogyne baudensis	—
Calyptrogyne coloradensis	Kew Herbarium
Calyptrogyne condensata	—
Calyptrogyne costatifrons	—
Calyptrogyne deneversii	Henderson, 2005
Calyptrogyne fortunensis	—
Calyptrogyne ghiesbreghtiana	—
Calyptrogyne herrerae	Kew Herbarium
Calyptrogyne kunorum	—
Calyptrogyne osensis	—
Calyptrogyne panamensis	AAU Herbarium
Calyptrogyne pubescens	—
Calyptrogyne sanblasensis	Henderson, 2005
Calyptrogyne trichostachys	—
Calyptrogyne tutensis	AAU Herbarium
Calyptronoma occidentalis	Kew Herbarium
Calyptronoma plumeriana	—
Calyptronoma rivalis	Kew Herbarium
Carpentaria acuminata	Dowe, 2010
Carpoxylon macrospermum	Kew Herbarium
Caryota bacsonensis	Henderson, 2002
Caryota cumingii	Kew Herbarium
Caryota kiriwongensis	Henderson, 2009
Caryota maxima	—
Caryota mitis	—
Caryota monostachya	—
Caryota no	Kew Herbarium
Caryota obtusa	—
Caryota ochlandra	—
Caryota ophiopellis	—
Caryota rumphiana	AAU Herbarium

Caryota sympetala	Kew Herbarium
Caryota urens	Henderson, 2009
Caryota zebrina	Kew Herbarium
Ceratolobus concolor	AAU Herbarium
Ceratolobus discolor	Kew Herbarium
Ceratolobus glaucescens	Kew Herbarium
Ceratolobus kingianus	Kew Herbarium
Ceratolobus pseudoconcolor	—
Ceratolobus subangulatus	—
Ceroxylon alpinum	Kew Herbarium
Ceroxylon amazonicum	Kew Herbarium
Ceroxylon ceriferum	Kew Herbarium
Ceroxylon echinulatum	Kew Herbarium
Ceroxylon parvifrons	Kew Herbarium
Ceroxylon parvum	Kew Herbarium
Ceroxylon quindiuense	Kew Herbarium
Ceroxylon sasaimae	Kew Herbarium
Ceroxylon ventricosum	Kew Herbarium
Ceroxylon vogelianum	—
Ceroxylon weberbaueri	Kew Herbarium
Chamaedorea adscendens	Kew Herbarium
Chamaedorea allenii	Kew Herbarium
Chamaedorea alternans	—
Chamaedorea amabilis	Kew Herbarium
Chamaedorea anemophila	—
Chamaedorea angustisecta	Kew Herbarium
Chamaedorea arenbergiana	Kew Herbarium
Chamaedorea atrovirens	Kew Herbarium
Chamaedorea benziei	Kew Herbarium
Chamaedorea binderi	Hodel, 1996
Chamaedorea brachyclada	Kew Herbarium
Chamaedorea brachypoda	Kew Herbarium
Chamaedorea carchensis	Kew Herbarium
Chamaedorea castillo-montii	—
Chamaedorea cataractarum	Kew Herbarium
Chamaedorea christinae	AAU Herbarium
Chamaedorea correae	Kew Herbarium
Chamaedorea costaricana	Kew Herbarium
Chamaedorea crucensis	Jones, 1995
Chamaedorea dammeriana	Kew Herbarium
Chamaedorea deckeriana	Kew Herbarium
Chamaedorea deneversiana	Kew Herbarium
Chamaedorea elatior	Kew Herbarium
Chamaedorea elegans	Kew Herbarium

Chamaedorea ernesti-augusti	Kew Herbarium
Chamaedorea falcifera	—
Chamaedorea foveata	Kew Herbarium
Chamaedorea fractiflexa	—
Chamaedorea fragrans	Kew Herbarium
Chamaedorea frondosa	Hodel et al., 1995
Chamaedorea geonomiformis	Kew Herbarium
Chamaedorea glaucifolia	Kew Herbarium
Chamaedorea graminifolia	Kew Herbarium
Chamaedorea guntheriana	Kew Herbarium
Chamaedorea hodelii	—
Chamaedorea hooperiana	Kew Herbarium
Chamaedorea ibarrae	—
Chamaedorea incrustata	Kew Herbarium
Chamaedorea keelerorum	Kew Herbarium
Chamaedorea klotzschiana	Kew Herbarium
Chamaedorea latisecta	Kew Herbarium
Chamaedorea lehmannii	Kew Herbarium
Chamaedorea liebmannii	Kew Herbarium
Chamaedorea linearis	Kew Herbarium
Chamaedorea lucidifrons	Kew Herbarium
Chamaedorea macrospadix	Kew Herbarium
Chamaedorea matae	—
Chamaedorea metallica	Kew Herbarium
Chamaedorea microphylla	—
Chamaedorea microspadix	—
Chamaedorea moliniana	Hodel et al., 1995
Chamaedorea murriensis	—
Chamaedorea nationsiana	Kew Herbarium
Chamaedorea neurochlamys	—
Chamaedorea nubium	Kew Herbarium
Chamaedorea oblongata	Kew Herbarium
Chamaedorea oreophila	Kew Herbarium
Chamaedorea pachecoana	Kew Herbarium
Chamaedorea palmeriana	Kew Herbarium
Chamaedorea parvifolia	Kew Herbarium
Chamaedorea parvisecta	Kew Herbarium
Chamaedorea pauciflora	Kew Herbarium
Chamaedorea pedunculata	Hodel, 1992
Chamaedorea pinnatifrons	Kew Herbarium
Chamaedorea piscifolia	Hodel et al., 1997
Chamaedorea pittieri	Kew Herbarium
Chamaedorea plumosa	Kew Herbarium
Chamaedorea pochutlensis	Kew Herbarium

Chamaedorea ponderosa	Hodel et al., 1997
Chamaedorea pumila	—
Chamaedorea pygmaea	Kew Herbarium
Chamaedorea queroana	—
Chamaedorea radicalis	Kew Herbarium
Chamaedorea recurvata	Hodel et al., 1995
Chamaedorea rhizomatosa	Kew Herbarium
Chamaedorea ricardoi	—
Chamaedorea rigida	Kew Herbarium
Chamaedorea robertii	Kew Herbarium
Chamaedorea rojasiana	Kew Herbarium
Chamaedorea rosibeliae	—
Chamaedorea rossteniorum	Hodel et al., 1997
Chamaedorea sartorii	Kew Herbarium
Chamaedorea scheryi	—
Chamaedorea schiedeana	—
Chamaedorea schippii	Henderson, 2002
Chamaedorea seifrizii	—
Chamaedorea selvae	Kew Herbarium
Chamaedorea serpens	Kew Herbarium
Chamaedorea simplex	Kew Herbarium
Chamaedorea skutchii	Hodel, 1992
Chamaedorea smithii	Hodel, 1992
Chamaedorea stenocarpa	Jones, 1995
Chamaedorea stolonifera	Kew Herbarium
Chamaedorea stricta	Kew Herbarium
Chamaedorea subjectifolia	Hodel et al., 1995
Chamaedorea tenerrima	Kew Herbarium
Chamaedorea tepejilote	Kew Herbarium
Chamaedorea tuerckheimii	Kew Herbarium
Chamaedorea undulatifolia	—
Chamaedorea verapazensis	Hodel, 1992
Chamaedorea verecunda	Kew Herbarium
Chamaedorea volcanensis	Kew Herbarium
Chamaedorea vulgata	—
Chamaedorea warscewiczii	Kew Herbarium
Chamaedorea whitelockiana	Kew Herbarium
Chamaedorea woodsoniana	—
Chamaedorea zamorae	—
Chamaerops humilis	AAU Herbarium
Chambeyronia lepidota	—
Chambeyronia macrocarpa	Henderson, 2002
Chelyocarpus chuco	Kew Herbarium
Chelyocarpus dianeurus	—

Chelyocarpus repens	Kew Herbarium
Chelyocarpus ulei	AAU Herbarium
Chuniophoenix hainanensis	AAU Herbarium
Chuniophoenix nana	Henderson, 2009
Clinosperma bracteale	Kew Herbarium
Clinosperma lanuginosa	Kew Herbarium
Clinosperma macrocarpa	—
Clinosperma vaginata	Kew Herbarium
Clinostigma carolinense	—
Clinostigma collegarum	Kew Herbarium
Clinostigma exorrhizum	Kew Herbarium
Clinostigma gronophyllum	Kew Herbarium
Clinostigma haerestigma	Kew Herbarium
Clinostigma harlandii	—
Clinostigma onchorhynchum	Kew Herbarium
Clinostigma ponapense	—
Clinostigma samoense	Kew Herbarium
Clinostigma savoryanum	—
Clinostigma warburgii	—
Coccothrinax acunana	Kew Herbarium
Coccothrinax alexandri	—
Coccothrinax alta	Kew Herbarium
Coccothrinax argentata	Kew Herbarium
Coccothrinax argentea	AAU Herbarium
Coccothrinax baracoensis	—
Coccothrinax barbadensis	Henderson, 2002
Coccothrinax bermudezii	—
Coccothrinax borhidiana	—
Coccothrinax boschiana	—
Coccothrinax camagueyana	Kew Herbarium
Coccothrinax clarensis	Kew Herbarium
Coccothrinax concolor	—
Coccothrinax crinita	Henderson, 2002
Coccothrinax cupularis	—
Coccothrinax ekmanii	Henderson, 2002
Coccothrinax elegans	Kew Herbarium
Coccothrinax fagildei	Kew Herbarium
Coccothrinax fragrans	—
Coccothrinax garciana	Kew Herbarium
Coccothrinax gracilis	—
Coccothrinax guantanamensis	Kew Herbarium
Coccothrinax gundlachii	Henderson, 2002
Coccothrinax hioramii	palmpedia
Coccothrinax inaguensis	—

Coccothrinax jamaicensis	—
Coccothrinax leonis	Kew Herbarium
Coccothrinax litoralis	Kew Herbarium
Coccothrinax macroglossa	—
Coccothrinax microphylla	—
Coccothrinax miraguama	Henderson, 2002
Coccothrinax moaensis	Kew Herbarium
Coccothrinax montana	Kew Herbarium
Coccothrinax munizii	Kew Herbarium
Coccothrinax muricata	—
Coccothrinax nipensis	Kew Herbarium
Coccothrinax orientalis	Kew Herbarium
Coccothrinax pauciramosa	—
Coccothrinax proctorii	Jones, 1995
Coccothrinax pseudorigida	Kew Herbarium
Coccothrinax pumila	Kew Herbarium
Coccothrinax readii	AAU Herbarium
Coccothrinax rigida	—
Coccothrinax salvatoris	Kew Herbarium
Coccothrinax savannarum	—
Coccothrinax saxicola	Kew Herbarium
Coccothrinax scoparia	—
Coccothrinax spissa	AAU Herbarium
Coccothrinax torrida	Kew Herbarium
Coccothrinax trinitensis	—
Coccothrinax victorini	Kew Herbarium
Coccothrinax yunquensis	Kew Herbarium
Coccothrinax yuraguana	—
Cocos nucifera	Kew Herbarium
Colpothrinax aphanopetala	Kew Herbarium
Colpothrinax cookii	Kew Herbarium
Colpothrinax wrightii	Kew Herbarium
Copernicia alba	—
Copernicia baileyana	—
Copernicia berteroana	Henderson, 2002
Copernicia brittonorum	Henderson, 2002
Copernicia burretiana	Kew Herbarium
Copernicia cowellii	Henderson, 2002
Copernicia curbeloi	—
Copernicia curtissii	Kew Herbarium
Copernicia ekmanii	Henderson, 2002
Copernicia fallaensis	—
Copernicia gigas	Henderson, 2002
Copernicia glabrescens	Henderson, 2002

Copernicia hospita	—
Copernicia humicola	—
Copernicia longiglossa	Kew Herbarium
Copernicia macroglossa	Henderson, 2002
Copernicia molineti	Kew Herbarium
Copernicia occidentalis	Kew Herbarium
Copernicia oxycalyx	Kew Herbarium
Copernicia prunifera	Kew Herbarium
Copernicia rigida	Henderson, 2002
Copernicia roigii	Kew Herbarium
Copernicia shaferi	—
Copernicia sueroana	Kew Herbarium
Copernicia tectorum	Kew Herbarium
Copernicia textilis	Kew Herbarium
Copernicia vespertilionum	Kew Herbarium
Copernicia yarey	Kew Herbarium
Corypha griffithiana	Kew Herbarium
Corypha lecomtei	Henderson, 2002
Corypha microclada	—
Corypha taliera	—
Corypha umbraculifera	AAU Herbarium
Corypha utan	AAU Herbarium
Cryosophila bartlettii	Kew Herbarium
Cryosophila cookii	—
Cryosophila grayumii	—
Cryosophila guagara	Kew Herbarium
Cryosophila kalbreyeri	—
Cryosophila macrocarpa	Henderson, 2002
Cryosophila nana	Kew Herbarium
Cryosophila stauracantha	Kew Herbarium
Cryosophila warscewiczii	—
Cryosophila williamsii	AAU Herbarium
Cyphokentia cerifera	—
Cyphokentia macrostachya	Kew Herbarium
Cyphophoenix alba	Kew Herbarium
Cyphophoenix elegans	Kew Herbarium
Cyphophoenix fulcita	Kew Herbarium
Cyphophoenix nucele	—
Cyphosperma balansae	Kew Herbarium
Cyphosperma tanga	—
Cyphosperma trichospadix	Essig et al., 1999
Cyphosperma voutmelense	—
Cyrtostachys brassii	Kew Herbarium
Cyrtostachys compsoclada	Kew Herbarium

Cyrtostachys elegans	—
Cyrtostachys glauca	Kew Herbarium
Cyrtostachys kisu	Kew Herbarium
Cyrtostachys ledermanniana	Kew Herbarium
Cyrtostachys loriae	—
Cyrtostachys microcarpa	—
Cyrtostachys peekeliana	Kew Herbarium
Cyrtostachys phanerolepis	Kew Herbarium
Cyrtostachys renda	AAU Herbarium
Daemonorops acamptostachys	—
Daemonorops acehensis	palmweb
Daemonorops affinis	Kew Herbarium
Daemonorops angustifolia	AAU Herbarium
Daemonorops aruensis	—
Daemonorops asteracantha	—
Daemonorops atra	Kew Herbarium
Daemonorops aurea	Henderson, 2009
Daemonorops banggiensis	Kew Herbarium
Daemonorops beguinii	Kew Herbarium
Daemonorops binnendijkii	Kew Herbarium
Daemonorops brachystachys	Kew Herbarium
Daemonorops calapparia	—
Daemonorops calicarpa	Kew Herbarium
Daemonorops clemensiana	—
Daemonorops collarifera	Kew Herbarium
Daemonorops confusa	—
Daemonorops crinita	Kew Herbarium
Daemonorops cristata	—
Daemonorops curranii	Kew Herbarium
Daemonorops depressiuscula	Kew Herbarium
Daemonorops didymophylla	—
Daemonorops draco	Henderson, 2002
Daemonorops dracuncula	Kew Herbarium
Daemonorops dransfieldii	palmweb
Daemonorops elongata	Kew Herbarium
Daemonorops fissa	Kew Herbarium
Daemonorops forbesii	Kew Herbarium
Daemonorops formicaria	—
Daemonorops geniculata	Kew Herbarium
Daemonorops gracilipes	Kew Herbarium
Daemonorops gracilis	Kew Herbarium
Daemonorops grandis	Kew Herbarium
Daemonorops hirsuta	—
Daemonorops horrida	—

Daemonorops ingens	Kew Herbarium
Daemonorops jenkinsiana	Kew Herbarium
Daemonorops korthalsii	AAU Herbarium
Daemonorops kunstleri	—
Daemonorops kurziana	—
Daemonorops lamprolepis	Kew Herbarium
Daemonorops leptopus	AAU Herbarium
Daemonorops lewisiana	AAU Herbarium
Daemonorops loheriana	Kew Herbarium
Daemonorops longipes	AAU Herbarium
Daemonorops longispatha	—
Daemonorops longispinosa	Kew Herbarium
Daemonorops longistipes	AAU Herbarium
Daemonorops macrophylla	—
Daemonorops macroptera	Kew Herbarium
Daemonorops maculata	Henderson, 2002
Daemonorops manii	Henderson, 2009
Daemonorops margaritae	Kew Herbarium
Daemonorops megalocarpa	—
Daemonorops melanochaetes	—
Daemonorops micracantha	Dransfield, 1984
Daemonorops microcarpa	—
Daemonorops microstachys	AAU Herbarium
Daemonorops mirabilis	—
Daemonorops mollis	Kew Herbarium
Daemonorops mollispina	—
Daemonorops monticola	Kew Herbarium
Daemonorops nigra	—
Daemonorops oblata	Henderson, 2002
Daemonorops oblonga	Kew Herbarium
Daemonorops ochrolepis	—
Daemonorops oligolepis	Kew Herbarium
Daemonorops oligophylla	—
Daemonorops oxycarpa	Henderson, 2002
Daemonorops pachyrostris	Kew Herbarium
Daemonorops palembanica	Kew Herbarium
Daemonorops pannosa	Kew Herbarium
Daemonorops pedicellaris	—
Daemonorops periacantha	Kew Herbarium
Daemonorops plagiocycla	Kew Herbarium
Daemonorops poilanei	Kew Herbarium
Daemonorops polita	—
Daemonorops pumila	Kew Herbarium
Daemonorops rarispinosa	Henderson, 2009

Daemonorops riedeliana	Kew Herbarium
Daemonorops robusta	Kew Herbarium
Daemonorops rubra	Kew Herbarium
Daemonorops ruptilis	Kew Herbarium
Daemonorops sabut	Kew Herbarium
Daemonorops sarasinorum	Kew Herbarium
Daemonorops scapigera	Kew Herbarium
Daemonorops schlechteri	Kew Herbarium
Daemonorops sekundurensis	palmweb
Daemonorops sepal	AAU Herbarium
Daemonorops serpentina	—
Daemonorops siberutensis	palmweb
Daemonorops singalana	—
Daemonorops sparsiflora	—
Daemonorops spectabilis	Kew Herbarium
Daemonorops stenophylla	Kew Herbarium
Daemonorops treubiana	—
Daemonorops trichroa	—
Daemonorops unijuga	Henderson, 2002
Daemonorops urdanetana	Kew Herbarium
Daemonorops uschdraweitiana	Kew Herbarium
Daemonorops verticillaris	AAU Herbarium
Daemonorops wrightmyoensis	Henderson, 2009
Deckenia nobilis	Kew Herbarium
Desmoncus anomalus	—
Desmoncus chinantlensis	—
Desmoncus cirrhiferus	Kew Herbarium
Desmoncus costaricensis	palmweb
Desmoncus giganteus	Kew Herbarium
Desmoncus isthmius	Kew Herbarium
Desmoncus mitis	Kew Herbarium
Desmoncus orthacanthos	—
Desmoncus phoenicocarpus	Kew Herbarium
Desmoncus polyacanthos	Kew Herbarium
Desmoncus schippii	Kew Herbarium
Desmoncus stans	—
Dictyocaryum fuscum	—
Dictyocaryum lamarckianum	Kew Herbarium
Dictyocaryum ptarianum	Kew Herbarium
Dictyosperma album	Essig et al., 1999
Dransfieldia micrantha	palmweb
Drymophloeus hentyi	—
Drymophloeus lepidotus	—
Drymophloeus litigiosus	Kew Herbarium

Drymophloeus oliviformis	Kew Herbarium
Drymophloeus oninensis	—
Drymophloeus pachycladus	Kew Herbarium
Drymophloeus subdistichus	Kew Herbarium
Drymophloeus whitmeeanus	—
Dypsis acaulis	Kew Herbarium
Dypsis acuminum	—
Dypsis albofarinosa	—
Dypsis ambanjae	Kew Herbarium
Dypsis ambilaensis	—
Dypsis ambositrae	Kew Herbarium
Dypsis ampasindavae	Kew Herbarium
Dypsis andapae	—
Dypsis andrianatonga	Kew Herbarium
Dypsis angusta	—
Dypsis angustifolia	Kew Herbarium
Dypsis ankaizinensis	Kew Herbarium
Dypsis antanambensis	Kew Herbarium
Dypsis aquatilis	Kew Herbarium
Dypsis arenarum	—
Dypsis baronii	—
Dypsis basilonga	Kew Herbarium
Dypsis beentjei	Kew Herbarium
Dypsis bejofo	Kew Herbarium
Dypsis bernieriana	Kew Herbarium
Dypsis betamponensis	—
Dypsis boiviniana	Kew Herbarium
Dypsis bonsai	Kew Herbarium
Dypsis bosseri	Kew Herbarium
Dypsis brevicaulis	Kew Herbarium
Dypsis cabadae	—
Dypsis canaliculata	Kew Herbarium
Dypsis canescens	Kew Herbarium
Dypsis carlsmithii	Kew Herbarium
Dypsis catatiana	Kew Herbarium
Dypsis caudata	—
Dypsis ceracea	Kew Herbarium
Dypsis commersoniana	—
Dypsis concinna	Kew Herbarium
Dypsis confusa	—
Dypsis cookei	Kew Herbarium
Dypsis coriacea	—
Dypsis corniculata	—
Dypsis coursii	Kew Herbarium

Dypsis crinita	Kew Herbarium
Dypsis curtisii	—
Dypsis decaryi	—
Dypsis decipiens	—
Dypsis delicatula	Kew Herbarium
Dypsis digitata	—
Dypsis dransfieldii	Kew Herbarium
Dypsis elegans	Kew Herbarium
Dypsis eriostachys	Kew Herbarium
Dypsis faneva	—
Dypsis fanjana	Kew Herbarium
Dypsis fasciculata	—
Dypsis fibrosa	Kew Herbarium
Dypsis forficifolia	Kew Herbarium
Dypsis furcata	Kew Herbarium
Dypsis glabrescens	—
Dypsis henrici	Kew Herbarium
Dypsis heteromorpha	—
Dypsis heterophylla	Kew Herbarium
Dypsis hiarakae	Kew Herbarium
Dypsis hildebrandtii	—
Dypsis hovomantsina	Kew Herbarium
Dypsis humbertii	AAU Herbarium
Dypsis humblotiana	Kew Herbarium
Dypsis ifanadianae	—
Dypsis integra	Kew Herbarium
Dypsis intermedia	Kew Herbarium
Dypsis interrupta	Kew Herbarium
Dypsis jumelleana	—
Dypsis laevis	Kew Herbarium
Dypsis lanceolata	—
Dypsis lantzeana	Kew Herbarium
Dypsis lanuginosa	Kew Herbarium
Dypsis lastelliana	—
Dypsis leptocheilos	Kew Herbarium
Dypsis ligulata	Kew Herbarium
Dypsis linearis	Kew Herbarium
Dypsis lokohensis	Kew Herbarium
Dypsis louvelii	—
Dypsis lucens	—
Dypsis lutea	Kew Herbarium
Dypsis lutescens	Kew Herbarium
Dypsis madagascariensis	—
Dypsis mahia	Kew Herbarium

Dypsis malcomberi	Kew Herbarium
Dypsis mananjarensis	Kew Herbarium
Dypsis mangorensis	Kew Herbarium
Dypsis marojejyi	—
Dypsis mcdonaldiana	Kew Herbarium
Dypsis minuta	Kew Herbarium
Dypsis mirabilis	—
Dypsis mocquerysiana	Kew Herbarium
Dypsis monostachya	Kew Herbarium
Dypsis montana	Kew Herbarium
Dypsis moorei	—
Dypsis nauseosa	—
Dypsis nodifera	Kew Herbarium
Dypsis nossibensis	—
Dypsis occidentalis	Kew Herbarium
Dypsis onilahensis	Kew Herbarium
Dypsis oreophila	Kew Herbarium
Dypsis oropedionis	Kew Herbarium
Dypsis ovobontsira	Kew Herbarium
Dypsis pachyramea	Kew Herbarium
Dypsis paludosa	Kew Herbarium
Dypsis pembana	Kew Herbarium
Dypsis perrieri	Kew Herbarium
Dypsis pervillei	Kew Herbarium
Dypsis pilulifera	—
Dypsis pinnatifrons	Kew Herbarium
Dypsis plurisecta	Kew Herbarium
Dypsis poivreana	Kew Herbarium
Dypsis prestoniana	Kew Herbarium
Dypsis procera	Kew Herbarium
Dypsis procumbens	Kew Herbarium
Dypsis psammophila	—
Dypsis pulchella	—
Dypsis pumila	Kew Herbarium
Dypsis pusilla	Kew Herbarium
Dypsis ramentacea	Kew Herbarium
Dypsis remotiflora	Kew Herbarium
Dypsis rivularis	Kew Herbarium
Dypsis robusta	Kew Herbarium
Dypsis sahanofensis	Kew Herbarium
Dypsis saintelucei	Kew Herbarium
Dypsis sanctaemariae	—
Dypsis scandens	—
Dypsis schatzii	Kew Herbarium

Dypsis scottiana	—
Dypsis serpentina	Kew Herbarium
Dypsis simianensis	Kew Herbarium
Dypsis singularis	Kew Herbarium
Dypsis soanieranae	Kew Herbarium
Dypsis spicata	Kew Herbarium
Dypsis tanalensis	—
Dypsis tenuissima	Kew Herbarium
Dypsis thermarum	Kew Herbarium
Dypsis thiryana	Kew Herbarium
Dypsis thouarsiana	Kew Herbarium
Dypsis tokoravina	Kew Herbarium
Dypsis trapezoidea	Kew Herbarium
Dypsis tsaratananensis	—
Dypsis tsaravoasira	Kew Herbarium
Dypsis turkii	Kew Herbarium
Dypsis utilis	Kew Herbarium
Dypsis viridis	Kew Herbarium
Elaeis guineensis	—
Elaeis oleifera	Kew Herbarium
Eleiodoxa conferta	Kew Herbarium
Eremospatha barendii	Sunderland, 2007
Eremospatha cabrae	Sunderland, 2007
Eremospatha cuspidata	Sunderland, 2007
Eremospatha dransfieldii	Kew Herbarium
Eremospatha haullevilleana	—
Eremospatha hookeri	Sunderland, 2007
Eremospatha laurentii	Sunderland, 2007
Eremospatha macrocarpa	Sunderland, 2007
Eremospatha quinquecostulata	Kew Herbarium
Eremospatha tessmanniana	Kew Herbarium
Eremospatha wendlandiana	Sunderland, 2007
Eugeissona ambigua	Kew Herbarium
Eugeissona brachystachys	Kew Herbarium
Eugeissona insignis	—
Eugeissona minor	—
Eugeissona triste	—
Eugeissona utilis	—
Euterpe broadwayi	Kew Herbarium
Euterpe catinga	Kew Herbarium
Euterpe edulis	—
Euterpe longibracteata	Kew Herbarium
Euterpe luminosa	Kew Herbarium
Euterpe oleracea	Kew Herbarium

Euterpe precatoria	Kew Herbarium
Gaussia attenuata	—
Gaussia gomez-pompae	—
Gaussia maya	—
Gaussia princeps	Henderson, 2002
Gaussia spirituana	—
Geonoma appuniana	Kew Herbarium
Geonoma arundinacea	Kew Herbarium
Geonoma aspidiifolia	Kew Herbarium
Geonoma atrovirens	AAU Herbarium
Geonoma awaensis	AAU Herbarium
Geonoma baculifera	Kew Herbarium
Geonoma brenesii	AAU Herbarium
Geonoma brevispatha	Kew Herbarium
Geonoma brongniartii	Kew Herbarium
Geonoma camana	Kew Herbarium
Geonoma chlamydostachys	—
Geonoma chococola	Kew Herbarium
Geonoma concinna	—
Geonoma congesta	Kew Herbarium
Geonoma cuneata	Kew Herbarium
Geonoma densa	Kew Herbarium
Geonoma deversa	Kew Herbarium
Geonoma divisa	—
Geonoma ecuadoriensis	Kew Herbarium
Geonoma epetiolata	Kew Herbarium
Geonoma ferruginea	Kew Herbarium
Geonoma gamiova	Kew Herbarium
Geonoma hoffmanniana	—
Geonoma hollinensis	—
Geonoma hugonis	AAU Herbarium
Geonoma interrupta	Kew Herbarium
Geonoma irena	AAU Herbarium
Geonoma jussieuana	Kew Herbarium
Geonoma lanata	AAU Herbarium
Geonoma laxiflora	Kew Herbarium
Geonoma leptospadix	Kew Herbarium
Geonoma linearis	Kew Herbarium
Geonoma longipedunculata	Kew Herbarium
Geonoma longivaginata	Kew Herbarium
Geonoma macrostachys	Kew Herbarium
Geonoma maxima	Kew Herbarium
Geonoma monospatha	AAU Herbarium
Geonoma mooreana	palmweb

Geonoma myriantha	Kew Herbarium
Geonoma oldemanii	—
Geonoma oligoclona	Galeano & Bernal, 2010
Geonoma orbignyana	Kew Herbarium
Geonoma paradoxa	Kew Herbarium
Geonoma paraguanensis	—
Geonoma pauciflora	—
Geonoma poeppigiana	Kew Herbarium
Geonoma pohliana	—
Geonoma polyandra	Kew Herbarium
Geonoma polyneura	—
Geonoma rubescens	Kew Herbarium
Geonoma santanderensis	—
Geonoma schottiana	—
Geonoma scoparia	—
Geonoma seleri	Kew Herbarium
Geonoma simplicifrons	Kew Herbarium
Geonoma skovii	—
Geonoma spinescens	Kew Herbarium
Geonoma stricta	Kew Herbarium
Geonoma supracostata	AAU Herbarium
Geonoma talamancana	palmweb
Geonoma tenuissima	Kew Herbarium
Geonoma triandra	Kew Herbarium
Geonoma triglochin	Kew Herbarium
Geonoma trigona	Kew Herbarium
Geonoma umbraculiformis	Kew Herbarium
Geonoma undata	Kew Herbarium
Geonoma weberbaueri	Kew Herbarium
Geonoma wilsonii	Galeano & Bernal, 2010
Guihaia argyrata	—
Guihaia grossifibrosa	AAU Herbarium
Hedyscepe canterburyana	Dowe, 2010
Hemithrinax compacta	Henderson et al., 1995
Hemithrinax ekmaniana	—
Hemithrinax rivularis	palmweb
Heterospathe annectens	—
Heterospathe arfakiana	Kew Herbarium
Heterospathe brevicaulis	—
Heterospathe cagayanensis	—
Heterospathe califrons	—
Heterospathe clemensiae	Kew Herbarium
Heterospathe delicatula	—
Heterospathe dransfieldii	—

Heterospathe elata	Kew Herbarium
Heterospathe elegans	AAU Herbarium
Heterospathe elmeri	—
Heterospathe glabra	AAU Herbarium
Heterospathe glauca	—
Heterospathe humilis	—
Heterospathe intermedia	Kew Herbarium
Heterospathe kajewskii	Kew Herbarium
Heterospathe ledermanniana	Kew Herbarium
Heterospathe lepidota	—
Heterospathe longipes	Essig et al., 1999
Heterospathe macgregorii	AAU Herbarium
Heterospathe minor	—
Heterospathe muelleriana	AAU Herbarium
Heterospathe negrosensis	Kew Herbarium
Heterospathe obriensis	Principes 13
Heterospathe parviflora	Principes 36
Heterospathe philippinensis	Kew Herbarium
Heterospathe phillipsii	Principes 41
Heterospathe pilosa	Kew Herbarium
Heterospathe pulchra	Principes 13
Heterospathe ramulosa	—
Heterospathe salomonensis	—
Heterospathe scitula	—
Heterospathe sensisi	Webbia
Heterospathe sibuyanensis	Leaflets
Heterospathe sphaerocarpa	—
Heterospathe trispatha	palmweb
Heterospathe uniformis	—
Heterospathe versteegiana	Kew Herbarium
Heterospathe woodfordiana	—
Howea belmoreana	—
Howea forsteriana	Dowe, 2010
Hydriastele affinis	Kew Herbarium
Hydriastele aprica	Kew Herbarium
Hydriastele beccariana	Kew Herbarium
Hydriastele beguinii	Kew Herbarium
Hydriastele boumae	—
Hydriastele brassii	—
Hydriastele cariosa	Kew Herbarium
Hydriastele carrii	—
Hydriastele chaunostachys	—
Hydriastele costata	—
Hydriastele cyclopensis	Kew Herbarium

Hydriastele cylindrocarpa	—
Hydriastele dransfieldii	Kew Herbarium
Hydriastele flabellata	Kew Herbarium
Hydriastele geelvinkiana	Kew Herbarium
Hydriastele gibbsiana	Kew Herbarium
Hydriastele gracilis	Kew Herbarium
Hydriastele hombronii	Kew Herbarium
Hydriastele kasesa	Kew Herbarium
Hydriastele kjellbergii	—
Hydriastele ledermanniana	—
Hydriastele lepidota	—
Hydriastele longispatha	Kew Herbarium
Hydriastele lurida	Kew Herbarium
Hydriastele macrospadix	Kew Herbarium
Hydriastele manusii	Kew Herbarium
Hydriastele mayrii	Kew Herbarium
Hydriastele micrantha	—
Hydriastele microcarpa	Kew Herbarium
Hydriastele microspadix	Kew Herbarium
Hydriastele moluccana	Kew Herbarium
Hydriastele montana	—
Hydriastele nannostachys	—
Hydriastele oxypetala	Kew Herbarium
Hydriastele palauensis	—
Hydriastele pinangoides	Kew Herbarium
Hydriastele pleurocarpa	—
Hydriastele procera	Kew Herbarium
Hydriastele ramsayi	Dowe, 2010
Hydriastele rheophytica	Dowe & Ferrero, 2000
Hydriastele rhopalocarpa	Kew Herbarium
Hydriastele rostrata	—
Hydriastele sarasinorum	—
Hydriastele selebica	Kew Herbarium
Hydriastele valida	Kew Herbarium
Hydriastele variabilis	Kew Herbarium
Hydriastele vitiensis	Kew Herbarium
Hydriastele wendlandiana	—
Hyophorbe amaricaulis	Henderson, 2002
Hyophorbe indica	Kew Herbarium
Hyophorbe lagenicaulis	AAU Herbarium
Hyophorbe vaughanii	Henderson, 2002
Hyophorbe verschaffeltii	Kew Herbarium
Hyospathe elegans	AAU Herbarium
Hyospathe frontinensis	—

Hyospathe macrorhachis	—
Hyospathe peruviana	—
Hyphaene compressa	—
Hyphaene coriacea	Kew Herbarium
Hyphaene dichotoma	—
Hyphaene guineensis	Kew Herbarium
Hyphaene macrosperma	—
Hyphaene petersiana	Henderson, 2002
Hyphaene reptans	Tuley, 1995
Hyphaene thebaica	Kew Herbarium
Iguanura ambigua	Kew Herbarium
Iguanura asli	palmweb
Iguanura belumensis	palmweb
Iguanura bicornis	AAU Herbarium
Iguanura borneensis	AAU Herbarium
Iguanura cemurung	AAU Herbarium
Iguanura chaiana	Henderson, 2002
Iguanura corniculata	Henderson, 2002
Iguanura curvata	Henderson, 2002
Iguanura diffusa	Kew Herbarium
Iguanura divergens	—
Iguanura elegans	Kew Herbarium
Iguanura geonomiformis	Kew Herbarium
Iguanura humilis	palmweb
Iguanura kelantanensis	—
Iguanura leucocarpa	Henderson, 2002
Iguanura macrostachya	Kew Herbarium
Iguanura melinauensis	—
Iguanura minor	Kew Herbarium
Iguanura mirabilis	—
Iguanura myochodoides	—
Iguanura palmuncula	Kew Herbarium
Iguanura parvula	Kew Herbarium
Iguanura perdana	palmweb
Iguanura piahensis	—
Iguanura polymorpha	AAU Herbarium
Iguanura prolifera	Kew Herbarium
Iguanura remotiflora	Henderson, 2002
Iguanura sanderiana	Kew Herbarium
Iguanura tenuis	Henderson, 2002
Iguanura thalangensis	Henderson, 2009
Iguanura wallichiana	—
Iriartea deltoidea	AAU Herbarium
Iriartella setigera	—

Iriartella stenocarpa	palmpedia
Itaya amicorum	AAU Herbarium
Johannesteijsmannia altifrons	AAU Herbarium
Johannesteijsmannia lanceolata	Henderson, 2002
Johannesteijsmannia magnifica	Henderson, 2002
Johannesteijsmannia perakensis	—
Juania australis	AAU Herbarium
Jubaea chilensis	AAU Herbarium
Jubaeopsis caffra	Henderson, 2002
Kentiopsis magnifica	Henderson, 2002
Kentiopsis oliviformis	Henderson, 2002
Kentiopsis piersoniorum	—
Kentiopsis pyriformis	Henderson, 2002
Kerriodoxa elegans	AAU Herbarium
Korthalsia angustifolia	AAU Herbarium
Korthalsia bejaudii	—
Korthalsia brassii	Kew Herbarium
Korthalsia celebica	—
Korthalsia cheb	Henderson, 2002
Korthalsia concolor	Kew Herbarium
Korthalsia debilis	palmweb
Korthalsia echinometra	Kew Herbarium
Korthalsia ferox	Kew Herbarium
Korthalsia flagellaris	AAU Herbarium
Korthalsia furcata	—
Korthalsia furtadoana	AAU Herbarium
Korthalsia hispida	AAU Herbarium
Korthalsia jala	Kew Herbarium
Korthalsia junghuhnii	AAU Herbarium
Korthalsia laciniosa	AAU Herbarium
Korthalsia lanceolata	Henderson, 2002
Korthalsia merrillii	Kew Herbarium
Korthalsia paucijuga	Kew Herbarium
Korthalsia rigida	AAU Herbarium
Korthalsia robusta	Kew Herbarium
Korthalsia rogersii	—
Korthalsia rostrata	AAU Herbarium
Korthalsia scaphigeroides	Kew Herbarium
Korthalsia scortechinii	Henderson, 2009
Korthalsia tenuissima	Kew Herbarium
Korthalsia zippelii	—
Laccospadix australasicus	Dowe, 2010
Laccosperma acutiflorum	—
Laccosperma korupensis	Kew Herbarium

Laccosperma laeve	—
Laccosperma opacum	AAU Herbarium
Laccosperma robustum	AAU Herbarium
Laccosperma secundiflorum	AAU Herbarium
Latania loddigesii	Kew Herbarium
Latania lontaroides	Kew Herbarium
Latania verschaffeltii	—
Lemurophoenix halleuxii	Essig, 2008
Leopoldinia major	—
Leopoldinia piassaba	Kew Herbarium
Leopoldinia pulchra	Kew Herbarium
Lepidocaryum tenue	Kew Herbarium
Lepidorrhachis mooreana	Dowe, 2010
Leucothrinax morrisii	palmpedia
Licuala acaulis	AAU Herbarium
Licuala acuminata	Kew Herbarium
Licuala acutifida	—
Licuala ahlidurii	Kew Herbarium
Licuala angustiloba	—
Licuala anomala	Kew Herbarium
Licuala arbuscula	Kew Herbarium
Licuala aruensis	Kew Herbarium
Licuala atroviridis	—
Licuala averyanovii	Henderson, 2009
Licuala bachmaensis	Kew Herbarium
Licuala bacularia	—
Licuala bayana	AAU Herbarium
Licuala beccariana	Kew Herbarium
Licuala bellatula	Kew Herbarium
Licuala bidentata	—
Licuala bidoupensis	Kew Herbarium
Licuala bifida	palmweb
Licuala bintulensis	Kew Herbarium
Licuala bissula	Kew Herbarium
Licuala borneensis	—
Licuala bracteata	Kew Herbarium
Licuala brevicalyx	Kew Herbarium
Licuala cabalionii	Kew Herbarium
Licuala calciphila	Henderson, 2009
Licuala cameronensis	—
Licuala cattienensis	Kew Herbarium
Licuala celebica	Kew Herbarium
Licuala centralis	AAU Herbarium
Licuala concinna	AAU Herbarium

Licuala cordata	Kew Herbarium
Licuala corneri	Kew Herbarium
Licuala crassiflora	AAU Herbarium
Licuala dasyantha	—
Licuala debilis	—
Licuala densiflora	Kew Herbarium
Licuala distans	Kew Herbarium
Licuala egregia	Henderson, 2002
Licuala elegans	Kew Herbarium
Licuala elegantissima	—
Licuala ellipsoidalis	—
Licuala fatua	Kew Herbarium
Licuala ferruginea	Kew Herbarium
Licuala ferruginoides	—
Licuala flabellum	Kew Herbarium
Licuala flavida	Kew Herbarium
Licuala flexuosa	—
Licuala fordiana	—
Licuala fractiflexa	—
Licuala furcata	Kew Herbarium
Licuala gjellerupii	—
Licuala glaberrima	Kew Herbarium
Licuala glabra	Kew Herbarium
Licuala gracilis	—
Licuala graminifolia	Kew Herbarium
Licuala grandiflora	Kew Herbarium
Licuala grandis	—
Licuala hainanensis	AAU Herbarium
Licuala hallieriana	Kew Herbarium
Licuala hexasepala	Henderson, 2009
Licuala insignis	—
Licuala kamarudinii	—
Licuala kemamanensis	Kew Herbarium
Licuala khoonmengii	Kew Herbarium
Licuala kiahii	Kew Herbarium
Licuala kingiana	Henderson, 2002
Licuala klossii	Kew Herbarium
Licuala kunstleri	AAU Herbarium
Licuala lanata	—
Licuala lanuginosa	Henderson, 2002
Licuala lauterbachii	Kew Herbarium
Licuala leprosa	Kew Herbarium
Licuala leptocalyx	—
Licuala linearis	AAU Herbarium

Licuala longicalycata	Kew Herbarium
Licuala longiflora	Henderson, 2009
Licuala longipes	Kew Herbarium
Licuala longispadix	—
Licuala macrantha	Kew Herbarium
Licuala magalonii	—
Licuala magna	AAU Herbarium
Licuala malajana	Kew Herbarium
Licuala manglaensis	Henderson, 2009
Licuala mattanensis	Kew Herbarium
Licuala merguensis	—
Licuala micholitzii	—
Licuala micrantha	—
Licuala mirabilis	—
Licuala modesta	Kew Herbarium
Licuala montana	Kew Herbarium
Licuala moszkowskiana	Kew Herbarium
Licuala moyseyi	—
Licuala mustapana	—
Licuala nana	—
Licuala naumoniensis	—
Licuala nauroannii	Kew Herbarium
Licuala olivifera	Kew Herbarium
Licuala oliviformis	—
Licuala oninensis	Kew Herbarium
Licuala orbicularis	Kew Herbarium
Licuala pachycalyx	—
Licuala pahangensis	Kew Herbarium
Licuala palas	Kew Herbarium
Licuala paludosa	Kew Herbarium
Licuala parviflora	AAU Herbarium
Licuala patens	Kew Herbarium
Licuala paucisecta	Kew Herbarium
Licuala peekelii	Kew Herbarium
Licuala peltata	—
Licuala penduliflora	Kew Herbarium
Licuala petiolulata	—
Licuala pitta	—
Licuala platydactyla	Kew Herbarium
Licuala polyschista	Kew Herbarium
Licuala poonsakii	AAU Herbarium
Licuala pulchella	Kew Herbarium
Licuala pumila	Kew Herbarium
Licuala punctulata	—

Licuala pusilla	Kew Herbarium
Licuala radula	Henderson, 2009
Licuala ramsayi	Kew Herbarium
Licuala reptans	—
Licuala ridleyana	Henderson, 2002
Licuala robinsoniana	Henderson, 2009
Licuala robusta	—
Licuala rumphii	Kew Herbarium
Licuala ruthiae	—
Licuala sallehana	Kew Herbarium
Licuala sarawakensis	—
Licuala scortechinii	—
Licuala simplex	—
Licuala spathellifera	—
Licuala spectabilis	—
Licuala spicata	Kew Herbarium
Licuala spinosa	—
Licuala steinii	—
Licuala stipitata	Kew Herbarium
Licuala stongensis	—
Licuala tanycola	—
Licuala taynguyensis	AAU Herbarium
Licuala telifera	AAU Herbarium
Licuala tenuissima	Saw, 2003
Licuala terengganuensis	—
Licuala thoana	Kew Herbarium
Licuala tiomanensis	Saw, 2003
Licuala tomentosa	—
Licuala tonkinensis	Kew Herbarium
Licuala triphylla	AAU Herbarium
Licuala valida	Kew Herbarium
Licuala whitmorei	Saw, 2003
Linospadix albertisianus	AAU Herbarium
Linospadix apetiolatus	Dowe, 2010
Linospadix caninus	Kew Herbarium
Linospadix microcaryus	Dowe, 2010
Linospadix microspadix	Kew Herbarium
Linospadix minor	Dowe, 2010
Linospadix monostachyos	Dowe, 2010
Linospadix palmerianus	Dowe, 2010
Livistona alfredii	—
Livistona australis	AAU Herbarium
Livistona benthamii	Dowe, 2010
Livistona brevifolia	Kew Herbarium

Livistona carinensis	palmweb
Livistona chinensis	AAU Herbarium
Livistona chocolatina	AAU Herbarium
Livistona concinna	AAU Herbarium
Livistona decora	Dowe, 2010
Livistona drudei	Dowe, 2010
Livistona eastonii	Dowe, 2010
Livistona endauensis	AAU Herbarium
Livistona exigua	—
Livistona fulva	Dowe, 2010
Livistona halongensis	Kew Herbarium
Livistona humilis	Dowe, 2010
Livistona inermis	—
Livistona jenkinsiana	—
Livistona lanuginosa	—
Livistona lorophylla	Dowe, 2010
Livistona mariae	Dowe, 2010
Livistona merrillii	Kew Herbarium
Livistona muelleri	Dowe, 2010
Livistona nasmophila	Dowe, 2010
Livistona nitida	Dowe, 2010
Livistona papuana	AAU Herbarium
Livistona rigida	AAU Herbarium
Livistona robinsoniana	Kew Herbarium
Livistona rotundifolia	Henderson, 2002
Livistona saribus	AAU Herbarium
Livistona surru	—
Livistona tahanensis	palmweb
Livistona tothur	—
Livistona victoriae	—
Livistona woodfordii	Kew Herbarium
Lodoicea maldivica	Henderson, 2002
Loxococcus rupicola	Henderson, 2009
Lytocaryum hoehnei	Henderson, 2002
Lytocaryum weddellianum	Lorenzi, 2010
Manicaria saccifera	AAU Herbarium
Marojejya darianii	Henderson, 2002
Marojejya insignis	Henderson, 2002
Masoala kona	Henderson, 2002
Masoala madagascariensis	Dransfield & Beentje, 1995
Mauritia carana	Galeano & Bernal, 2010
Mauritia flexuosa	AAU Herbarium
Mauritiella aculeata	AAU Herbarium
Mauritiella armata	AAU Herbarium

Mauritiella macroclada	Henderson, 2002
Maxburretia furtadoana	AAU Herbarium
Maxburretia gracilis	AAU Herbarium
Maxburretia rupicola	Henderson, 2002
Medemia argun	Henderson, 2002
Metroxylon amicarum	—
Metroxylon paulcoxii	Henderson, 2002
Metroxylon sagu	AAU Herbarium
Metroxylon salomonense	Henderson, 2002
Metroxylon upoluense	Kew Herbarium
Metroxylon vitiense	Henderson, 2002
Metroxylon warburgii	—
Myrialepis paradoxa	AAU Herbarium
Nannorrhops ritchiana	Henderson, 2009
Nenga banaensis	AAU Herbarium
Nenga gajah	Kew Herbarium
Nenga grandiflora	Fernando, 1983
Nenga macrocarpa	—
Nenga pumila	—
Neonicholsonia watsonii	AAU Herbarium
Neoveitchia brunnea	Kew Herbarium
Neoveitchia storckii	—
Nephrosperma van-houtteanum	Essig et al., 2001
Normanbya normanbyi	Dowe, 2010
Nypa fruticans	AAU Herbarium
Oenocarpus andersonii	Kew Herbarium
Oenocarpus bacaba	AAU Herbarium
Oenocarpus balickii	AAU Herbarium
Oenocarpus bataua	AAU Herbarium
Oenocarpus circumtextus	AAU Herbarium
Oenocarpus distichus	Henderson, 2002
Oenocarpus makeru	Henderson, 2002
Oenocarpus mapora	AAU Herbarium
Oenocarpus minor	—
Oenocarpus simplex	—
Oncocalamus djodu	Kew Herbarium
Oncocalamus macrospathus	palmweb
Oncocalamus mannii	—
Oncocalamus tuleyi	—
Oncocalamus wrightianus	—
Oncosperma fasciculatum	—
Oncosperma gracilipes	Kew Herbarium
Oncosperma horridum	AAU Herbarium
Oncosperma platyphyllum	—

Oncosperma tigillarium	AAU Herbarium
Orania archboldiana	palmweb
Orania decipiens	palmweb
Orania disticha	palmweb
Orania gagavu	palmweb
Orania glauca	Kew Herbarium
Orania lauterbachiana	palmweb
Orania longisquama	Henderson, 2002
Orania macropetala	palmweb
Orania moluccana	Kew Herbarium
Orania oreophila	—
Orania palindan	palmweb
Orania paraguanensis	palmweb
Orania parva	palmweb
Orania ravaka	Henderson, 2002
Orania regalis	—
Orania rubiginosa	Kew Herbarium
Orania sylvicola	AAU Herbarium
Orania trispatha	Henderson, 2002
Oraniopsis appendiculata	palmpedia
Parajubaea cocoides	AAU Herbarium
Parajubaea sunkha	AAU Herbarium
Parajubaea torallyi	AAU Herbarium
Pelagodoxa henryana	Essig et al., 1999
Phoenicophorium borsigianum	Essig et al., 2001
Phoenix acaulis	Henderson, 2009
Phoenix andamanensis	—
Phoenix atlantica	—
Phoenix caespitosa	Henderson, 2002
Phoenix canariensis	Henderson, 2002
Phoenix dactylifera	AAU Herbarium
Phoenix loureiroi	—
Phoenix paludosa	—
Phoenix pusilla	Henderson, 2009
Phoenix reclinata	AAU Herbarium
Phoenix roebelenii	Henderson, 2009
Phoenix rupicola	Henderson, 2009
Phoenix sylvestris	Henderson, 2009
Phoenix theophrasti	Henderson, 2002
Pholidocarpus ihur	—
Pholidocarpus kingianus	AAU Herbarium
Pholidocarpus macrocarpus	AAU Herbarium
Pholidocarpus majadum	—
Pholidocarpus mucronatus	Kew Herbarium

Pholidocarpus sumatranus	Kew Herbarium
Pholidostachys dactyloides	—
Pholidostachys kalbreyeri	AAU Herbarium
Pholidostachys pulchra	AAU Herbarium
Pholidostachys synanthera	AAU Herbarium
Physokentia avia	—
Physokentia dennisii	—
Physokentia insolita	—
Physokentia petiolata	palmweb
Physokentia tete	—
Physokentia thurstonii	Henderson, 2002
Physokentia whitmorei	Henderson, 2002
Phytelephas aequatorialis	Kew Herbarium
Phytelephas macrocarpa	Kew Herbarium
Phytelephas schottii	AAU Herbarium
Phytelephas seemannii	—
Phytelephas tenuicaulis	AAU Herbarium
Phytelephas tumacana	—
Pigafetta elata	Kew Herbarium
Pigafetta filaris	—
Pinanga acaulis	—
Pinanga acuminata	—
Pinanga adangensis	Henderson, 2002
Pinanga albescens	Kew Herbarium
Pinanga andamanensis	AAU Herbarium
Pinanga angustisecta	—
Pinanga annamensis	Henderson, 2009
Pinanga arinasae	Kew Herbarium
Pinanga aristata	Kew Herbarium
Pinanga arundinacea	Kew Herbarium
Pinanga auriculata	Henderson, 2009
Pinanga badia	—
Pinanga basilanensis	Henderson, 2002
Pinanga batanensis	Kew Herbarium
Pinanga baviensis	—
Pinanga bicolana	—
Pinanga borneensis	Kew Herbarium
Pinanga brevipes	Kew Herbarium
Pinanga caesia	Kew Herbarium
Pinanga capitata	Kew Herbarium
Pinanga cattienensis	Kew Herbarium
Pinanga celebica	Kew Herbarium
Pinanga chaiana	Kew Herbarium
Pinanga chinensis	Kew Herbarium

Pinanga cleistantha	Kew Herbarium
Pinanga copelandii	Kew Herbarium
Pinanga coronata	Kew Herbarium
Pinanga crassipes	Kew Herbarium
Pinanga cucullata	—
Pinanga cupularis	Kew Herbarium
Pinanga curranii	Kew Herbarium
Pinanga declinata	—
Pinanga decora	—
Pinanga densiflora	Kew Herbarium
Pinanga dicksonii	Kew Herbarium
Pinanga discolor	Kew Herbarium
Pinanga disticha	AAU Herbarium
Pinanga dumetosa	Henderson, 2002
Pinanga duperreana	—
Pinanga egregia	—
Pinanga forbesii	Kew Herbarium
Pinanga fractiflexa	—
Pinanga furfuracea	Kew Herbarium
Pinanga geonomiformis	—
Pinanga glauca	—
Pinanga glaucifolia	palmweb
Pinanga globulifera	Kew Herbarium
Pinanga gracilis	Henderson, 2009
Pinanga gracillima	Kew Herbarium
Pinanga grandijuga	Kew Herbarium
Pinanga grandis	Kew Herbarium
Pinanga griffithii	—
Pinanga heterophylla	Kew Herbarium
Pinanga hexasticha	—
Pinanga hookeriana	—
Pinanga humilis	AAU Herbarium
Pinanga hymenospatha	Henderson, 2009
Pinanga inaequalis	Kew Herbarium
Pinanga insignis	Kew Herbarium
Pinanga isabelensis	Kew Herbarium
Pinanga jamariensis	Kew Herbarium
Pinanga jambusana	Kew Herbarium
Pinanga javana	palmweb
Pinanga johorensis	—
Pinanga keahii	Kew Herbarium
Pinanga kontumensis	Kew Herbarium
Pinanga lacei	Kew Herbarium
Pinanga latisecta	Kew Herbarium

Pinanga lepidota	Kew Herbarium
Pinanga ligulata	Kew Herbarium
Pinanga limbangensis	Kew Herbarium
Pinanga limosa	Kew Herbarium
Pinanga macroclada	Kew Herbarium
Pinanga macrospadix	Kew Herbarium
Pinanga maculata	Kew Herbarium
Pinanga malaiana	AAU Herbarium
Pinanga manii	Henderson, 2009
Pinanga megalocarpa	—
Pinanga micholitzii	Kew Herbarium
Pinanga minor	—
Pinanga minuta	Kew Herbarium
Pinanga mirabilis	Kew Herbarium
Pinanga modesta	Kew Herbarium
Pinanga mooreana	Henderson, 2002
Pinanga negrosensis	Kew Herbarium
Pinanga pachycarpa	Kew Herbarium
Pinanga pachyphylla	Henderson, 2002
Pinanga palustris	—
Pinanga pantiensis	Kew Herbarium
Pinanga paradoxa	—
Pinanga parvula	Kew Herbarium
Pinanga patula	Kew Herbarium
Pinanga pectinata	—
Pinanga perakensis	Henderson, 2009
Pinanga philippinensis	Kew Herbarium
Pinanga pilosa	Kew Herbarium
Pinanga plicata	Kew Herbarium
Pinanga polymorpha	Henderson, 2009
Pinanga porrecta	—
Pinanga pulchella	Kew Herbarium
Pinanga purpurea	—
Pinanga quadrijuga	Kew Herbarium
Pinanga ridleyana	Kew Herbarium
Pinanga rigida	—
Pinanga riparia	Henderson, 2009
Pinanga rivularis	Kew Herbarium
Pinanga rumphiana	Kew Herbarium
Pinanga rupestris	Henderson, 2002
Pinanga salicifolia	Kew Herbarium
Pinanga samarana	Kew Herbarium
Pinanga sarmentosa	Kew Herbarium
Pinanga sclerophylla	Kew Herbarium

Pinanga scortechinii	—
Pinanga sessilifolia	—
Pinanga sibuyanensis	—
Pinanga sierramadreana	palmweb
Pinanga simplicifrons	—
Pinanga singaporensis	Kew Herbarium
Pinanga sinii	Kew Herbarium
Pinanga sobolifera	palmweb
Pinanga speciosa	Henderson, 2002
Pinanga stricta	Kew Herbarium
Pinanga stylosa	Kew Herbarium
Pinanga subintegra	Henderson, 2009
Pinanga subruminata	Kew Herbarium
Pinanga sylvestris	AAU Herbarium
Pinanga tashiroi	Henderson, 2009
Pinanga tenacinervis	—
Pinanga tenella	Kew Herbarium
Pinanga tomentella	Kew Herbarium
Pinanga trichoneura	—
Pinanga uncinata	—
Pinanga urdanetensis	Kew Herbarium
Pinanga urosperma	Kew Herbarium
Pinanga variegata	Kew Herbarium
Pinanga veitchii	Kew Herbarium
Pinanga versicolor	Kew Herbarium
Pinanga viridis	Kew Herbarium
Pinanga watanaiana	—
Pinanga woodiana	Kew Herbarium
Pinanga yassinii	Kew Herbarium
Plectocomia assamica	Henderson, 2009
Plectocomia billitonensis	Kew Herbarium
Plectocomia bractealis	palmweb
Plectocomia dransfieldiana	—
Plectocomia elmeri	—
Plectocomia elongata	AAU Herbarium
Plectocomia himalayana	Kew Herbarium
Plectocomia kerriana	Hodel, 1998
Plectocomia khasyana	Kew Herbarium
Plectocomia longistigma	Kew Herbarium
Plectocomia lorzingii	Kew Herbarium
Plectocomia macrostachya	Kew Herbarium
Plectocomia microstachys	Henderson, 2009
Plectocomia mulleri	—
Plectocomia pierreana	Kew Herbarium

Plectocomia pygmaea	Kew Herbarium
Plectocomiopsis corneri	Kew Herbarium
Plectocomiopsis geminiflora	Kew Herbarium
Plectocomiopsis mira	AAU Herbarium
Plectocomiopsis triquetra	Kew Herbarium
Plectocomiopsis wrayi	Henderson, 2009
Podococcus acaulis	Kew Herbarium
Podococcus barteri	—
Pogonotium divaricatum	—
Pogonotium moorei	—
Pogonotium ursinum	palmweb
Ponapea hosinoi	Essig, 1978
Ponapea ledermanniana	Essig, 1978
Ponapea palauensis	Essig, 1978
Prestoea acuminata	—
Prestoea carderi	AAU Herbarium
Prestoea decurrens	AAU Herbarium
Prestoea ensiformis	AAU Herbarium
Prestoea longipetiolata	AAU Herbarium
Prestoea pubens	AAU Herbarium
Prestoea pubigera	Henderson, 2002
Prestoea schultzeana	AAU Herbarium
Prestoea simplicifolia	Henderson, 2002
Prestoea tenuiramosa	Henderson, 2002
Pritchardia arecina	Hodel, 2007
Pritchardia beccariana	Hodel, 2007
Pritchardia flynnii	Hodel, 2007
Pritchardia forbesiana	Hodel, 2007
Pritchardia glabrata	Hodel, 2007
Pritchardia gordonii	Hodel, 2007
Pritchardia hardyi	Hodel, 2007
Pritchardia hillebrandii	Hodel, 2007
Pritchardia kaalae	Hodel, 2007
Pritchardia kahukuensis	—
Pritchardia lanigera	Hodel, 2007
Pritchardia lowreyana	Hodel, 2007
Pritchardia maideniana	Hodel, 2007
Pritchardia martii	Hodel, 2007
Pritchardia minor	Hodel, 2007
Pritchardia mitiaroana	Hodel, 2007
Pritchardia munroi	—
Pritchardia napaliensis	Hodel, 2007
Pritchardia pacifica	Hodel, 2007
Pritchardia perlmanii	Hodel, 2007

Pritchardia remota	Hodel, 2007
Pritchardia schattaueri	—
Pritchardia thurstonii	Hodel, 2007
Pritchardia viscosa	—
Pritchardia vuylstekeana	palmweb
Pritchardia waialealeana	Hodel, 2007
Pritchardia woodii	Hodel, 2007
Pritchardiopsis jeanneneyi	Kew Herbarium
Pseudophoenix ekmanii	—
Pseudophoenix lediniana	Henderson, 2002
Pseudophoenix sargentii	—
Pseudophoenix vinifera	Henderson, 2002
Ptychococcus lepidotus	AAU Herbarium
Ptychococcus paradoxus	AAU Herbarium
Ptychosperma ambiguum	Henderson, 2002
Ptychosperma buabe	Henderson, 2002
Ptychosperma burretianum	—
Ptychosperma caryotoides	—
Ptychosperma cuneatum	Henderson, 2002
Ptychosperma elegans	Dowe, 2010
Ptychosperma furcatum	Henderson, 2002
Ptychosperma gracile	—
Ptychosperma hartmannii	Henderson, 2002
Ptychosperma lauterbachii	Henderson, 2002
Ptychosperma lineare	Henderson, 2002
Ptychosperma macarthurii	AAU Herbarium
Ptychosperma macrocerum	AAU Herbarium
Ptychosperma mambare	—
Ptychosperma microcarpum	Henderson, 2002
Ptychosperma mooreanum	—
Ptychosperma nicolai	Kew Herbarium
Ptychosperma praemorsum	Kew Herbarium
Ptychosperma propinquum	—
Ptychosperma pullenii	Henderson, 2002
Ptychosperma ramosissimum	Kew Herbarium
Ptychosperma rosselense	—
Ptychosperma salomonense	—
Ptychosperma sanderianum	Essig, 1978
Ptychosperma schefferi	Henderson, 2002
Ptychosperma streimannii	Henderson, 2002
Ptychosperma tagulense	Henderson, 2002
Ptychosperma vestitum	Henderson, 2002
Ptychosperma waitianum	Henderson, 2002
Raphia africana	—

Raphia australis	Henderson, 2002
Raphia farinifera	AAU Herbarium
Raphia gentiliana	Henderson, 2002
Raphia hookeri	AAU Herbarium
Raphia laurentii	Henderson, 2002
Raphia longiflora	Henderson, 2002
Raphia mambillensis	Henderson, 2002
Raphia mannii	Henderson, 2002
Raphia matombe	Henderson, 2002
Raphia monbuttorum	—
Raphia palma-pinus	Tuley, 1995
Raphia regalis	AAU Herbarium
Raphia rostrata	Henderson, 2002
Raphia ruwenzorica	Henderson, 2002
Raphia sese	Henderson, 2002
Raphia sudanica	Henderson, 2002
Raphia taedigera	Galeano & Bernal, 2010
Raphia textilis	Henderson, 2002
Raphia vinifera	Henderson, 2002
Ravenea albicans	Kew Herbarium
Ravenea delicatula	AAU Herbarium
Ravenea dransfieldii	Kew Herbarium
Ravenea glauca	Henderson, 2002
Ravenea hildebrandtii	Henderson, 2002
Ravenea julietiae	Henderson, 2002
Ravenea krociana	Henderson, 2002
Ravenea lakatra	Henderson, 2002
Ravenea latisecta	AAU Herbarium
Ravenea louvelii	Henderson, 2002
Ravenea madagascariensis	Henderson, 2002
Ravenea moorei	Henderson, 2002
Ravenea musicalis	Henderson, 2002
Ravenea nana	Henderson, 2002
Ravenea rivularis	—
Ravenea robustior	Henderson, 2002
Ravenea sambiranensis	Henderson, 2002
Ravenea xerophila	Henderson, 2002
Reinhardtia elegans	AAU Herbarium
Reinhardtia gracilis	Henderson, 2002
Reinhardtia koschnyana	AAU Herbarium
Reinhardtia latisecta	AAU Herbarium
Reinhardtia paiewonskiana	AAU Herbarium
Reinhardtia simplex	Henderson, 2002
Retispatha dumetosa	AAU Herbarium

Rhapidophyllum hystrix	palmpedia
Rhapis excelsa	—
Rhapis gracilis	—
Rhapis humilis	Henderson, 2009
Rhapis laosensis	Henderson, 2009
Rhapis micrantha	—
Rhapis multifida	Henderson, 2009
Rhapis puhuongensis	Henderson, 2009
Rhapis robusta	—
Rhapis subtilis	Henderson, 2009
Rhapis vidalii	AAU Herbarium
Rhopaloblaste augusta	Henderson, 2009
Rhopaloblaste ceramica	Henderson, 2009
Rhopaloblaste elegans	AAU Herbarium
Rhopaloblaste gideonii	palmweb
Rhopaloblaste ledermanniana	palmweb
Rhopaloblaste singaporensis	palmweb
Rhopalostylis baueri	—
Rhopalostylis sapida	Dowe, 2010
Roscheria melanochaetes	palmpedia
Roystonea altissima	—
Roystonea borinquena	Kew Herbarium
Roystonea dunlapiana	Kew Herbarium
Roystonea lenis	—
Roystonea maisiana	Kew Herbarium
Roystonea oleracea	—
Roystonea princeps	Kew Herbarium
Roystonea regia	Kew Herbarium
Roystonea stellata	Kew Herbarium
Roystonea violacea	Henderson, 2002
Sabal bermudana	—
Sabal causiarum	—
Sabal domingensis	—
Sabal etonia	—
Sabal gretherae	AAU Herbarium
Sabal maritima	AAU Herbarium
Sabal mauritiiformis	Henderson, 2002
Sabal mexicana	AAU Herbarium
Sabal miamiensis	—
Sabal minor	Henderson, 2002
Sabal palmetto	—
Sabal pumos	AAU Herbarium
Sabal rosei	Henderson, 2002
Sabal uresana	Henderson, 2002

Sabal yapa	Henderson, 2002
Salacca affinis	AAU Herbarium
Salacca clemensiana	Kew Herbarium
Salacca dolicholepis	Kew Herbarium
Salacca dransfieldiana	Kew Herbarium
Salacca flabellata	Henderson, 2002
Salacca glabrescens	Furtado, 1949
Salacca graciliflora	Henderson, 2009
Salacca griffithii	Kew Herbarium
Salacca lophospatha	Kew Herbarium
Salacca magnifica	Kew Herbarium
Salacca minuta	Mogea, 1991
Salacca multiflora	Kew Herbarium
Salacca ramosiana	Kew Herbarium
Salacca rupicola	Kew Herbarium
Salacca sarawakensis	Kew Herbarium
Salacca secunda	—
Salacca stolonifera	Henderson, 2009
Salacca sumatrana	Henderson, 2009
Salacca vermicularis	AAU Herbarium
Salacca wallichiana	—
Salacca zalacca	AAU Herbarium
Satakentia liukiuensis	Kew Herbarium
Satranala decussilvae	Henderson, 2009
Schippia concolor	Henderson, 2002
Sclerosperma mannii	Kew Herbarium
Sclerosperma profizianum	—
Sclerosperma walkeri	palmweb
Serenoa repens	Tuley, 1995
Socratea exorrhiza	AAU Herbarium
Socratea hecatonandra	—
Socratea montana	AAU Herbarium
Socratea rostrata	AAU Herbarium
Socratea salazarii	—
Solfia samoensis	AAU Herbarium
Sommieria leucophylla	AAU Herbarium
Syagrus amara	AAU Herbarium
Syagrus botryophora	Henderson, 2002
Syagrus campestris	AAU Herbarium
Syagrus campos-portoana	Kew Herbarium
Syagrus campylospatha	Glassman, 1987
Syagrus cardenasii	Lorenzi, 2010
Syagrus cearensis	AAU Herbarium
Syagrus cocoides	Lorenzi, 2010

Syagrus comosa	AAU Herbarium
Syagrus coronata	AAU Herbarium
Syagrus costae	AAU Herbarium
Syagrus duartei	Glassman, 1987
Syagrus evansiana	Lorenzi, 2010
Syagrus flexuosa	Kew Herbarium
Syagrus glaucescens	Lorenzi, 2010
Syagrus graminifolia	Henderson, 2002
Syagrus harleyi	—
Syagrus inajai	—
Syagrus macrocarpa	AAU Herbarium
Syagrus matafome	—
Syagrus microphylla	Glassman, 1987
Syagrus oleracea	—
Syagrus orinocensis	AAU Herbarium
Syagrus petraea	Lorenzi, 2010
Syagrus picrophylla	—
Syagrus pleioclada	AAU Herbarium
Syagrus pseudococos	—
Syagrus romanzoffiana	—
Syagrus ruschiana	AAU Herbarium
Syagrus sancona	Henderson, 2002
Syagrus schizophylla	AAU Herbarium
Syagrus smithii	—
Syagrus stratincola	—
Syagrus tostana	Henderson, 2002
Syagrus vagans	—
Syagrus vermicularis	—
Syagrus werdermannii	Lorenzi, 2010
Syagrus yungasensis	Henderson, 2002
Synechanthus fibrosus	palmweb
Synechanthus warscewiczianus	AAU Herbarium
Tahina spectabilis	AAU Herbarium
Tectiphiala ferox	palmweb
Thrinax ekmaniana	—
Thrinax excelsa	Kew Herbarium
Thrinax morrisii	Henderson, 2002
Thrinax parviflora	—
Thrinax radiata	AAU Herbarium
Thrinax rivularis	—
Trachycarpus fortunei	Kew Herbarium
Trachycarpus geminisectus	AAU Herbarium
Trachycarpus latisectus	Henderson, 2009
Trachycarpus martianus	Henderson, 2009

Trachycarpus nanus	Henderson, 2009
Trachycarpus oreophilus	Henderson, 2009
Trachycarpus princeps	Henderson, 2009
Trachycarpus takil	Henderson, 2009
Trachycarpus ukhrulensis	Henderson, 2009
Trithrinax brasiliensis	—
Trithrinax campestris	Henderson, 2002
Trithrinax schizophylla	—
Veitchia arecina	Henderson, 2002
Veitchia filifera	Henderson, 2002
Veitchia joannis	Henderson, 2002
Veitchia metiti	Henderson, 2002
Veitchia simulans	—
Veitchia spiralis	Henderson, 2002
Veitchia vitiensis	Henderson, 2002
Veitchia winin	Henderson, 2002
Verschaffeltia splendida	Henderson, 2002
Voanioala gerardii	palmpedia
Wallichia caryotoides	Henderson, 2002
Wallichia chinensis	Henderson, 2009
Wallichia densiflora	Henderson, 2009
Wallichia disticha	Henderson, 2009
Wallichia gracilis	Henderson, 2009
Wallichia lidiae	AAU Herbarium
Wallichia marianneae	—
Wallichia mooreana	AAU Herbarium
Wallichia siamensis	—
Wallichia triandra	—
Washingtonia filifera	—
Washingtonia robusta	AAU Herbarium
Welfia regia	palmpedia
Wendlandiella gracilis	Kew Herbarium
Wettinia aequalis	AAU Herbarium
Wettinia aequalis	AAU Herbarium
Wettinia aequatorialis	Kew Herbarium
Wettinia anomala	AAU Herbarium
Wettinia augusta	AAU Herbarium
Wettinia castanea	AAU Herbarium
Wettinia disticha	Galeano & Bernal, 2010
Wettinia drudei	Galeano & Bernal, 2010
Wettinia equalis	AAU Herbarium
Wettinia fascicularis	AAU Herbarium
Wettinia hirsuta	Galeano & Bernal, 2010
Wettinia kalbreyeri	AAU Herbarium

Wettinia lanata	—
Wettinia longipetala	AAU Herbarium
Wettinia maynensis	AAU Herbarium
Wettinia microcarpa	Galeano & Bernal, 2010
Wettinia minima	Henderson, 2002
Wettinia oxycarpa	AAU Herbarium
Wettinia panamensis	AAU Herbarium
Wettinia praemorsa	Galeano & Bernal, 2010
Wettinia quinaria	AAU Herbarium
Wettinia radiata	AAU Herbarium
Wettinia verruculosa	AAU Herbarium
Wodyetia bifurcata	Dowe, 2010
Zombia antillarum	AAU Herbarium

References

AAU Herbarium, The Aarhus University Herbarium (AAU), Ole Worms Allé 1, 8000 Aarhus C, Denmark.

Dowe, J.L. & Ferrero, M.D. (2000) A new species of rheophytic palm from New Guinea. *Palms*, **44**, 194–197.

Dowe, J.L. & Ferrero, M.D. (2001) Revision of *Calyptrocalyx* and the New Guinea species of *Linospadix* (Linospadicinae, Arecoideae, Arecaceae). *Blumea*, **46**, 207–251.

Dowe, J.L. (2010) *Australian palms, biogeography, ecology and systematics*. CSIRO Publishing, Collingwood, Australia.

Dransfield, J.L. (1979) *A manual of the rattans of the Malay Peninsula*, Malayan Forest Records 29, Kuala Lumpur.

Dransfield, J. & Beentje, H. (1995) *Palms of Madagascar*, Royal Botanical Gardens, Kew.

Dransfield, J. (1984) *The rattans of Sabah*, Sabah forest record 13, Sabah.

Essig, F.B. (1978) A revision of the genus *Ptychosperma* Labill. (Arecaceae). *Allertonia*, **1**, 415–478.

Essig, F.B. (2008) A systematic histological study of palm fruits. VIII. Subtribe Dypsidinae (Arecaceae). *Brittonia*, **60**, 82–92.

Essig, F.B., Bussard, L. & Hernandez, N. (2001) A systematic histological study of palm fruits. IV. Subtribe Oncospermatinae (Arecaceae). *Brittonia*, **53**, 466–471.

Essig, F.B., Manka, T. J. & Bussard, L. (1999) A systematic histological study of palm fruits. III. Subtribe Iguanurinae (Arecaceae). *Brittonia*, **51**, 307–325.

Fernando, E.S. (1983) A revision of the Genus *Nenga. Principes*, **27**, 55–70.

Galeano, G. & Bernal, R. (2010) *Palmas de Colombia*, *guia de campo.*Panamericana Formas e Impresos S.A., Bogota.

Glassman, S.F. (1987) Revisions of the palm genus *Syagrus* Mart. and other selected genera in the *Cocos* alliance. Illinois Biological Monographs, **59**, 1–414.

Henderson, A. (2002) *Evolution and Ecology of Palms*. New York Botanical Garden Press, Bronx.

Henderson, A. (2009) *Palms of Southern Asia,* Princeton University Press, Princeton.

Henderson, A., Galeono, G. & Bernal, R. (1995) *Field Guide to the Palms of the America*, Princeton University Press, Princeton.

Henderson, A. (2005) A multivariate study of *Calyptrogyne* (Palmae). *Systematic Botany*, **30**, 60–83.

Hodel, D.R. (1992) *Chamaedorea palms. The International Palm Society*, Allen Press, Lawrence, Kansas.

Hodel, D.R. (1996) Two new species of *Chamaedorea* from Costa Rica. *Principes*, **40**, 212–216.

Hodel, D.R. (1998) *The palms of Thailand.* Allen Press, Lawrence, Kansas.

Hodel, D.R. (2007) A review of the Genus *Pritchardia. Palms*, **51**, S1–S52.

Hodel, D.R., Herrera, G. & Cascante, A. (1997) A remarkable new species and additional novelties of *Chamaedorea* from Costa Rica and Panama. *Palms*, **139**, 32–44.

Hodel, D.R., Mont, J.J.C. & Zuniga, R. (1995) Two new species of *Chamaedorea* from Honduras. *Principes*, **39**, 183–189.

Jones, D.L. (1995) *Palms throughout the world*. Smithsonian Institution Press, Washington, D.C.

Kew Herbarium (K), The Royal Botanic Gardens, Kew, Richmond, Surrey TW9 3AE, UK.

Leaflets of Philippine Botany (1938), **10**, 3014.

Lorenzi, H. (2010) *Brazilian Flora Arecaceae (Palms)*. Instituto Plantarum, Nova Odessa.

Mogea, J.P. (1991) *Palms for human needs in Asia, Palm utilization and Conservation in India, Indonesia, Malaysia and Philippines*, AA Belkama, Rotterdam, the Netherlands.

palmpedia (http//www.palmpedia.net/).

palmweb (http//palmweb.org/).

Principes: Journal of the International Palm Society (1969), **13**, 104.

Principes: Journal of the International Palm Society (1992), **36**, 4.

Principes: Journal of the International Palm Society (1997), **41**, 66.

Saw, L.G. (2003) Morphological diversity of the genus *Licuala* (Palmae). Telopea, **10**, 187–206.
Sunderland, T.C.H. (2007) *Field guide to the rattans of Africa*, Royal Botanic Gardens, Kew.
Tuley, P. (1995) *The palms of Africa*, The Trendrine Press, Zennor.
Webbia: Journal of Plant Taxonomy and Geography (1914), **4**, 278.

Table S2: For each genus (*n*=183), the number of all species, the number of species for which fruit size has been estimated, and the trait variation (mean, median and standard deviation SD) for all species with available data is given. Note that SD is not available for genera with only one species.

Genus	Number of species	Estimated values	Mean	Median	Standard deviation
Acanthophoenix	3	1	1.21	1	0.70
Acoelorrhaphe	1	—	1.1	1.1	
Acrocomia	4	1	3.03	3	1.31
Actinokentia	2	0	3.1	3.17	0.81
Actinorhytis	1	0	10	10	
Adonidia	1	0	2.5	2.5	
Aiphanes	26	8	1.45	1.3	0.73
Allagoptera	5	1	2.32	1.75	1.18
Ammandra	1	—	1.65	1.65	
Aphandra	1	—	2.5	2.5	
Archontophoenix	6	—	1.62	1.55	0.46
Areca	48	12	3.19	2.75	1.45
Arenga	25	7	2.60	1.8	1.79
Asterogyne	5	1	3.01	3	0.60
Astrocaryum	36	10	5.05	5	1.46
Attalea	70	19	7.59	7.5	2.27
Bactris	78	17	2.18	1.97	1.02
Balaka	11	3	2.35	2	0.67
Barcella	1	—	3.5	3.5	
Basselinia	12	2	0.94	1.02	0.22
Beccariophoenix	2	—	2.95	2.95	0.77
Bentinckia	2	—	1.5	1.5	0
Bismarckia	1	—	4.4	4.4	
Borassodendron	2	—	12	12	0
Borassus	5	3	18.5	15	6.92
Brahea	11	2	1.55	1.5	0.42

Brassiophoenix	2	2	3.55	3.55	0.35
Burretiokentia	5	1	3.88	3	2.54
Butia	13	5	2.36	2	0.84
Calamus	383	113	1.67	1.5	1.02
Calyptrocalyx	26	14	1.53	1.3	0.87
Calyptrogyne	17	10	1.40	1.5	0.42
Calyptronoma	3	1	1.86	1.8	0.61
Carpentaria	1	—	2	2	
Carpoxylon	1	—	6	6	
Caryota	14	6	2.50	2.4	0.68
Ceratolobus	6	2	1.59	1.57	0.42
Ceroxylon	11	1	2.21	2.2	0.57
Chamaedorea	107	23	1.06	1	0.34
Chamaerops	1	—	2.23	2.23	
Chambeyronia	2	1	3.75	3.75	1.06
Chelyocarpus	4	1	2.2	2.25	0.57
Chuniophoenix	2	—	2.05	2.05	0.63
Clinosperma	4	1	1.56	1.45	0.50
Clinostigma	11	5	1.05	0.9	0.52
Coccothrinax	53	20	2.08	1.9	1.23
Cocos	1	—	0.95	0.95	
Colpothrinax	3	—	2.70	2.65	0.33
Copernicia	28	7	2.65	2.5	0.86
Corypha	6	2	5.16	5.25	1.94
Cryosophila	10	4	2.06	2	0.59
Cyphokentia	2	1	1.22	1.22	0.03
Cyphophoenix	4	1	1.88	1.97	0.42
Cyphosperma	4	2	2.27	1.55	1.34
Cyrtostachys	11	3	0.94	1	0.30
Daemonorops	102	30	1.93	1.8	0.72
Deckenia	1	—	1.2	1.2	
Desmoncus	12	4	1.77	1.63	0.78

Dictyocaryum	3	1	3.05	3.25	0.34
Dictyosperma	1	—	1.8	1.8	
Dransfieldia	1	—	1.54	1.54	
Drymophloeus	8	4	1.93	1.85	0.84
Dypsis	143	43	1.37	1.25	0.63
Elaeis	2	1	3.5	3.5	1.06
Eleiodoxa	1	—	2.5	2.5	
Eremospatha	11	—	2.75	2.75	0.65
Eugeissona	6	4	6.5	6.5	1.48
Euterpe	7	1	2.15	2	0.44
Gaussia	5	4	1.34	1.4	0.20
Geonoma	68	14	0.86	0.8	0.26
Guihaia	2	1	0.8	0.8	0.28
Hedyscepe	1	—	4	4	
Hemithrinax	3	1	2.6	2.6	1.1
Heterospathe	39	17	1.31	1.2	0.52
Howea	2	1	3.75	3.75	0.35
Hydriastele	48	17	1.02	1	0.30
Hyophorbe	5	—	2.48	2.3	0.78
Hyospathe	4	3	1.01	1.02	0.19
Hyphaene	8	3	6.25	6.25	1.22
Iguanura	32	7	1.17	1	0.43
Iriartea	1	—	2.6	2.6	
Iriartella	2	1	1.37	1.37	0.24
Itaya	1	—	2.25	2.25	
Johannesteijsmannia	4	1	7.95	7.9	2.60
Juania	1	—	2.5	2.5	
Jubaea	1	—	3.75	3.75	
Jubaeopsis	1	—	3	3	
Kentiopsis	4	1	1.97	2	0.20
Kerriodoxa	1	—	4	4	
Korthalsia	27	5	1.64	1.75	0.63

Laccospadix	1	—	1.35	1.35	
Laccosperma	6	2	1.69	1.7	0.30
Latania	3	1	5	4.5	1.32
Lemurophoenix	1	—	4	4	
Leopoldinia	3	1	3.28	3.5	0.38
Lepidocaryum	1	—	2.25	2.25	
Lepidorrhachis	1	—	1.3	1.3	
Leucothrinax	1	—	0.5	0.5	
Licuala	149	53	1.17	1	0.47
Linospadix	8	—	1.29	1.25	0.41
Livistona	35	8	1.95	1.9	0.76
Lodoicea	1	—	45	45	
Loxococcus	1	—	2.5	2.5	
Lytocaryum	2	—	2.57	2.57	0.81
Manicaria	1	—	3.5	3.5	
Marojejya	2	—	2.1	2.1	0.21
Masoala	2	—	2.85	2.85	0.56
Mauritia	2	—	6.75	6.75	0.35
Mauritiella	3	—	3.25	3	1.14
Maxburretia	3	—	1.25	1	0.47
Medemia	1	—	4.5	4.5	
Metroxylon	7	2	11	11.5	2.59
Myrialepis	1	—	3	3	
Nannorrhops	1	—	2	2	
Nenga	5	2	3.7	3.5	1.96
Neonicholsonia	1	—	0.95	0.95	
Neoveitchia	2	1	5.5	5.5	0.70
Nephrosperma	1	—	1.4	1.4	
Normanbya	1	—	4.25	4.25	
Nypa	1	—	11.5	11.5	
Oenocarpus	10	2	2.26	2.15	0.68
Oncocalamus	5	3	2.17	2	0.46

Oncosperma	5	2	1.23	1.2	0.27
Orania	18	2	4.63	4.12	1.44
Oraniopsis	1	—	3.4	3.4	
Parajubaea	3	—	4.5	4.75	0.90
Pelagodoxa	1	—	2.5	2.5	
Phoenicophorium	1	—	0.8	0.8	
Phoenix	14	4	2.20	1.9	1.41
Pholidocarpus	6	2	7.04	7.12	2.71
Pholidostachys	4	1	1.77	1.83	0.52
Physokentia	7	4	2.25	2.5	0.69
Phytelephas	6	2	12.58	11.5	3.77
Pigafetta	2	1	0.9	0.9	0
Pinanga	139	36	1.61	1.5	0.56
Plectocomia	16	3	2.49	2.5	0.61
Plectocomiopsis	5	—	2.95	3	0.27
Podococcus	2	1	2.12	2.12	0.24
Pogonotium	3	2	1.56	1.7	0.23
Ponapea	3	—	3.08	3	0.87
Prestoea	10	9	1.86	1.75	0.42
Pritchardia	27	4	3.17	2.8	1.18
Pritchardiopsis	1	—	2.5	2.5	
Pseudophoenix	4	2	2.43	2.57	0.66
Ptychococcus	2	—	3.1	3.1	2.68
Ptychosperma	29	8	1.52	1.5	0.37
Raphia	20	2	7.325	7.12	1.98
Ravenea	18	1	1.64	1.72	0.58
Reinhardtia	6	—	1.64	1.7	0.31
Retispatha	1	—	2	2	
Rhapidophyllum	1	—	2	2	
Rhapis	10	4	1.24	0.9	0.70
Rhopaloblaste	6	—	2.16	2.17	0.77
Rhopalostylis	2	1	1.35	1.35	0.07

Roscheria	1	—	3.5	3.5	
Roystonea	10	3	1.28	1.3	0.14
Sabal	15	6	1.59	1.5	0.52
Salacca	21	2	5.50	5	1.89
Satakentia	1	—	1.3	1.3	
Satranala	1	—	5.6	5.6	
Schippia	1	—	2	2	
Sclerosperma	3	1	3.66	3.5	0.76
Serenoa	1	—	2.05	2.05	
Socratea	5	2	3.5	3.5	0.61
Solfia	1	—	2	2	
Sommieria	1	—	1.2	1.2	
Syagrus	38	11	3.56	3	1.46
Synechanthus	2	—	2.05	2.05	0.42
Tahina	1	—	3.2	3.2	
Tectiphiala	1	—	1.1	1.1	
Thrinax	6	3	2.17	2.6	0.91
Trachycarpus	9	—	1.28	1.3	0.19
Trithrinax	3	2	1.1	1.1	0.1
Veitchia	8	1	2.70	2.35	1.22
Verschaffeltia	1	—	2.5	2.5	
Voanioala	1	—	7.5	7.5	
Wallichia	10	3	1.65	1.6	0.39
Washingtonia	2	1	1.6	1.6	0.28
Welfia	1	—	3	3	
Wendlandiella	1	—	0.9	0.9	
Wettinia	23	1	2.91	2.52	0.93
Wodyetia	1	—	5.75	5.75	
Zombia	1	—	1.2	1.2	

Table S3: List shows the largest present-natural mammal species and their potential weight (in g) for each of the major biogeographical realms (New World, Western and Eastern Old World). Only mammal species are listed which occur in at least 5 TDWG level 3 units in which also palms occur.

Species	Family	Size (in g)	Extinction
New World			
Mammuthus columbi	ELEPHANTIDAE	8,000,000	yes
Stegomastodon platensis	GOMPHOTHERIIDAE	7,580,000	yes
Megatherium americanum	MEGATHERIIDAE	6,265,000	yes
Stegomastodon waringi	GOMPHOTHERIIDAE	6,193,000	yes
Cuvieronius hyodon	GOMPHOTHERIIDAE	5,000,000	yes
Mammut americanum	MAMMUTIDAE	4,523,800	yes
Lestodon armatus	MYLODONTIDAE	3,397,000	yes
Megatherium tarijense	MEGATHERIIDAE	3,049,954	yes
Eremotherium laurillardi	MEGATHERIIDAE	2,150,000	yes
Glyptodon clavipes	GLYPTODONTIDAE	2,000,000	yes
Western Old World			
Elephas iolensis	ELEPHANTIDAE	6,500,000	yes
Elephas antiquus	ELEPHANTIDAE	6,500,000	yes
Loxodonta africana	ELEPHANTIDAE	3,940,034	no
Ceratotherium simum	RHINOCEROTIDAE	2,949,986	no
Stephanorhinus hemitoechus	RHINOCEROTIDAE	2,943,176	yes
Hippopotamus amphibious	HIPPOPOTAMIDAE	1,417,490	no
Diceros bicornis	RHINOCEROTIDAE	1,180,510	no
Pelorovis antiquus	BOVIDAE	1,000,000	yes
Bos primigenius	BOVIDAE	900,000	no
Giraffa camelopardalis	GIRAFFIDAE	899,994	no
Eastern Old World			
Stephanorhinus kirchbergensis	RHINOCEROTIDAE	3,630,932	yes
Stephanorhinus hemitoechus	RHINOCEROTIDAE	2,943,176	yes
Elephas maximus	ELEPHANTIDAE	2,915,040	no
Rhinoceros sondaicus	RHINOCEROTIDAE	1,750,000	no
Rhinoceros unicornis	RHINOCEROTIDAE	1,602,333	no
Hippopotamus amphibious	HIPPOPOTAMIDAE	1,417,490	no
Dicerorhinus sumatrensis	RHINOCEROTIDAE	1,266,667	no
Bos primigenius	BOVIDAE	900,000	no
Stegodon orientalis	STEGODONTIDAE	850,000	yes
Bos gaurus	BOVIDAE	825,000	no

Appendix 2. Supplementary methods

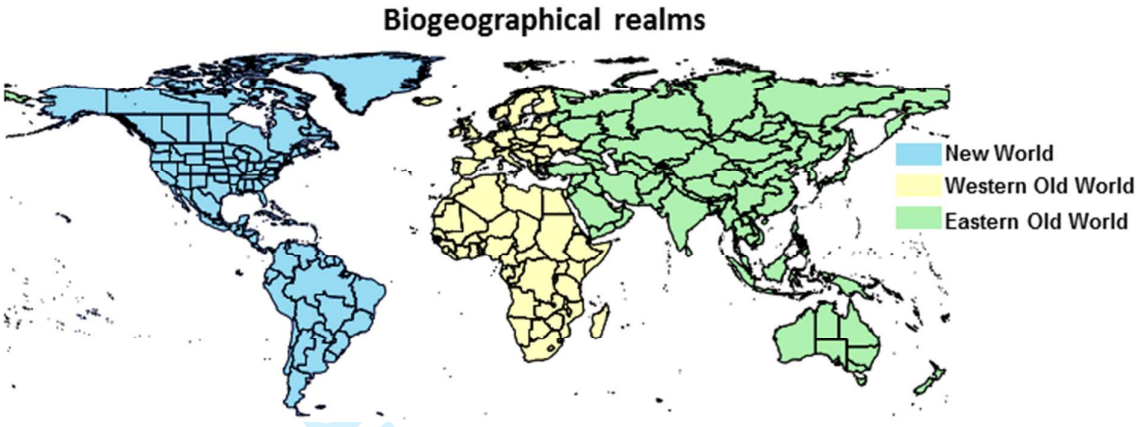


Figure S1. Map shows the geographic units as defined by the International Working Group on Taxonomic Databases (TDWG level 3 units) and the assignment of each TDWG level 3 unit to a major biogeographical realms (New World, *n* = 61 TDWG units; Western Old World, *n* = 62; Eastern Old World, *n* = 64).

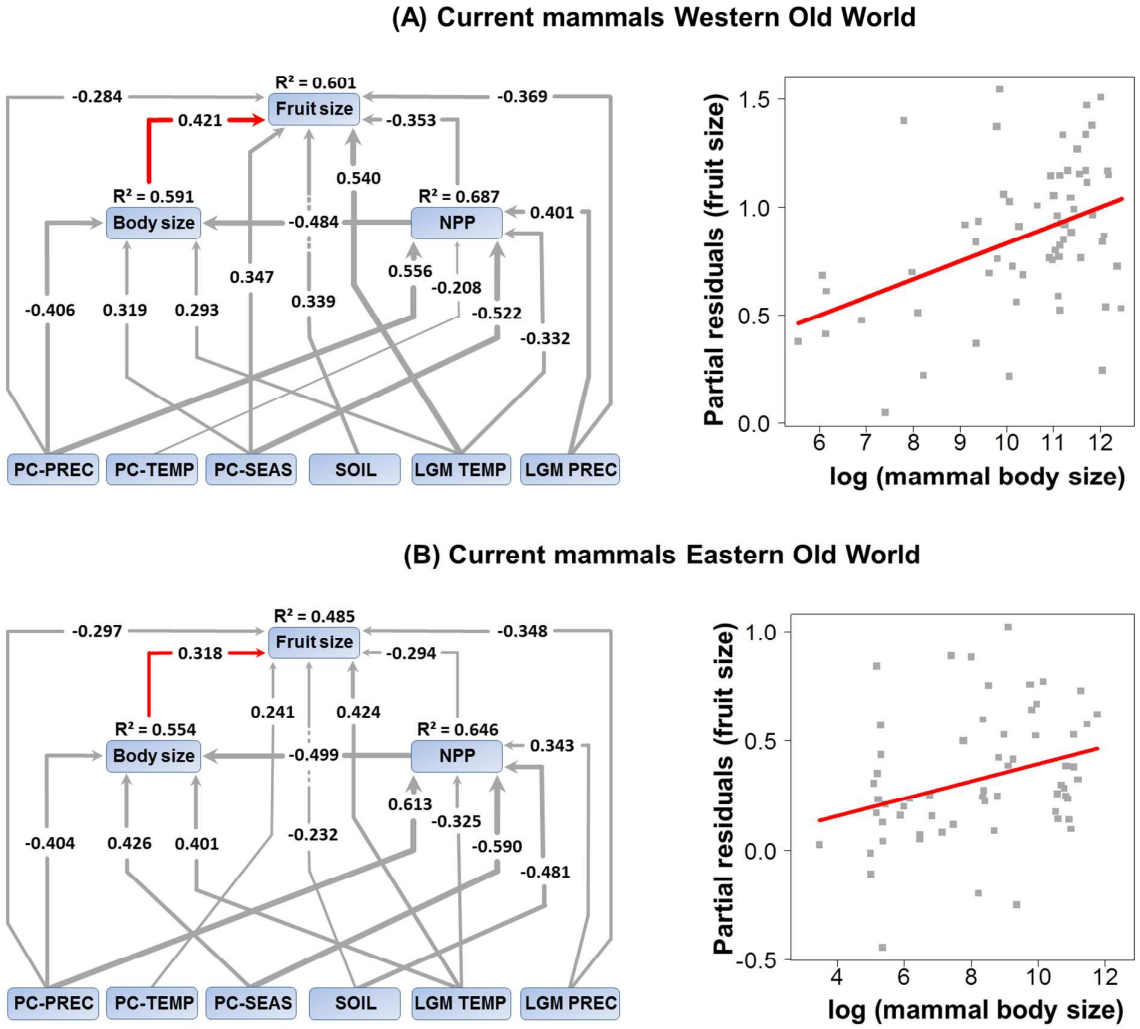


Figure S2. Results of the structural equation models (SEM) of current frugivorous mammals within the Western Old World (A) and Eastern Old World (B) showing direct and indirect effects of biotic and abiotic drivers on the response variables palm fruit size, mammal body size and net primary productivity (NPP). All arrows illustrate statistically significant effects and values show standardized coefficients, with arrow thickness being proportional to effect strength. R^2–values show the explained variance of the response variable. On the right partial residual plots illustrate the relationship between assemblage-level mean fruit sizes of palms and mammal body sizes with current distributions for the Western (C) and Eastern Old World (D) when all other predictor variables in the multi-predictor model are statistically accounted for. Abbreviations of predictor and response variables can be found in Table 1.

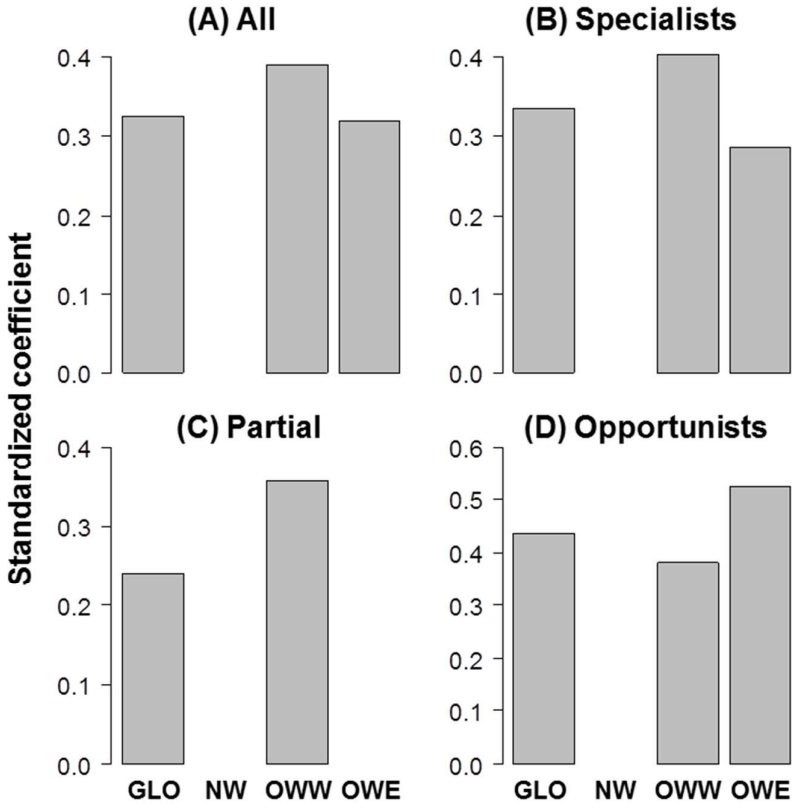


Figure S3. Barplots showing the results of structural equation models (SEMs) focusing on the direct, positive statistically significant relationships (standardized path coefficients) between assemblage means for mammal body sizes and palm fruit sizes. Effects are illustrated for current mammal ranges on a global scale (GLO, *n* = 187 TDWG units), for the New World (NW, *n* = 61), Western Old World (OWW, *n* = 62) and Eastern Old World (OWE, *n* = 64). The barplots are shown for all frugivorous mammals (A, *n* = 1806 species), for fruit specialists (B, *n* = 1578), for partial frugivores (C, *n* = 194) and for opportunists (D, *n* = 34). Specialists represent mammals with fruits as major important diet, partial frugivores with fruits as intermediate and opportunists with fruits as minor important diet.

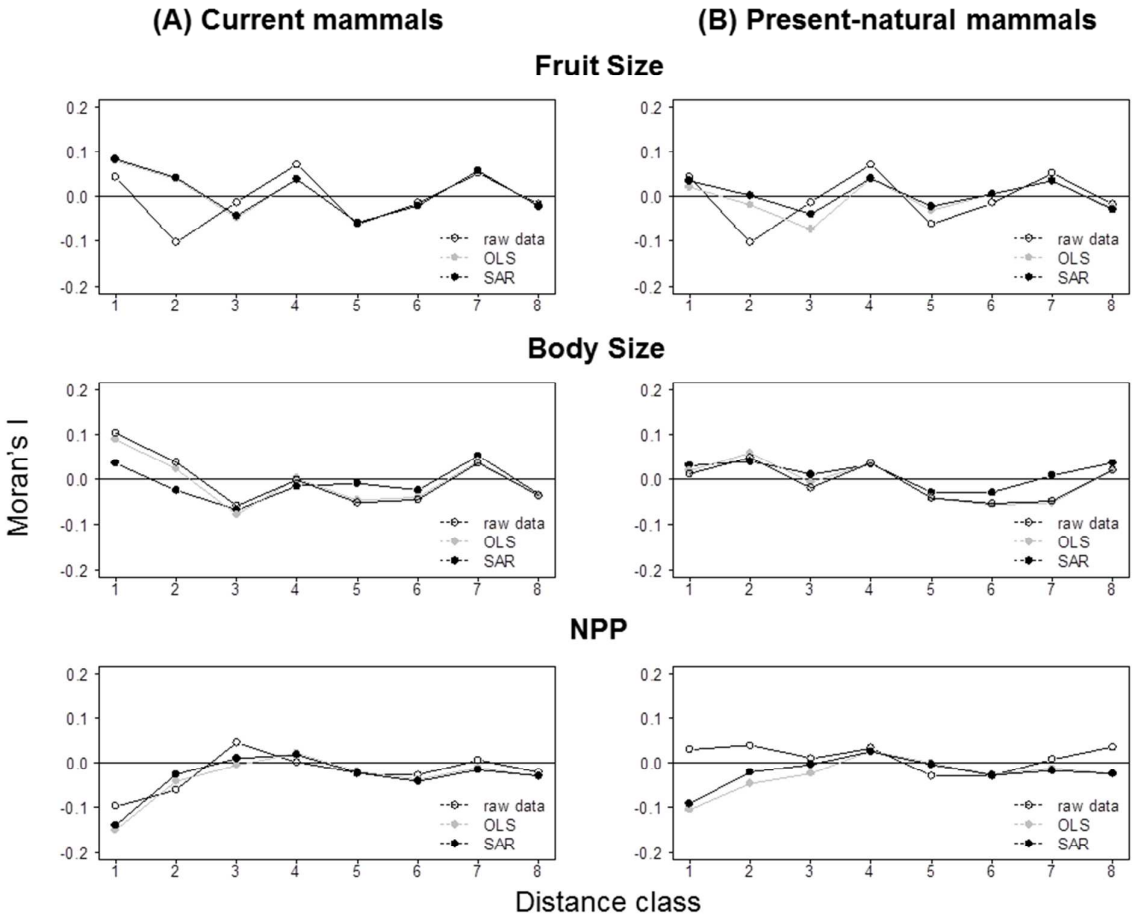


Figure S4. Moran's *I* correlograms of the raw trait data (white circles), of the residuals of the non-spatial OLS models (grey dots), and the residuals of the SAR model (black dots) for the three response variables (A, B: fruit size; C, D: body size; E, F: NPP) within the SEM models. This is illustrated for current mammal ranges (left) and present-natural mammal ranges (right).