

Palms

Journal of the International Palm Society

Vol. 59(2) Jun. 2015



THE INTERNATIONAL PALM SOCIETY, INC.

The International Palm Society

Founder: Dent Smith

The International Palm Society is a nonprofit corporation engaged in the study of palms. The society is international in scope with worldwide membership, and the formation of regional or local chapters affiliated with the international society is encouraged. Please address all inquiries regarding membership or information about the society to The International Palm Society Inc., 9300 Sandstone St., Austin, TX 78737-1135 USA, or by e-mail to info@palms.org, fax 512-607-6468.

OFFICERS:

President: Leland Lai, 21480 Colina Drive, Topanga, California 90290 USA, e-mail lelandlai@aquafauna.com, tel. 1-310-383-2607.

Vice-Presidents: Jeff Brusseau, 1030 Heather Drive, Vista, California 92084 USA, e-mail jbrusseau@newportnational.biz, tel. 1-760-271-8003. Ray Hernandez, 4315 W. San Juan Street, Tampa, Florida 33629 USA, e-mail subtropicofcancer@hotmail.com, tel. 1-813-832-3561.

Corresponding Secretary: Susan Hubbell, 690 Calle César González, Apt. 2402, San Juan, Puerto Rico 00918 USA, e-mail sushubbell@aol.com, tel. 1-787-765-5711.

Administrative Secretary: Larry Noblick, Montgomery Botanical Center, 11901 Old Cutler Road, Miami, Florida 33156 USA, e-mail lnob@montgomerybotanical.org, tel. 1-305-667-3800 ex 104.

Treasurer: Tom Jackson, P.O. Box 1102, Ross, California 94957, USA, e-mail jacksot@sutterhealth.org, tel. 1-415-923-3299.

Directors: 2012–2016: David Bleistein, California; Tim Brian, Hawaii; Jeff Brusseau, California; Paul Craft, Florida; John DeMott, Florida; Haresh, India; Susan Hubbell, Puerto Rico; Tom Jackson, California; Ken Johnson, Florida; Leland Lai, California; Michael Merritt, Hawaii; Kathryn Morgan, Louisiana; Carlo Morici, Spain; Larry Noblick, Florida; Jack Sayers, California; Grant Stephenson, Texas; Scott Zona, Florida. **2014–2018:** Cindy Adair, Virginia; Faith Bishock, Florida; Kimberley Cyr, California; Walter Donovan, Australia; John Dransfield, United Kingdom; Len Geiger, California; Ray Hernandez, Florida; Horace Hobbs, Texas; Julie Cleaver Malzoni, Brazil; Paco Martí, Spain; Don Martin, California; Jill Menzel, Brazil; Fernando Roca, Peru; Tobias Spanner, Germany; David Tanswell, Australia; Lee Tracy, Hawaii.

Bookstore: www.palms.org

Chapters: See www.palms.org

Website: www.palms.org

Palms (formerly PRINCIPES)

Journal of The International Palm Society

An illustrated, peer-reviewed quarterly devoted to information about palms and published in March, June, September and December by The International Palm Society Inc., 9300 Sandstone St., Austin, TX 78737-1135 USA.

Editors: John Dransfield, Herbarium, Royal Botanic Gardens, Kew, Richmond, Surrey, TW9 3AE, United Kingdom, e-mail j.dransfield@kew.org, tel. 44-20-8332-5225, Fax 44-20-8332-5278. Scott Zona, Dept. of Biological Sciences (OE 167), Florida International University, 11200 SW 8 Street, Miami, Florida 33199 USA, e-mail zonas@fiu.edu, tel. 1-305-348-1247, Fax 1-305-348-1986.

Associate Editor: Natalie Uhl, 228 Plant Science, Cornell University, Ithaca, New York 14853 USA, e-mail nwu1@cornell.edu, tel. 1-607-257-0885.

Guidelines for authors are available on request from the Editors or on-line at: www.palms.org/palms_author_guidelines.cfm

Annual membership dues are US\$45.00 for Individuals (or US\$120 for three years) and include a subscription to the Journal. Donor memberships are US\$500 per year. Individual Lifetime memberships are available for a one-time fee of US\$1000. Benefactor memberships require a one-time payment of US\$2500. Subscription price is US\$45.00 per year for libraries and institutions. Dues include mailing of the Journal by airlift service to addresses outside the USA. Dues may be paid on-line at www.palms.org.

Change of Address: Send change of address, phone number or e-mail to The International Palm Society Inc., 9300 Sandstone St., Austin, TX 78737-1135 USA, or by e-mail to info@palms.org.

Claims for Missing Issues: Claims for issues not received in the USA should be made within three months of the mailing date; claims for issues outside the USA should be made within six months of the mailing date.

Periodical postage paid at Austin, TX, USA. Postmaster: Send address changes to The International Palm Society Inc., 9300 Sandstone St., Austin, TX 78737-1135 USA.

PALMS (ISSN 1523-4495)

Mailed at Lawrence, Kansas 15 Jun. 2015
© 2015 The International Palm Society

The full text of PALMS is available on EBSCO Publishing's database.

This publication is printed on acid-free paper.

CONTENTS

57 The Transfer of the Genus *Lytocaryum* to *Syagrus*

L.R. NOBLICK & A.W. MEEROW

63 The Palms in the Riviera from the Latter Half of the 19th Century to the First World War

P.G. CAMPODONICO, G. CAMPODONICO & C. LITTARDI

85 Ethnobotany and Conservation of Palms from Ghana

D.N. OUATTARA, P. EKPE, A. BAKAYOKO & F.W. STAUFFER

Features

Palm News

56

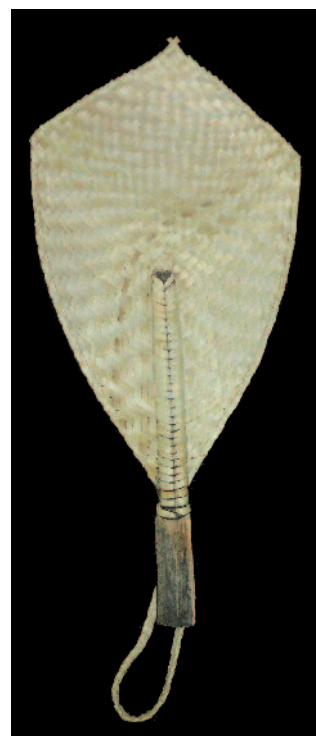


FRONT COVER

Laccosperma secundiflorum growing vigorously in southern Cameroon. This species also occurs in Ghana. See related article by Ouattara et al., p. 85. Photo by J. Dransfield.

BACK COVER

Memorial bust of Lodovico Winter in Bordighera, Italy. See article by Campodonico et al., p. 63.



Fan made from *Hyphaene thebaica* leaflets in Bolgatanga (Upper East region), Ghana. See article by Ouattara et al., p. 85.

PALM NEWS

A recent letter by D.M.J.S. Bowman et al. (Nature 520: 33. 2015.) **sheds light on the history of *Livistona mariae* (right)**, an endemic species from central Australia, which is isolated by some 1000 km from its nearest relative, *L. rigida* of northern Australia. Botanists long assumed that *L. mariae* became isolated as Australia became more arid in the mid-Miocene (15 million years ago), but molecular analysis by T. Kondo et al. (Proceedings of the Royal Society, B. 279: 2652–2661. 2012.) estimated the divergence between the two species to have occurred only 15,000 years ago, a period which overlaps with the time of human occupation. Kondo et al. could not rule out the possibility that the ancestors of what would become *L. mariae* were brought by humans from the populations of *L. rigida* in the north. Bowman et al. brought to light a recently translated text written by a German anthropologist and missionary, Carl Strehlow, in 1895. Strehlow noted the population of *L. mariae* and related the traditional Aboriginal legend that “the gods from the high north brought the seeds to this place a long time ago.” Aboriginal legend neatly coincides with estimates of molecular divergence time and gives further credence to the hypothesis that the ancestors to *L. mariae* were brought to central Australia by humans.



Janis Laraine Cossill

Micropropagation of endangered species of palms continues to be a promising avenue of research and conservation. A recent paper by D.H. Tejavath et al. (International Journal of Current Microbiology and Applied Sciences 4: 436–440. 2015) described a technique for regenerating plantlets of the rare palm, *Calamus wightii* (under the synonym *C. huegelianus*), a species endemic to the Western Ghats of India. In trials of two media and various combinations of growth regulators and hormones, the authors were able to identify the best medium for this species of rattan.

Betel nut, the seed of *Areca catechu*, is a wildly popular masticatory in parts of east Africa, Asia and the Pacific. Chewing betel nut releases an alkaloid, arecoline, which acts as a stimulant, but physicians have long known of the dark side of betel nut: it is a significant cause of oral cancers. **The government of Taiwan is offering subsidies to farmers to cut down their betel nut palms** in order to reduce the domestic supply and discourage the cancer-causing habit. India and Thailand have also launched campaigns to discourage betel nut use and reduce the rate of oral cancers.

Earlier this year, the palm world was **saddened to learn of the passing of Dr. Hermilo J. Quero Rico**. Quero had a long career working with the palm flora of Mexico and described several new species, including *Brahea sarukhanii* and *Gaussia gomez-pompae*. He will be remembered for his love of palms, his country and his home state of Quintana Roo.

The Transfer of the Genus *Lytocaryum* to *Syagrus*

LARRY R. NOBLICK
Montgomery Botanical Center
11901 Old Cutler Road,
Miami, FL 33156 USA
larryn@montgomery
botanical.org

AND

ALAN W. MEEROW
USDA-ARS-SHRS,
National Germplasm
Repository
13601 Old Cutler Road,
Miami, FL 33158 USA
alan.meerow@ars.usda.gov

In this paper we formally transfer all four known species of *Lytocaryum* to the genus *Syagrus* based on recent molecular analyses that show it as a monophyletic group either nested within *Syagrus*, making *Syagrus* paraphyletic or sister to it. Because of these conflicting results between gene and species trees and the imperfect morphological character distinctions used to maintain these two genera, we have decided that *Lytocaryum* should be subsumed taxonomically within *Syagrus*. The new combination *Syagrus itapebiensis* is made.

Noblick and Lorenzi (2010a) reviewed the genus *Lytocaryum* in detail and a new species, *L. itapebiense*, was described. The objective of this paper is to justify the transfer of *Lytocaryum* to *Syagrus*. Placing *Lytocaryum* and *Syagrus* into the same genus is not a new concept. Early-discovered species of *Lytocaryum* were originally placed together with many current *Syagrus* species in the genus *Cocos*, i.e. *C. insignis* and *C. weddelliana* (Drude 1881, Hooker 1884, Wendland 1871). Transferring *Lytocaryum* into *Syagrus* is also not a new concept. Beccari (1916) did just that when he created two new names in *Syagrus*, *S. insignis*

and *S. weddelliana*. Even Burret (1937) did the same when he described *Syagrus hoehnei*. It was Toledo (1944) and Burret and Potzal (1956) who respectively created the genera *Lytocaryum* and *Microcoelum*, with the only difference being in the nature of their endosperm. However, because the only differences were in endosperm, *Microcoelum* was then synonymized into *Lytocaryum* by Uhl and Dransfield (1987). After several failed attempts to publish a revision of *Syagrus*, Glassman (1987) was forced by the strong popular botanical opinion at the time to reverse his earlier unpopular idea of sinking most of the

segregate genera including *Lytocaryum* and *Microcoelum* into the genus *Syagrus* (Glassman 1965). In the 1965 publication, Glassman had denigrated the importance of the splitting exocarp and mesocarp (Fig. 1) in *Microcoelum* and *Lytocaryum* as a weak characteristic for generic distinction. Although he conceded the presence of a thin, fragile endocarp as a character of these two genera, he still questioned whether these two characteristics (splitting exocarp and mesocarp and fragile endocarp) were sufficient for generic distinction. Thus, Glassman (1965) synonymized *Lytocaryum* and *Microcoelum* into *Syagrus* along with several other segregate genera, including *Arecastrum*, *Arykuryroba*, *Barbosa*, and *Chrysallidosperma*. All of these segregate genera have presently been accepted as synonyms of *Syagrus* except for *Lytocaryum* (Uhl & Dransfield 1987, Dransfield et al. 2005, 2008).

Imperfect Morphological Evidence

There is no one character found in *Lytocaryum* that is also not more or less already present in *Syagrus*, except perhaps for the fine abaxial leaflet tomentum. Dransfield et al. (2008) used the following characters in their dichotomous key to maintain *Lytocaryum* generically distinct from *Syagrus*:

Leaflets densely white or pale brown tomentose abaxially.

Leaflets very narrow, close, and regularly arranged.

Epicarp and mesocarp splitting regularly and longitudinally from the apex to the base into three sections at maturity, exposing the thin endocarp (Fig. 1).

Anthers versatile.

Leaflets with densely white or pale brown tomentose abaxially. While many *Syagrus* species have a heavy waxy bloom abaxially, there are no species with fine tomentose hairs on the abaxial side of the leaflet laminae. Many *Syagrus* do have ramenta on the abaxial vein (sometimes even profusely so), but no fine tomentum on the abaxial leaflet blade. Nevertheless, this is a weak character on which to base a genus. Take for example the former genus *Polyandrococos* and *Allagoptera*. *Polyandrococos* not only has tomentum abaxially, while *Allagoptera* is glabrous, but it is also caulescent and has an entirely different leaflet anatomy. *Polyandrococos* is a proven sister to the *Allagoptera* clade both with

molecular (Hahn 2002, Gunn 2004) and morphological data (Noblick et al. 2013), but nevertheless the genus was synonymized (Dransfield et al. 2005, 2008). Therefore, Dransfield et al. (2005, 2008) apparently concluded that the presence of tomentum on the abaxial side of leaflets was not a good character on which to base a genus.

Leaflets that are very narrow, close, and regularly arranged. Middle leaflet width in *Lytocaryum* can vary from 0.5–2.0 cm, with *L. hoehnei* having the widest leaflets. Narrow leaflets with a regular leaflet arrangement are also found in *Syagrus*, especially among the acaulescent ones. The combination of narrow and regularly spaced leaflets is not as common in *Syagrus*; yet, *S. graminifolia*, *S. lilliputiana*, *S. procumbens* and *S. pleiocladooides* have both very narrow (0.4–1.5 cm) and regularly arranged leaflets.

The epicarp and mesocarp splitting from apex to base. In the most recently discovered *Lytocaryum* species (Noblick & Lorenzi 2010a), we observed that the newest species belonging to this clade, *L. itapebiense*, does not have a splitting exocarp and mesocarp and yet it has all of the other morphological characters that have been used to delineate the genus (narrow, regularly spaced leaflets and abaxially tomentose leaflets, versatile anthers). The molecular analyses of several WRKY loci also place it solidly in the *Lytocaryum* clade with strong support (Meerow et al. 2009, 2014). There are four other *Syagrus* species the fruit of which split at least at their tips, often exposing their endocarp (Fig. 2). All of these are rock-loving palms from the Serra do Mar region of Brazil (Rio de Janeiro, Espirito Santo, southern Bahia) and include *S. picrophylla* Barb.Rodr., *S. lorenzoniorum* Noblick & Lorenzi, *S. kellyana* Noblick & Lorenzi, and *S. ruschiana* (Bondar) Glassman (Lorenzi et al. 2010, Noblick & Lorenzi 2010b).

Anthers versatile. Under the *Lytocaryum/Syagrus* couplet, Dransfield et al. (2008) admitted that some *Syagrus* species (even if only rarely) do also have versatile anthers.

Dransfield et al. (2008) also mentioned a thin, rather fragile endocarp, which Glassman (1965) reported as well. Although the presence of a thin fragile endocarp is mostly true, even some of the newly discovered acaulescent *Syagrus* species have thin endocarps as well. Therefore, it would appear that nearly all of the morphological characters for maintaining the genus *Lytocaryum* distinct from *Syagrus* are imperfect.



1. Mature *Lytocaryum weddellianum* (= *Syagrus weddelliana*) fruits showing the longitudinally splitting epicarps and exposed endocarps.

Molecular Evidence

The close relationship of *Lytocaryum* and *Syagrus* inferred by previous studies with plastid (Hahn 2002) and nuclear (Gunn 2004) sequences, morphology (Dransfield et al. 2008, Uhl et al. 1987), and combinations of molecular and morphological characters (Baker et al. 2009) was further corroborated by Meerow et al. (2009, 2014). Meerow and colleagues used the highly resolute WRKY gene family, first across 72 samples of the subtribe Attaleinae (Meerow et al. 2009) and later across the entire tribe Cocoseae (Meerow et al. 2014). The former 2009 study resolved *Lytocaryum* embedded within *Syagrus*. In Meerow et al. (2014), *Lytocaryum*, previously nested in *Syagrus*, was now positioned by combined maximum parsimony with the software program PAUP ver. 4.0b10 (Swofford 2002) and maximum likelihood (ML) using TREEFINDER (Jobb 2011) as sister to *Syagrus* with high support; but Bayesian analysis (BEAST v.1.8.0; Heled & Drummond 2010, Drummond et al. 2012) maintained *Lytocaryum* embedded within *Syagrus*. *Lytocaryum* was also embedded within *Syagrus* in four parsimony (shortest) consensus gene trees for the loci WRKY12,

WRKY16, WRKY19 and WRKY21 (Supplementary Information Figs. S3–S6, respectively, in Meerow et al. 2014). Meerow et al. (2014) also did three different species tree analyses. Species tree analyses attempt to resolve the most likely phylogeny (evolutionary tree) for the group under study, treating each of the individual gene trees separately (rather than combining them into one super matrix). These methodologies grew out of the realization that each gene history may not conform exactly to the “true” species phylogeny. This can be due to several factors: hybridization, gene duplication and loss, or what is called incomplete lineage sorting or deep coalescence (Maddison 1997, Maddison & Knowles 2006, Degnan & Rosenberg 2009, Edwards 2009, Knowles 2009, Anderson et al. 2012). In the latter, gene sequences diverge before speciation takes place. The species trees from all three analyses positioned *Lytocaryum* as sister to *Syagrus*.

Conclusion

Whether *Lytocaryum* is indeed sister to *Syagrus* is clearly controversial. Again, it is necessary to look at the six MP consensus gene trees,



2. Mature *Syagrus ruschiana* fruits showing the epicarps beginning to split longitudinally.

four of which render *Syagrus* paraphyletic by embedding *Lytocaryum* within it (Meerow et al. 2014, Supplementary Information Figs. S3–6). It is only when all six loci are combined that a sister relationship emerges (Fig. 1 in Meerow et al. 2014). Yet this is also supported by all three of the species trees (Fig. 3A–C in Meerow et al. 2014). The question that perhaps should be asked, then, is whether there is much merit maintaining *Lytocaryum* as a genus distinct from *Syagrus*, regardless of which resolution is the “true” one. Our conclusion is that there is no merit in maintaining *Lytocaryum* as a distinct genus. Not only is the morphological support imperfect, but the molecular evidence is inconclusive as well, even though we are inclined to accept the genus as a sister to *Syagrus*. The question of whether the *Lytocaryum* clade is a sister to *Syagrus* or embedded within *Syagrus* becomes a moot point by simply synonymizing *Lytocaryum* species into *Syagrus* as did Glassman (1965) nearly 50 years ago.

Taxonomic Treatment

Syagrus Mart., Palm. fam. 18. 1824. Type: *S. cocoides* Mart.

Langsdorffia Raddi, Mem. Mat. Fis. Soc. Ital. Sci. 18(2): 345. 1820 (non Mart., 1818).

Type: *L. pseudococos* Raddi (= *Syagrus pseudococos* (Raddi) Glassman).

Platenia H. Karst., Linnaea 28: 250. 1856. Type: *P. chiragua* H. Karst. (= *Syagrus chiragua* (H. Karst.) H. Wendl.) (see Bernal & Galeano 1989).

Glaziova Mart. ex Drude, in Mart., Fl. bras. 3(2): 295. 1881. Lectotype: *G. martiana* Glaz. ex Drude (illegitimate name) (= *Lytocaryum weddellianum* [H. Wendl.] Toledo) (see H.E. Moore 1963) (= *Syagrus weddelliana* [H. Wendl.] Becc.).

Barbosa Becc., Malpighia 1: 349, 352. 1887. Type: *B. pseudococos* (Raddi) Becc. (*Langsdorffia pseudococos* Raddi) (= *Syagrus pseudococos* (Raddi) Glassman).

Rhyticocos Becc., Malpighia 1: 350, 353. 1887. Type: *R. amara* (Jacq.) Becc. (*Cocos amara* Jacq.) (= *Syagrus amara* (Jacq.) Mart.).

Arikuryroba Barb. Rodr., Pl. jard. Rio de Janeiro 1:5. 1891. Type: *A. capanemae* Barb. Rodr. = *A. schizophylla* (Mart.) L.H. Bailey (*Cocos schizophylla* Mart.). = *Syagrus schizophylla* (Mart.) Glassman).

Arikury Becc., Agric. Colon. 10: 445. 1916. Superfluous substitute name.

Arecastrum (Drude) Becc., Agric. Colon. 10: 446. 1916. *Cocos* subgenus *Arecastrum* Drude in Mart., Fl. bras. 3 (2): 402. 1881. Type: *A. romanzoffianum* (Cham.) Becc. (*Cocos romanzoffiana* Cham.) (= *Syagrus romanzoffiana* (Cham.) Glassman).

Lytocaryum Toledo, Arq. Bot. Estado São Paulo ser. 2. 2(1): 6. 1944. Type: *L. hoehnei* (Burret) Toledo (= *Syagrus hoehnei* Burret).

Microcoelum Burret & Potztal, Willdenowia 1: 387. 1956. Lectotype: *M. martianum* (Glaz. ex Drude) Burret & Potztal (*Glaziova martiana* Glaz. ex Drude [illegitimate name], = *Syagrus weddelliana* [H. Wendl.] Becc. [*Cocos weddellianum* H. Wendl., *Lytocaryum weddellianum* (H. Wendl.) Toledo, *M. weddellianum* (H. Wendl.) H.E. Moore]).

Chrysallidosperma H.E. Moore, Principes 7: 109. 1963. Type: *C. smithii* H.E. Moore (= *Syagrus smithii* (H.E. Moore) Glassman).

Syagrus hoehnei Burret, Notizbl. Bot. Gart. Berlin-Dahlem 13: 678. 1937.

Lytocaryum hoehnei (Burret) Toledo, Arq. Bot. Estado São Paulo, n.s., f.m., 2: 7. 1944.

Syagrus insignis (Rob.) Becc., Agric. Colon. 10: 467. 1916.

**Glaziova insignis* Rob., Gard. Chron., n.s., 1: 665. 1874.

Cocos insignis (Rob.) Mart. ex Hook. f., Rep. Roy. Bot. Gard. Kew 1882: 72, 74. 1884.

Calappa insignis (Rob.) Kuntze, Revis. Gen. Pl. 2: 982. 1891.

Lytocaryum insigne (Rob.) Toledo, Arq. Bot. Estado São Paulo, n.s., f.m., 2: 8. 1944.

Microcoelum insigne (Rob.) Burret & Potztal, Willdenowia 1: 388. 1956.

Syagrus itapebiensis (Noblick & Lorenzi) Noblick & Meerow, **comb. nov.**

**Lytocaryum itapebiense* Noblick & Lorenzi, Palms 54: 13. 2010.

Syagrus weddelliana (H. Wendl.) Becc., Agric. Colon. 10: 468. 1916.

**Cocos weddelliana* H. Wendl., Florist & Pomol. 1871: 114. 1871.

Lytocaryum weddellianum (H. Wendl.) Toledo, Arq. Bot. Estado São Paulo, n.s., f.m., 2: 8. 1944.

Microcoelum weddellianum (H. Wendl.) H.E. Moore, Gentes Herb. 9: 267. 1963.

Glaziova elegantissima H. Wendl., Florist & Pomol. 1871: 116. 1871.

Cocos elegantissima (H. Wendl.) Schaedtler, Hamburger Garten-Blumenzeitung 31: 158. 1875.

Glaziova martiana Glaz. ex Drude in Mart., Fl. bras. 3(2): 397. 1881.

Calappa elegantina Kuntze, Revis. Gen. Pl. 2: 982. 1891.

Cocos pynaertii auct., Gard. Chron., ser. 3, 9: 683. 1891.

Cocos weddelliana var. *pinaertii* G. Nicholson & Mottet, Dict. Prat. Hort. 5: 754. 1899.

Syagrus weddelliana var. *cinereus* Becc., Agric. Colon. 10: 471. 1916.

Syagrus weddelliana var. *pinaertii* Becc., Agric. Colon. 10: 468. 1916.

Lytocaryum weddellianum var. *cinereum* (Becc.) A.D. Hawkes, Arch. Bot. São Paulo, n.s., 2: 190. 1952.

Lytocaryum weddellianum var. *pinaertii* (G. Nicholson & Mottet) A.D. Hawkes, Arch. Bot. São Paulo, n.s., 2: 190. 1952.

Microcoelum martianum (Glaz. ex Drude) Burret & Potztal, Willdenowia 1: 388. 1956.

* indicates the basionym

Acknowledgments

We thank the technicians at the USDA lab, who helped with the large scale sequencing of the Cocoseae, and William J. Baker for his careful reading of an earlier version of this manuscript.

LITERATURE CITED

- ANDERSON, C.N., L. LIU, D. PEARL AND S.V. EDWARDS. 2012. Tangled trees: the challenge of inferring species trees from coalescent and noncoalescent genes. *Methods in Molecular Biology* 856: 3–28.
- BAKER, W.J., V. SAVOLAINEN, C.B. ASMUSSEN-LANGE, M.W. CHASE, J. DRANSFIELD, F. FOREST, M.M. HARLEY, N.W. UHL AND M. WILKINSON. 2009. Complete generic-level phylogenetic analyses of palms (Arecaceae) with comparisons of supertree and supermatrix approaches. *Systematic Biology* 58: 240–256.
- BECCARI, O. 1916. Il genere *Cocos* Linn. e le palme affine. L' Agricoltura Coloniale 10: 435–471, 489–532, 585–623.
- BERNAL, R. AND G. GALEANO-GARCÉS. 1989. The identity of *Roebelia* and *Platenia* (Palmae). *Kew Bulletin* 44: 321–328.
- BURRET, M. 1937. Die Palmengattung *Syagrus* Mart. Notizblatt des Botanischen Gartens und Museums zu Berlin-Dahlem 13: 677–696.
- BURRET, M. AND E. POTZTAL. 1956. *Microcoelum*, eine neue Palmengattung (Cocoideae). *Willdenowia* 1: 386–388.
- DEGNAN, J.H. AND N.A. ROSENBERG. 2009. Gene tree discordance, phylogenetic inference and the multispecies coalescent. *Trends in Ecology and Evolution* 24: 332–340.
- DRANSFIELD, J., N.W. UHL, C.B. ASMUSSEN, W.J. BAKER, M.M. HARLEY AND C.E. LEWIS. 2005. A new phylogenetic classification of the palm family, Arecaceae. *Kew Bulletin* 60: 559–569.
- DRANSFIELD, J., N.W. UHL, C.B. ASMUSSEN, W.J. BAKER, M.M. HARLEY AND C.E. LEWIS. 2008. *Genera Palmarum, the Evolution and Classification of Palms*. Royal Botanic Gardens Kew.
- DRUDE, O. 1881. *Martius Flora Brasiliensis* 3: 353–460.

- DRUMMOND, A., M. SUCHARD, D. XIE AND A. RAMBAUT. 2012. Bayesian phylogenetics with BEAUti and the BEAST 1.7. *Molecular Biology and Evolution* 29: 1969–1973.
- EDWARDS, S.V. 2009. Is a new and general theory of molecular systematics emerging? *Evolution* 63: 1–19.
- GLASSMAN, S.F. 1965. Preliminary studies in the palm genus *Syagrus* Mart. and its allies. *Fieldiana: Botany* 31: 147–164, figs. 44–50.
- GLASSMAN, S.F. 1987. Revisions of the palm genus *Syagrus* Mart. and other selected genera in the *Cocos* alliance. *Illinois Biological Monographs* 56: 1–230.
- GUNN, B. 2004. The phylogeny of the Cocoeae (Arecaceae) with emphasis on *Cocos nucifera*. *Annals of the Missouri Botanical Garden* 91: 505–522.
- HAHN, W.J. 2002. A phylogenetic analysis of the Arecoid line of palms based on plastid DNA sequence data. *Molecular Phylogenetics and Evolution* 23: 189–204.
- HELED, J. AND A.J. DRUMMOND. 2010. Bayesian inference of species trees from multilocus data. *Molecular Biology and Evolution* 27: 570–580.
- HOOKE, J.D. 1884. List of palms cultivated in the Royal Gardens, Kew. Report Royal Garden Kew 1882: 53–73.
- KNOWLES, L.L. 2009. Estimating species trees: methods of phylogenetic analysis when there is incongruence across genes. *Systematic Biology* 58: 463–467.
- LORENZI, H., L.R. NOBLICK, F. KAHN AND E. FERREIRA. 2010. LORENZI: ARECACEAE (PALMS). Brazilian flora, Instituto Plantarum, Nova Odessa.
- MADDISON, W.P. 1997. Gene trees in species trees. *Systematic Biology* 46: 523–536.
- MADDISON, W.P. AND L.L. KNOWLES. 2006. Inferring phylogeny despite incomplete lineage sorting. *Systematic Biology* 55: 21–30.
- MEEROW, A.W., L. NOBLICK, J.W. BORRONE, T.L. COUVREUR, M. MAURO-HERRERA, W.J. HAHN, D.N. KUHN, K. NAKAMURA, N.H. OLEAS AND R.J. SCHNELL. 2009. Phylogenetic analysis of seven WRKY genes across the palm subtribe Attaleinae (Arecaceae) [corrected] identifies *Syagrus* as sister group of the coconut. *PLoS One* 4: e7353.
- MEEROW, A.W., L. NOBLICK, D.E. SALAS-LEIVA, V. SANCHEZ, J. FRANCISCO-ORTEGA, B. JESTROW AND K. NAKAMURA. 2014. Phylogeny and historical biogeography of the cocosoid palms (Arecaceae, Arecoidae, Cocoseae) inferred from sequences of six WRKY gene family loci. *Cladistics* DOI: 10.1111/Cla. 12100
- MOORE, H.E. 1963. The types and lectotypes of some palm genera. *Gentes Herbarum*. 9: 245–274.
- NOBLICK, L.R. AND H. LORENZI. 2010a. *Lytocaryum*, including a new species from Bahia, Brazil. *Palms* 54: 5–17.
- NOBLICK, L.R. AND H. LORENZI. 2010b. New *Syagrus* Species from Brazil. *Palms* 54: 18–42.
- NOBLICK, L.R., W. HAHN AND M.P. GRIFFITH. 2013. Structural cladistic study of Cocoseae, subtribe Attaleinae (Arecaceae): Evaluating taxonomic limits in Attaleinae and the neotropical genus *Syagrus*. *Brittonia* 65: 232–261.
- SWOFFORD, D.L. 2002. PAUP*. Phylogenetic Analysis Using Parsimony (*and Other Methods). Version 4. Sinauer Associates. Sunderland.
- TOLEDO, J.F. 1944. Estudos sobre algumas palmeiras do Brasil. I. Uma Novo Genero da tribu Cocoeae. *Arquivos de Botanica do Estado de São Paulo n.s., f.m.,* 2: 3–9, t.1–3.
- WENDLAND, H. 1871. In T. MOORE, Pictures of palm trees. II. *Cocos weddelliana*. *Florist and Pomologist* 1871: 114.
- UHL N.W. AND J. DRANSFIELD. 1987. Genera Palmarum: A Classification of Palms Based on the Work of H. E. Moore, Jr. Lawrence, Kansas: International Palm Society and L. H. Bailey Hortorium.

The Palms in the Riviera from the Latter Half of the 19th Century to the First World War

PIER GIORGIO
CAMPODONICO,
GABRIELE CAMPODONICO
*Piazza San Bartolomeo,
6 - 18039 Ventimiglia,
Italy*

AND

CLAUDIO LITTARDI
*Centro Studi e Ricerche
per le Palme,
Corso Cavallotti,
113 - 18038 Sanremo,
Italy*

1. The palms of Nice were featured in early post-cards.



Palm horticulture along the French and Italian Riviera flourished in the late 19th and early 20th centuries (Fig. 1). Public and private gardens featured an astonishing diversity of palms, as documented by the contemporary literature. Palm nurseries, especially that of Ludwig Winter, pushed the horticultural limits during this golden age.

The Riviera, i.e. the Mediterranean coast of what is now Italy and France, had a strong appeal to the leisure classes of northern, central and eastern Europe during the whole of the 19th century and the beginning of the 20th century. The development of communication routes, especially the railways, stimulated tourism in the region (Figs. 2 & 3). To this end, the first sleeping cars of the Compagnie Internationale des Wagons-Lits started to operate from Paris to Menton in 1872. This service soon extended to Calais. Among the many other services that have followed, the Vienna–Cannes line stands out. That service began in 1896, and only two years later it was extended to Saint Petersburg.

Purchasing agricultural land along the coast to build vacation homes was extremely appealing not only for English people, but also for Germans and Russians. The particularly favorable climatic conditions of the Mediterranean coast offered the possibility to extend stays not only in winter but also during a great part of the autumn and the spring. It is clear that all these factors played a role in the creation of a large number of private gardens, into which plants of every type and origin were introduced. At the same time, thanks to the development and the transformation of the coastal villages from small groups of houses into places which were capable of receiving and satisfying a great number of guests, many green spaces were created, especially in the areas next to the old town centers, where clusters of villas and hotels were appearing. So, plants and especially palms began to be used to decorate boulevards and town spaces. These small coastal villages became little towns, and their new, well-organized urban green spaces were soon welcoming guests.

New, exotic plants from private gardens enriched the pre-existing urban green spaces, which consisted mostly of olive tree groves, pine forests or areas of native coastal vegetation. In creating these new gardens, their owners were effectively botanical collectors, who on the one hand exchanged plants with one another, and on the other hand competed with one another for possessing and growing rarities. In this context, the experimentation with and acclimatization of exotic species were no longer the exclusive prerogative of research centers but became the vocation of wealthy land-owners as well. These activities caused such a demand for plants that some of the regional plant nurseries began seeking out new



2. A travel poster for train service from Paris to the Mediterranean coast.

3 (facing page). Travel posters used palms to emphasize the exotic ambiance of the Riviera.

plants and in turn became centers of both plant introduction and research.

The great collectors and the major nurseries managed to import plants from important international nurseries thanks to the railway development, which was completed in the Riviera in 1872 with the inauguration of the Menton – Ventimiglia section, which connected the Italian and the French networks. The resulting plant introductions remade the landscape, in which a leading role was played by palms, which transformed the image of the Riviera during this period. Palms were used as in advertisements to represent the Riviera's mild, almost subtropical climate.

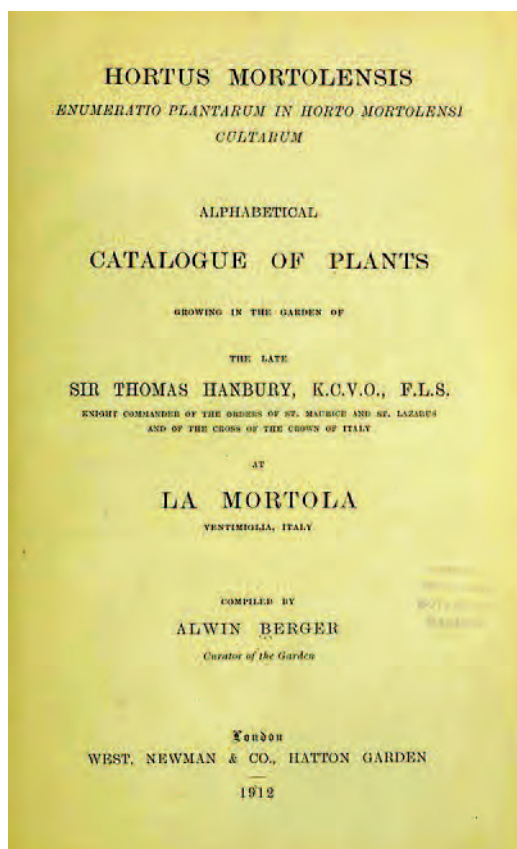
Of course, some palm species were already present in the Riviera and had been for decades, particularly in the area of Sanremo and Bordighera, where specimens of *Phoenix dactylifera* were cultivated to produce and sell leaves for Jewish and Catholic religious ceremonies. A detailed report of this activity was given by Eduard Strasburger (1913) in his book *Streifzüge an der Riviera*.

We cannot speak about the development of the Riviera's horticulture, garden design, public



landscapes and the introduction of an impressive number of new plants without remembering the figure of Ludwig Winter

(1846–1912). We credit him, directly or indirectly, for the great progress in introducing palms in the coastal towns of the Riviera on



4. The title page of Berger's catalog of the plants of La Mortola from 1912.

both sides of the border between Italy and France. Ludwig Winter came to Italy following a suggestion made by Charles Huber, who took the liberty of recommending Winter to Thomas Hanbury, who few years before had acquired the property of Capo Mortola, where he had begun to set up one of the most important acclimatization gardens of the Mediterranean area. Thomas Hanbury was looking for a project coordinator who could replace him and his brother Daniel when they were absent from their property at La Mortola. A better choice could not have been made. The young German not only proved himself able to fulfil the tasks assigned to him but he also became the designer and builder of the garden's layout. The mark which Winter left is clear and evident even today. We owe him credit for the introduction of most of La Mortola's palms, for which it is said that the owner did not have a particular taste!

Much information about the palms of La Mortola can be gathered from analyses of three published catalogues or inventories (Cronmeyer 1889, Dinter 1897, Berger 1912).

Among them, the one published by Alwin Berger (1912) is surely the richest in information (Fig. 4). Beyond the mere listing, it contains some very interesting notes about the taxa that were found in La Mortola at that time. As with every catalogue, the list indicates only the presence of at least one individual for each taxon, but it does not tell us whether the plants were adult or young, if they were in the ground or in a container, if they had just been introduced or if they were well acclimatized. Fortunately, the appendix includes many interesting notes concerning the plants and their introduction to La Mortola, their origins, their systematic classification, their acclimatization results and phenological observations on cultivated specimens. Sometimes there are notes concerning the acclimatization of palm specimens in other gardens of the Riviera. In particular, there are notes on some palms in gardens of Garavan, viz. Villa Hindoue, Villa Paradu and Villa St. Louis.

With his 5-years of experience in La Mortola's gardens, Ludwig Winter created a large nursery of his own near the town of Bordighera, from which and for some decades he provided

5. Winter's nursery, Bordighera.



plants to clients in the Riviera and beyond (Fig. 5). Each catalogue (Fig. 6) gives us the opportunity of knowing all the plants that Winter offered for sale and consequently which taxa were distributed in the region. There was a huge selection of plants. About fifty taxa of palms were offered in a variety of sizes and ages.

The great demand for plants caused the birth and growth of other nurseries in the region. Many of them were little more than shops, but some of them could be considered as rivals of Winter's nursery, especially when they were on the other side of the international border. Among the rivals, the Zacharias & Keller nurseries in Beaulieu sur Mer (France) offered a rich catalogue with a wide selection of palms. We must not forget another famous enterprise for the cultivation and marketing of palms: Charles Huber's nursery in Hyères. He was the first in the region to offer *Jubaea chilensis*.

Evidence of the wide variety of cultivated plants in Sanremo was provided by the Baron Carl von Hüttner, a doctor who, enchanted by the Riviera, chose Villa Parva (Fig. 7) in Sanremo as his residence. He is famous for having written a small book which described the flora of Sanremo's villas and gardens,

6. Winter's Bordighera catalog.

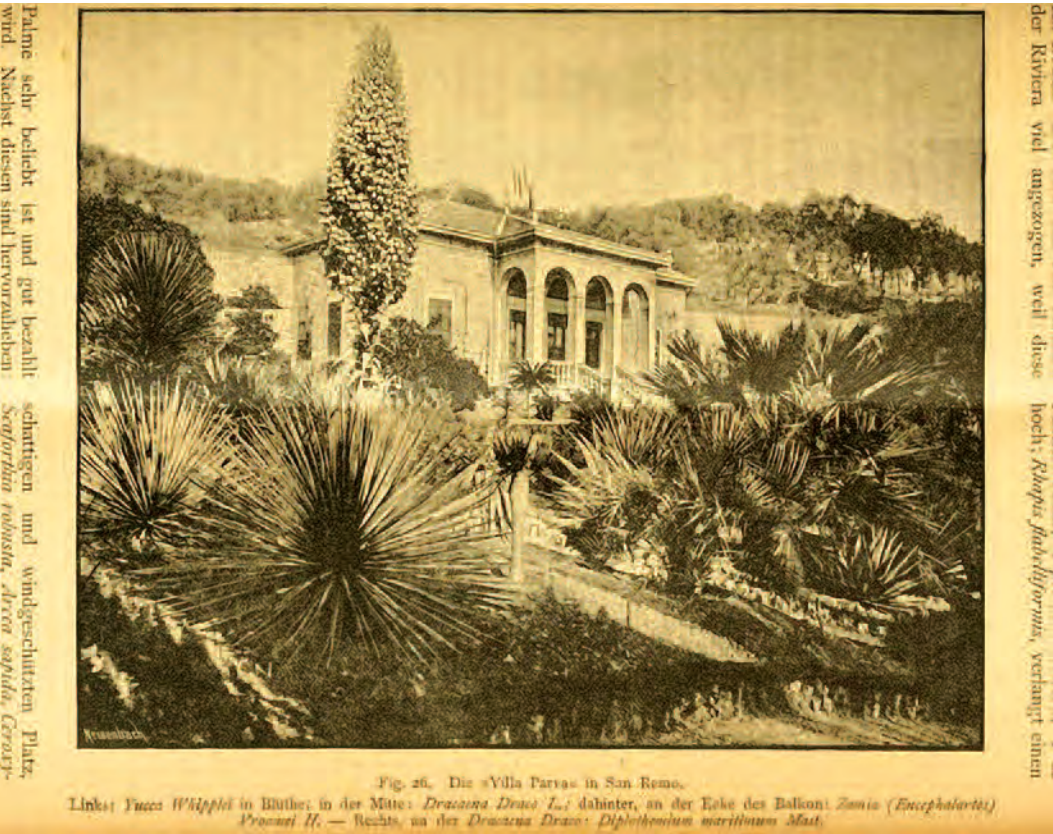


Abb. 27. Ngavenblüte im Palmengarten der Villa Parva in San Remo. Nach einer Photographie von G. Scotti in San Remo. (Zu Seite 40.)

7. The garden of Villa Parva.

entitled *Gartenflora des Klimatischen Winter-Kurorts San Remo* (1884). He noticed that "... the number of hosts who evidence an interest for the local gardens grows every year ..." and "... our German compatriots have begun to settle in this wonderful region" With this guide, Hüttner passed on an important source of information about plants in Sanremo's parks and gardens. The uniqueness and the best quality of this work, and at the same time its limitation, is the narrowness of the territory considered. This inventory is an exceptional testimony of the wide variety of Sanremo's flora of that time. His text is neither a mere summary nor a simple guide: it includes notes and detailed comments about the various taxa. The list of the private villas is very extensive and evinces how much passion and interest there was in gardening. On the other hand, we note with disappointment that so many of these green spaces either no longer exist or were changed beyond recognition by subsequent development. Among Sanremo's villas with important collections of palms, without any doubt, Hüttner's Villa Parva stood out (Fig. 8).

Additional precious evidence of the palms in the Riviera comes from Giorgio Roster's writings. He was a Florentine doctor, a scientist and a famous photographer. These last two



8 (top). An early published photograph of the garden of Villa Parva in Sanremo. 9 (bottom). The Passeggiata, Ospedaletti, Italy.

interests – passions, really –made of him a leading figure among high society and a curious traveler. Being fascinated by the perfectly acclimatized plants he saw in the Riviera, Roster (1903) wrote, “Whoever goes from San Remo to Cannes cannot help but wonder at seeing the typical flora of the region combined with some rare decorative plants which come from the warm countries and are

scattered everywhere, on the slopes, in the fields, along the streets and in the public walks.” At that time, owners were proud of their gardens and took pleasure in exhibiting their collections to their guests. They were probably especially pleased to welcome an important scientist such as Roster, who was at the same time an expert of the new art of photography. Roster had the occasion to visit

10 & 11. Postcards illustrating the gardens of Monte Carlo, in which palms play a prominent role.





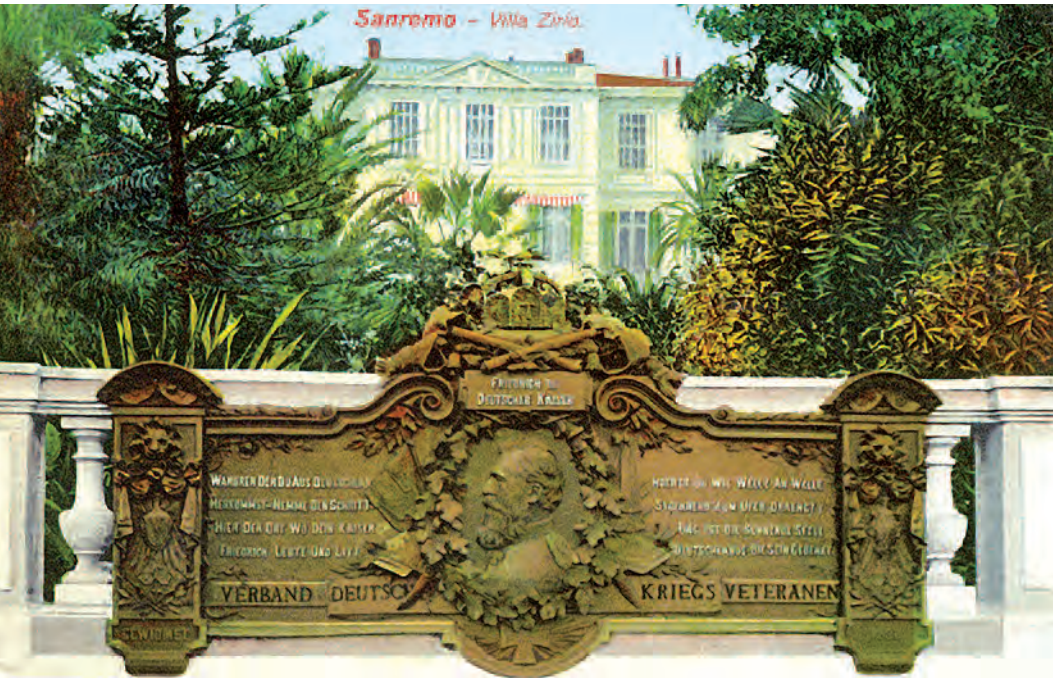
12. The Casino and Garden at Monte Carlo.

many gardens along the whole coastal arc from Sanremo to Cannes.

Texts from the late 19th and early 20th centuries paint a picture of the diversity of palms cultivated in the Riviera (Figs. 9–12). Among

the most significant gardens mentioned in the texts are: in Sanremo (Villa Parva [Figs. 7 & 8], Villa Thiem, Villa delle Palme, Villa Weber, Villa Ormond, Villa Zirio [Fig 13], Villa Marsaglia, Marsaglia Castle [Figs. 14 & 15], Villa Evellina, Palazzina Roverizio, Villa

13. Villa Zirio, Sanremo.





14. (top). A vintage postcard from Marsaglia Castle, Sanremo, showing palms. 15 (bottom). Another postcard showing *Phoenix* palms.

Patrone, parks of the Westend and Victoria Hotels, garden of the Pensione Flora, public garden near the railway station [Figs. 16 & 17], Garden Imperatrice and town square), in Bordighera (Winter Garden in the so-called zone Madonna della Ruota [Figs. 18 & 19], Winter nursery in the valley of the Sasso River

and urban spaces), at La Mortola di Ventimiglia (Hanbury Gardens, Fig. 20), in Menton (especially in Garavan: Villa Saint Louis, Villa Hindoue, Villa Paradou – the former Villa Kennedy – in addition to other areas that were not clearly defined Fig. 21), in Monaco (gardens of the Casino), in Nice (the new



San Remo - Passeggiata dell'Imperatrice



San Remo - Treno in partenza

16 & 17. Two postcards showing the palms of the Corso Imperatrice, Sanremo.

Promenade des Anglais, Achille-Georges Viscount of Vigier's Villa on the Mont Boron, Victor Spitalieri Count of Cessole's Villa Mariposa in Mantega, Dr. Robertson-Proshowski's Villa Les Tropiques, Villa Robertson, and others (Figs. 22 & 23), in Antibes (Gustave Thuret's Villa along the Boulevard du Cap), in Golfe-Juan (Villa Mauresque – Les Cocotiers, which was created

by Jacques Duval, Count of Éprémèsnil and Villa Niobe) and, at last, in Cannes (Villa Menier and Villa Valetta – the former Villa Dognin – now Villa Mariposa). Unfortunately many of these gardens, especially on the French side, do not exist anymore. In some cases, groups of palms still exist, hidden between modern buildings that were built where these splendid parks were located.



18. A painting by H. Nestel was the basis for this postcard from the Winter Garden, Bordighera.

The texts consulted for this paper were published over one-hundred years ago, and moreover, they have very different origins. Nevertheless, it is possible to reconcile the

nomenclature of that time with modern nomenclature. In this following discussion, we have modernized the nomenclature for all the cited taxa. During our research, some



19. Palms of Bordighera.

illegitimate names were found. With methods which were typical of commercial nurseries,

hybrids, varieties or even clones were sometimes considered as species.

The palms

The genus *Phoenix*, represented by *Phoenix dactylifera*, was already present in the Riviera since time immemorial and growers had learned to select clones with the best phenological features for commercial needs. The aesthetic requirements of the 19th Century, when these palms were used more for street landscaping (Figs. 24–26), were very different from the past when they were grown for church decor. However, nurseries sold a lot of adult plants, which came from old cultivation areas. On the other hand, major nurseries produced new plants either by separating suckers or from seeds. This last activity allowed the exploitation of great individual variability and the selection of clones with particular characteristics.

These selections, which were made in Ludwig Winter's nursery, resulted in plants with unique features. The most striking case concerns a palm in the garden of Villa Spitalieri de Cessole in Nice (Fig. 27): this rare specimen was able to produce and ripen edible dates, something remarkable for southern Europe. Émile Sauvaigo (1891), at that time the director of the Natural History Museum of Nice, described the palm and gave it the name

20. A postcard view of the Hanbury Gardens, Ventimiglia, based on a painting by H. Nestel.



Phoenix mariposae. He mentioned this palm for the second time three years later, but he gave it a different name, *Phoenix melanocarpa* (Sauvaigo 1894), and attributed the name to Charles Naudin, who had described it in the previous year (Naudin 1893). In 1924, Auguste Chevalier proposed a new combination: *Phoenix dactylifera* var. *mariposae*. It is possible

that this plant was purchased in 1882 in Winter's nursery in Bordighera. Chevalier reported that the date production by this palm was decidedly abundant. In 1893, 50 kg of dates were harvested (Dru 1894), while in 1916 no less than 80 kg of dates were harvested (Chevalier 1924). When Sauvaigo described this palm he noted its similarity to both *P.*

21 (top). The famous Allée des Palmiers, Menton. 22 (bottom). Postcard from La Grotte des Jardines, Nice.





23. An allée of palms in the garden of a villa in Nice.

canariensis and *P. dactylifera*; we suspect that it was some sort of hybrid between both species.

Phoenix canariensis is a palm that was introduced in the Riviera soon after the fashion for palms took hold: it was first planted in 1864 in Villa Vigier's park on the slopes of the Mont Boron on the bluffs around Nice (Zona 2008). Until then it was completely unknown in the region. Some specimens of *Phoenix canariensis*, because of their aesthetic and landscape characteristics, were planted out in towns along both the French and Italian coasts, especially by Ludwig Winter. In the last quarter of the 19th century, it was widely planted in boulevards, promenades, parks and gardens. Soon the nurseries in the Riviera, which were always searching for something new, made hybrids, as it has been already said, with it. A hybrid of *Phoenix dactylifera* with *Phoenix canariensis* was obtained by Naudin, who called it *Phoenix × intermedia*.

In the meantime, a palm was found that had features of *Phoenix canariensis*, but it produced much bigger fruits (dates). Sauvaigo (1894b) described it and gave it the name *Phoenix macrocarpa*. Ludwig Winter requested seeds of that particular palm. Upon growing them, he obtained a plants whose features did not match with the ones reported in Sauvaigo's description. Regretting these differences and thinking that it was a hybrid, he offered for sale those little plants and called them *Phoenix* 'Hybrida Elegantissima.' Modern tests on herbarium specimens of *P. macrocarpa* showed

24. Postcard showing the Quai des Etats Unis, Nice, and the mature stands of *Phoenix*.





25 (top). Vintage postcard of the Promenade du Chateau, Allée des Palmiers, Nice. 26 (bottom). A postcard showing the Allée des Palmiers, Menton.

that it was simply a clone of *Phoenix canariensis*.

Other species of *Phoenix* were cultivated in the Riviera, including *Phoenix paludosa* and *Phoenix sylvestris* (both were present in Villa Parva, at La Mortola and in the Winter nurseries),

Phoenix reclinata (in La Mortola's gardens and in Villa Parva, where it was mentioned a second time under the synonym *Phoenix leonensis*, the latter name also present in Winter's catalogues) and *Phoenix rupicola* (in Les Cocotiers in Golfe Juan and in Sanremo's Park Marsaglia, as well as in Villa Parva, in the



Fig. 8. — *Phoenix melanocarpa*. (Eltich P. Henry).

27. *Phoenix melanocarpa* at Villa Cessole.

Hanbury gardens and in Winter's nursery). Although *Phoenix roebelenii* is mentioned in Winter's catalogues, it was not present in any garden, probably because at that time it was considered only as a houseplant.

Today *Chamaerops* is treated as a monospecific genus: it includes only the species *Chamaerops humilis*, which is the only native palm of the Italian territory. However, its original range extended from the coastal zones of the Tuscan Maremma towards the south. Its widespread cultivation has allowed it to become naturalized in some coastal stretches of both the Liguria and the Côte d'Azur. During the 19th century, the nurseries learned to offer *Chamaerops humilis* on a large scale from Charles Huber, who had been the first to offer it for sale in 1864. From then on, this small and often bushy palm was widely used. A note (Muratorio & Kiernan 1992) concerning the first introductions of *Chamaerops humilis* at La Mortola is very interesting: These palms arrived following a purchase made in December 1867 in Hyères. This purchase was made at Charles Huber's nursery where brothers Daniel and Thomas Hanbury made considerable purchases of many kinds of plants. Some years later other plants reached La Mortola coming from Algeria, from Hamma's Jardin d'Essai.

As demand for *Chamaerops humilis* increased, nurserymen began to search individuals with

particular features in order to offer something different. Individuals were selected sometimes with distinctive features; many of them were listed under varietal names with no botanical standing. They are nowadays simply *C. humilis*. Hüttner reported that the typical form of this species was widespread, but he also noted four different varieties within the municipality of Sanremo, in gardens that belonged to either private citizens or hotels: *Chamaerops humilis* var. "*arborea*" (possibly coinciding with *C. humilis* var. *arborescens*) in Villa Parva, in the Marsaglia Castle and in the Westend Hotel, *C. humilis* var. "*duplicifolia*" in Villa Parva, *C. humilis* var. "*elegans*" in Villa Parva, Villa Thiem and in the Westend Hotel, *C. humilis* var. "*tomentosa*" in Villa Parva. Berger reported that the following varieties could be found in La Mortola's gardens: *Chamaerops humilis* var. *arborescens*, *C. humilis* var. "*elegans*," *C. humilis* var. *macrocarpa* and *C. humilis* var. "*tomentosa*." In the notes at the end of the catalogue, Berger (1912) sketched out the differences that characterize these varieties.

The genus *Trachycarpus* includes the palm most tolerant to frigid temperatures: *Trachycarpus fortunei*. This palm, which comes from the Far East, can easily be cultivated far from the coast as well as in some temperate zones of northern Europe. Thanks to its easy acclimatization and its resistance to the hard winters, it was used throughout the Riviera. Other species of this genus were not as common. *Trachycarpus takil* was present only in the Hanbury gardens. It reached La Mortola in 1884 from the Kew Gardens under the name *Trachycarpus martiana*. This classification was ambiguous because this horticultural form was different from the true species *T. martiana*. This specimen was subsequently examined by Odoardo Beccari, who recognized it as *T. takil* (Berger 1912). *Trachycarpus takil* has since disappeared from the Hanbury gardens.

Winter sold *Trachycarpus wagnerianus*, which was also present in the Hanbury gardens. Berger (1916b) noted that his plants grew from seeds collected in the wild in an undefined location of either central or eastern Asia, probably in interior China. The seeds arrived to Wagner's horticultural firm in Gohlis, a northern suburb of Leipzig, Germany. Most of these seeds were acquired by Winter who, after having received them, germinated them and arranged the little plants in his garden. In 1911, the first of these palms bloomed and fruited. By 1916 there were no traces of this palm in Gohlis. Berger (1916b) wrote that Mr.

Wagner's widow, when questioned about *Trachycarpus wagnerianus*, confessed not only that she did not have it in her nursery, but also that she did not know that it even existed. Berger, in the pages of *Gartenwelt*, invited all German readers to report any possible existence of this palm from the Wagner nursery. We do not know whether Berger received any replies to his query. The specimens that were in the Winter nursery and in the Hanbury Gardens have long since disappeared.

Rhapidophyllum hystrix was mentioned by Berger (1912) among the palms of La Mortola's gardens. In Winter's ue, this palm was listed under its old name *Chamaerops hystrix*. Then as now, nurseries are reluctant to update their nomenclature. For them it was more useful to keep the familiar names that were known to their customers. The palm then known as *Chamaerops hystrix* was found in Sanremo, in Villa Parva's park. Roster pointed out its presence in Monte-Carlo (Casino garden) and in Golfe-Juan in Villa Mauresque's garden (Les Cocotiers).

Rhaphis excelsa and its synonym *Rhaphis flabelliformis* were mentioned as quite rare and present in only a few gardens (Villa Parva, Villa Hanbury and Villa Mauresque). Maybe it was not widespread because, as pointed out by Winter in his catalogue, it was thought to be a houseplant. Equally uncommon was the similar *Rhaphis humilis* (found only in La Mortola's gardens and in Villa Mauresque).

There was much written about the several species of *Brahea* (sometimes mentioned under its synonym *Erythea*). *Brahea armata* (which was mentioned in several gardens under its synonyms *Brahea roezlii*, *Brahea lucida*, *Brahea nobilis*, *Erythea armata*) was present in Villa Parva, at La Mortola, in Monte-Carlo, in Nice, in Golfe-Juan and in Villa Dognin in Cannes. *Brahea calcarea* (synonym *Brahea nitida*) was present in Bordighera, in Golfe-Juan and in Villa Dognin. *Brahea edulis* (synonym *Erythea edulis*) was more common and widespread in many places along the whole Riviera. *Brahea brandegeei* was found only in the Hanbury Gardens. *Brahea dulcis* was listed for Villa Parva, in the Winter nursery, in the gardens of Monte-Carlo's Casino and in Villa Mauresque's garden.

The genus *Sabal* was known from five different species. The first one, *Sabal palmetto* (which was kept separate from *Sabal blackburniana* but today the latter is considered a synonym of

the former), was widespread in Sanremo, in Bordighera, at La Mortola, in Nice, in Antibes, in Golfe-Juan and in Cannes. The specimen in La Mortola's gardens was purchased in 1888 by the prince Piotr Trubetskoy, who had his own garden on the Côte d'Azur. *Sabal minor* was not as common (at that time it was often called *Sabal adansonii*) and could be found in Villa Parva and in the Westend Hotel's park in Sanremo, in Bordighera, in La Mortola's gardens and in Villa Thuret's park in Antibes. The specimen in the Hanbury gardens was grown from a seed given by Gustave Thuret in 1869. The other three species, *Sabal bermudana*, *Sabal havanensis* and *Sabal ghiesbreghtii* (the latter two are uncertain names), were mentioned as present; the first two palms were reported in Villa Parva's park.

At that time there was some confusion about the genus *Washingtonia*. Berger (1912) wrote, "These plants are very much seen in gardens along the Riviera, but generally wrongly named...." Therefore it is necessary to heed this remark when examining the literature concerning the genus *Washingtonia* in the Riviera. Berger (1916) mentioned a rich collection in Villa Hindoue on Garavan's bluffs, just beyond Pont Saint Louis's border. *Washingtonia filifera* seems to have been widespread in many towns along the whole Riviera. *Washingtonia robusta* was not very common. It was found not only in Villa Hanbury's garden, but also in Villa Hindoue in Garavan, in Monte-Carlo and in Les Cocotiers's park in Golfe-Juan. Berger noted that, in Villa Hindoue, a specimen of *Washingtonia filifera* bloomed and fruited in 1893; *Washingtonia robusta* did the same in 1897.

To complete the analysis of *Washingtonia* palms that were found at that time in Villa Hanbury's garden in La Mortola, we have to mention *Washingtonia filifera* var. *microsperma*, *Washingtonia gracilis* and *Washingtonia sonorae*; today these three taxa are synonyms. The first one is synonym of *Washingtonia filifera*, and the others are synonyms of *Washingtonia robusta*.

In the 1880s, thousands of *Washingtonia* plants were raised in the nurseries in Hyères and in Ludwig Winter's nursery in Bordighera. The presence of such an abundance of palms implies that they were subsequently widely grown in the region. *Washingtonia robusta* and sometimes *W. filifera* were included by Winter in his garden designs as his signature palms. They were usually placed in his projects in

Die Gartenwelt.

Illustrierte Wochenschrift für den gesamten Gartenbau.

Jahrgang XXI.

16. März 1917.

Nr. 11.

Nachdruck und Nachbildung aus dem Inhalte dieser Zeitschrift werden strafrechtlich verfolgt.

Palmen.

Erythea.

Von Alwin Berger.

(Hierzu vier Abbildungen.)

Unter den schönen, großen Fächerpalmen, die zur Ausschmückung unserer Wintergärten und kühleren Häuser aus den berühmten Palmengärten meines unvergeßlichen Freundes Ludwig Winter in Bordighera vor dem Kriege nach Deutschland eingeführt wurden, spielten die sogenannten *Brahea* eine große Rolle. Vor allem war es *Erythea armata* S. Wats., die sogenannte *Brahea Roezli*, die den größten Beifall fand, sei es nun, daß man Gelegenheit hatte, sie auf Ausstellungen in Deutschland anzutreffen, wo Ludwig Winter mit seinen herrlichen Palmen nie fehlen durfte, oder daß man das Glück hatte, die Pflanze bodenständig an der Riviera selbst zu betrachten. Auf jeden Beschauer wirkte sie unter allen Umständen imponierend und verlockend, und so fanden ungezählte Stücke ihren Weg nach Norden. Ein wohl-gewachsenes Exemplar ist in der Tat etwas großartig schönes, ein Bild der Kraft und Schönheit zugleich. Wie eine große Halbkugel wölben sich die Wedel übereinander, deren Farbe und Beschaffenheit unter allen unseren Palmen nicht ihres Gleichen hat. Wenn die helle Sonne der lachend schönen Küste monatelang auf ihnen gelegen hat, erscheinen sie kreideweiß mit einem Ton ins Blaue, genau wie bei *Agave Franzosini*, und wie bei dieser kann in geeignetem Boden die Färbung während der Sommerzeit überraschend stark blau ausgeprägt sein. Mit dem Herannahen der Herbsttage und ihren Regengüssen läßt diese durchdringende Färbung nach und macht einer mehr grünlich erscheinenden Platz. In unseren Gewächshäusern, wo das Sonnenlicht spärlicher, ja zeitweise Winters überhaupt ganz ausbleibt und dann immer noch die Glasscheiben zu durchqueren hat, bleiben diese prachtvollen hellen Farbentöne aus oder verblassen nach und nach und machen einem Grüngrau Platz, wie es im Freien nicht vorkommt. Ich weiß nicht, ob es nicht möglich wäre, durch Verbringen der Pflanzen in das Freie auf warme, sonnige Plätze die hellen Farben wieder hervorzuzaubern. Ich habe darin keine Erfahrung, zweifle aber nicht, daß es in Deutschland *Brahea Roezli* gibt, die Sommers auf diese Weise behandelt werden.

Die Wedelspreiten dieser Palme sind derb, fast wie Blech so hart, sie klingen wie Metall, wenn man mit der Hand auf sie schlägt.

Gartenwelt XXI.

Die erste Veröffentlichung, die ich in der einschlägigen Literatur finde, ist eine Notiz in der „Illustration Horticole“ 1881, wo sie als *Brahea Roezli* Linden erscheint. Nach dieser von L. Linden selbst stammenden Notiz war sie im Jahre 1877 in Gent in der Lindenschen Gärtnerei ins freie Land gepflanzt worden. Ihr Wachstum sei zwar nicht rasch gewesen, aber sie habe die kalten Winter 1879–80 und 1880–81 unter dem Schutz einer einfachen Glasglocke aus-



Erythea armata am Lago Maggiore.

11

28. Berger published several illustrated articles about palms new to cultivation in Europe, including this one on *Erythea* (= *Brahea*). Note that the palm in the photograph was young and had not yet acquired a trunk.

groups of three specimens, in an asymmetrical placement. Furthermore, a large row of *Agapanthus africanus* was usually planted under them in order to complete the combination. This plant, which belongs to the amaryllis family, was particularly beloved by Ludwig

Winter because its inflorescence is reminiscent of a palm's shape.

Regarding the genus *Pritchardia*, only *P. pacifica* was mentioned by Berger (1912) for Villa Hanbury. The mention appeared only in the

Supplement, which was inserted just as the catalogue was ready to be printed. Its date of introduction and its origin were also reported: Palermo, 1911. This suggests that the plant was still young and in a pot. It is difficult to know whether the plant survived the events that some years later affected this garden and the whole of Europe. It appears that this taxon was absent from other gardens of the Riviera and from the catalogues of the Winter nursery.

Palms of the genus *Livistona* were quite widespread in the gardens of the Riviera with specimens of the following: *Livistona australis*, *L. chinensis* and *L. decora*. *Livistona chinensis* was often mentioned, along with its synonym *Livistona oliviformis*, as common and widespread: its presence was clearly mentioned in Villa Parva, in Villa Winter, in the Hanbury gardens, in Villa Vigier, in Les Cocotiers and in Villa Dognin. *Livistona australis*, reported as widespread, was indicated as present not only in La Mortola's gardens, but also in these Sanremo's private parks: Villa Parva, Marsaglia Castle, Villa Zirio, Westend Hotel and Pensione Flora. In contrast, *Livistona decora* (under its synonym *Livistona decipiens*) was much rarer and was found only in La Mortola's gardens, in villa Paradu in Garavan, in villas Dognin, Vigier and Robertson in Nice and in Les Cocotiers in Golfe-Juan.

Many of the texts describing the palms of the Riviera mentioned members of the genus *Cocos*. Today this genus is considered monospecific, with the only species *Cocos nucifera*, i.e. the coconut palm, which is too tender to be grown in the Riviera. Hüttner (1884) wrote that at his Villa Parva there were specimens of eight different species of *Cocos*, but today all of them would be classified in the genus *Syagrus* (and they would comprise fewer than eight species). In updated nomenclature, these palms would be *Syagrus romanzoffiana*, *Syagrus flexuosa*, and *Syagrus coronata*. Mention was made of "*Cocos blumenaui*," a name whose identification is uncertain. Its origin could be horticultural, and the name (without any description) was published in 1884. The first two species turn out to be widespread in the whole Riviera, from both sides of the border. *Syagrus romanzoffiana* was also mentioned as frequent and present in Monte-Carlo. On the contrary, *Syagrus coronata* was very rare, while "*Cocos blumenaui*" was unique. Specimens of both species are mentioned to be present only in Sanremo in Baron von Hüttner's property.

Berger (1912) wrote something interesting about the genus *Butia*, which at that time was

treated as a section of the genus *Cocos*: "Four species are in cultivation, occurring in gardens under a good many wrong names. Without flower and seeds they are not easily determined. It flowers are present, it will not be difficult to distinguish them by the following key...." After this remark, he provided a rather simple analytical key with which anyone in possession of the essential elements would be able to reach a correct classification (Berger 1912). *Butia capitata*, *Butia eriospatha* and *Butia yatay* were found at La Mortola. All the three taxa were mentioned as widespread in many places in the Riviera, but they were not reported as very common.

Some notes concerning the species of the genus *Archontophoenix* were reported in a beautiful article by Alwin Berger (1917a). In particular the author specified that specimens of *Archontophoenix cunninghamiana*, which he observed in the Riviera, were able to stand the cold during the most frigid winter of 1901 at La Mortola, even though they suffered some damage (Berger 1912). In Villa Hindoue in Garavan, where this plant was in a good position, i.e. protected both by a wall and by a great specimen of *Ficus macrophylla*, it was able to stand the exceptionally rigid winter temperatures without showing any signs of suffering. At the beginning of the 20th century, in Villa Les Cocotiers in Golfe-Juan, a specimen reached the height of 1.7 m (ca. 5.6 ft.).

Hüttner (1884) reported that *Archontophoenix alexandrae* was at Villa Parva. This claim raises some doubts. In fact, Berger (1917a) wrote that this species was very rare in the Riviera, and as far as he knew, only one specimen of it existed, in Villa Niobe in Golfe-Juan. This plant, at that time 10 m high (ca. 32.8 ft.), was planted in 1870. It came from a nursery of Ghent (Belgium). Why did Berger never mention Villa Parva's palm? There are two possible answers: first, it is possible that the palm was not classified correctly; second, the plant, for whatever reason, may not have survived. We must not forget that Hüttner's small book was published in 1884, while Berger wrote his articles thirty-three years later.

Several specimens of *Jubaea chilensis* were known in the Riviera. Of course, the palm which used to be found in Villa Thuret on the Cap d'Antibes aroused much admiration: its trunk was 7.5 m tall (ca. 24.6 ft.) and its circumference 4.1 m around (ca. 13.5 ft.) at 1 m (3.28 ft.) from the ground. It had been blooming and bearing fruits since 1894, but



29. A portrait of Ludwig Winter, the Riviera's most important horticulturist and promoter of palms.

unfortunately it died during the first years of the 20th century. Charles Naudin, who was the director of Villa Thuret at the time when it

became a national property, had planted lots of seeds of this palm. It is possible that the present specimens in Villa Thuret grew from

those seeds. Unfortunately, today these historic palms have been heavily attacked by the red palm weevil. The specimen of *Jubaea chilensis* which was mentioned for the Hanbury Gardens can still be found there; it had been given to Thomas Hanbury by Prof. Decaisne, the director at that time of the Jardin des Plantes in Paris.

The genus *Chamaedorea* was represented in area gardens by *Chamaedorea elatior* (in Villa Parva, at La Mortola and in Nice), *Chamaedorea elegans* (in Sanremo in Villa Parva, in Bordighera in Winter's Villa, at La Mortola in the Hanbury gardens, in Golfe-Juan in Villa Mauresque) and *Chamaedorea ernesti-augusti* (only in Bordighera, at La Mortola and in Golfe-Juan). Berger reported that a specimen of *Chamaedorea corallina* could be found in La Mortola, but we cannot be certain that the identification was correct. *Chamaedorea corallina* is a synonym of *Chamaedorea linearis*. The Winter nursery catalogue offered *Chamaedorea sartorii*, which was not mentioned among the palms cultivated in the garden of the Riviera.

Another group of palms that were mentioned were popularly united under the term "Kentia palms." These were mostly palms were not suited for outdoor gardens, but they were popular houseplants in Europe during the 19th century. Both *Howea belmoreana* and *Howea forsteriana* were reported to be found at La Mortola and in Villas Hindoue, Paradu and Saint Louis in Garavan. *Hedyscepe canterburyana* was reported only at La Mortola. *Rhopalostylis baueri* and *Rhopalostylis sapida* were at both La Mortola and Villa Parva.

Finally, some gardens boasted a few, exceptionally rare, exotic palms, which were never widely cultivated. *Trithrinax brasiliensis*, a graceful palm from southern Brazil, was found in La Mortola's gardens and aroused Roster's admiration. He had seen it before in Nice. The presence of *Wallichia caryotoides* was mentioned only for La Mortola and Les Cocotiers. *Copernicia prunifera* (reported under the synonymous name *Copernicia cerifera*) was found only in the Villa Parva. Amazingly enough, *Corypha utan*, a large palm from Indochina and the Philippines, was offered for sale in Winter's nursery catalogue. It was surely too tender to be grown outside, but too large to grow as a house or conservatory plant. Roster reported that in 1888 a specimen of *Acanthorrhiza aculeata*, could be found in Villa Vigier's garden; this species is now known as

Cryosophila nana. Villa Parva grew *Allagoptera arenaria* and *Ceroxylon alpinum* subsp. *alpinum*.

Conclusions

The palm-growing fashion, which English and other ex-patriots pursued on the Ligurian coast and Côte d'Azur, deeply influenced both the conception of the private garden and vernacular landscape design. In just over fifty years' time, a great deal of tender plants – particularly palms – found their place near the coast. Most of the palm species that grow today in the Riviera arrived thanks to highly specialized nurseries that pushed and even expanded the limits of palm horticulture. Surely the palm-rich landscapes that we admire today would look very different had it not been for the work of exceptional horticulturists, landscape architects and scientists in the region. Chief among them was Ludwig Winter. Had he not come to Bordighera, many palm species would be absent from the gardens of the Riviera.

LITERATURE CITED

- BERGER, A. 1912. Hortus Mortolensis. Enumeratio Plantarum in Horto Mortolensi Cultarum. West, Newman & Co., Hatton Garden, London.
- BERGER, A. 1916b. Palmen. *Trachycarpus*. Die Gartenwelt 20(39): 460, 461.
- BERGER, A. 1916c. Palmen. Die Washingtonien. Die Gartenwelt 20(46): 547–550.
- BERGER, A. 1917a. Palmen. *Archontophoenix*. Die Gartenwelt 21(3): 25, 26.
- CHEVALIER, A. 1924. Dattiers à fruits comestibles cultivés sur la Côte d'Azur. Revue de Botanique Appliquée et d'Agriculture Coloniale 4: 188–198.
- CRONMEYER, G. 1889. Systematic Catalogue of Plants Growing in the Open Air in the Garden of Thomas Hanbury F.L.S. Koenig, Erfurt.
- DINTER, D. 1897. Alphabetical Catalogue of Plants Growing in the Open Air in Garden of Thomas Hanbury F.L.S. Waser Brothers, Genoa.
- DRU, L. 1894. Les Palmiers dattiers. Bulletin de la Société Nationale d'Agriculture de France 54: 279–284.
- VON HÜTTNER, C. 1884. Gartenflora des Klimatischen Winter-Kurorts San Remo. Otto Wigand, Leipzig.

-
- MURATORIO, M. AND G. KIERNAN. 1992. Thomas Hanbury e il suo giardino. Tipolitografia S. Giuseppe, Arma di Taggia.
- NAUDIN, C. 1893. Le dattier à fruits noir. *Revue Horticole* 65: 563, 564.
- ROSTER, G. 1903. Una Visita ai Giardini della Riviera, da San Remo a Cannes. Ricci, Florence.
- SAUVAIGO, E. 1891. Sur un dattier de Nice à fruit comestibles. *Bulletin de la Société agricole des Alpes Maritimes, Nice* Reference incomplete: need volume and page range
- SAUVAIGO, E. 1894b. Les *Phoenix* cultivés dans les jardins de Nice. *Revue Horticole* 66: 493–499.
- STRASBURGER, E. 1913. *Streifzüge an der Riviera*. 3. Aufl. Gustav Fischer, Jena.
- Zona, S. 2008. The horticultural history of the Canary Island Date Palm (*Phoenix canariensis*). - *Garden History* 36: 301–308.
-

Ethnobotany and Conservation of Palms from Ghana

DOUDJO N. OUATTARA^{1, 2},
PATRICK EKPE³,
ADAMA BAKAYOKO^{2, 4}
AND FRED W. STAUFFER¹

¹ *Conservatoire et Jardin
Botaniques de la Ville de
Genève, Laboratoire de
systématique végétale et
biodiversité, Chemin de
l'Impératrice 1, 1292 Chambésy
- Genève, Suisse*

² *UFR des Sciences de la Nature
(SN), Université Nangui
Abrogoua, 02 BP 801 Abidjan
02, Côte-d'Ivoire
dojjoo@yahoo.fr*

³ *Department of Botany, College
of Basic & Applied Sciences,
University of Ghana, P.O. Box
LG 55, Legon, Ghana
patrickekpe@yahoo.co.uk*

⁴ *Centre Suisse des Recherches
Scientifiques en Côte d'Ivoire,
01 B.P. 1303 Abidjan 01, Côte-
d'Ivoire bakadamaci@yahoo.fr*
Corresponding author:
fred.stauffer@ville-ge.ch

Published information reporting uses of tropical African palms (i.e., Tuley 1995, Burkill 1997, Diniz & Martins 2002, Sunderland 2003, Latham & Konda 2007, Gruca et al. 2014) highlights the critical importance of these plants for local populations. In tropical Africa, from Senegal in the west to Somalia in the east, palms provide a wide array of food, drink and medicines and are usually regarded as a reliable yet inexpensive resource for building, weaving, clothing or fuel. Nevertheless, apart from the well-known oil palm, *Elaeis guineensis* Jacq., and to a lesser extent *Borassus aethiopum* Mart., a large majority of African palms is mostly harvested from wild populations.

Ghana is located in West Africa between 0° and 3°W and 5° and 11°N. It occupies 239,460 km² and is bordered by Togo to the east, Ivory Coast to the west and Burkina Faso to the north; the South opens on the Gulf of Guinea in the Atlantic Ocean. The vegetation of Ghana is predominantly tropical rain forest, covering the southwestern half of the country and open savannah woodland in the north. Vegetation types have been classified and their distributions mapped by various authors, e.g. Taylor (1952), Mooney (1961) and Hall and Swaine (1976). These include, among other edaphic formations, Wet Evergreen, Moist Evergreen, Upland Evergreen, Moist Semi-deciduous forest, Dry Semi-deciduous forest, Southern Marginal, South-east Outlier forest types and open savannah woodlands.

In Ghana palm resources rank among the most appreciated Non-Timber Forest Products (NTFPs); unfortunately, harvesting of leaves (including petioles and blades), stems and fruits are often carried out from wild populations. Palms contribute significantly to household incomes of Ghanaians, particularly living in rural areas. However, very high proportions of natural habitats where they grow, including forests, inland and coastal savannahs, are cleared for agriculture or logging. Previous studies on the palms of the country targeted some rattan species with economic importance (Oteng-Amoako & Obiri-Darko 2002, Oteng-Amoako et al. 2002, Ebanyenle & Oteng-Amoako 2003, Adu-Anning 2004). With respect to *Borassus aethiopum*, Ayarkwa (1997) studied its potential as a building material. More recently Asante et al. (2011) assessed the indigenous knowledge related to the utilization and conservation of this species in the Agotime traditional area (Volta Region), and Asafu-Adjaye et al. (2013) assessed the effects of density on its mechanical properties. Mintah et al. (2011) investigated the possibility of developing syrup and “malt-like” drink from the sap of *Raphia hookeri* Mann & H. Wendl. A market-based ethnobotanical study by Andel et al. (2012) identified at least four palm products (oil, leaves, inflorescences, seeds) frequently commercialized. Most of these studies highlighted the lack of sustainability associated with palm exploitation. In the framework of on-going initiatives by the Conservatory and Botanical Garden of Geneva towards a multidisciplinary study on West African palms we conducted two field missions to Ghana in 2011, covering all the political regions of the country (Ouattara 2012). This paper presents



1. *Borassus aethiopum* retained as a shade tree in farmland in the surroundings of the south-eastern town of Agbozume.

the first national scale account on the ethnobotany and conservation of palms in Ghana, including notes on their presence in agro-ecological landscapes.

Methodology

Field work

Fieldwork in Ghana was conducted in two missions in order to favor sampling of palms at reproductive stage; the first mission was carried out from May to June 2011, corresponding to the long rainy season, while a second mission took place from October to November 2011, during the so-called short dry season. Ethnobotanical and conservation data gathering and samples were obtained in nine of the ten administrative regions in Ghana. Our survey covered two broad ecological systems: disturbed areas or agro-ecosystems and protected areas. The agro-ecosystems, here defined as local farmlands, usually occupying surrounding urban areas and subject to heavy anthropogenic influence. Among these areas we chose localities characterized by specific vegetation type; the localities visited were



2. Coconut fruit juice on sale on the streets in Accra.

Techiman-Nkoranza (forest-savannah transition woodland), Agbozume (coastal savannah), Bolgatanga (open savannah woodland), Cape Coast (coastal savannah, forest-savannah mosaic with *Phoenix reclinata* Jacq.), and Abrafo-Adumasi (moist evergreen forest). The protected areas (forest reserves and national parks) are government managed and so far relatively free of human impact. Among these areas visited are the Mole National Park (open savannah woodland), Ankasa Conservation Area (wet evergreen forest), Bobiri Forest Reserve (moist semi-deciduous forest), Kakum National Park (moist evergreen forest) and Shai Hills Resources Reserve (South-east Outlier forest).

Identification of all palms sampled was based on specialized literature, in particular for rattans (Sunderland 2003, 2012), *Sclerosperma* (van Valkenburg et al. 2008), *Borassus* (Bayton 2007), and *Phoenix* (Barrow 1998), whereas the identification of other taxa made use of the general treatments by Tuley (1995) and Hawthorne and Jongkind (2006). We completed our identifications with the study of specimens deposited in the major herbaria from Ghana (GC, KUM and CCG), as well as in the European herbaria containing the most

important collections of West African palms (BM, BR, BRU, FI, G, K, P and WAG).

Gathering ethnobotanical information and conservation status assessment

The ethnobotanical assessment focused on the inventory of uses and common names. The assessment was mostly qualitative and based on surveys and structured interviews with local people (handicraft makers, local artisans, market retailers, etc.) in the various regions visited. Data gathered included the Ga and Ewe (Southeast, Southwest), Bono (Brong-Ahafo region), Akan-Ashanti (Ashanti region) and Gurune (Northeast), ethnic groups.

The criteria for evaluation of conservation status of a species were developed for a global assessment; however, they have proved to be also effective for the assessment of large geographic scales (Gärdenfors 2001, IUCN 2003). In the case of Ghanaian palms, the attribution of conservation categories followed the guidelines proposed by the IUCN (2003). For the species included in our study, five categories were assigned: LC (Least Concern), NT (Near Threatened), VU (Vulnerable), EN (Endangered) and CR (Critically Endangered). These categories were attributed to the species

on the basis of our direct field observations, for which we focused on the evaluation of: 1) state of the natural habitat, 2) level of harvest of the palm, 3) extent of occupancy of the species (EO), 4) presence/absence of the palm in protected areas, 5) presence/absence of the palm in agro-ecosystems, 6) estimated capability of regeneration, 7) current distribution of the palm, and 8) additional critical information provided by people on the loss of palm populations.

Results

Borassus: One species reported to be native in the country. The presence of the second West African *Borassus* (*B. akeassii*) in Ghana has not yet been reported. Probably its presence in the northern regions of the country may be confirmed with further fieldwork.

Borassus aethiopum L.

This is an important, multi-purpose palm as almost all its parts/organs are intensively used (Fig. 1). The stem is regarded as good material for building houses, both in the north and the south of the country. The stem appears to be very resistant to termites, fungi and general tropical conditions. It is also an excellent timber easy to split into planks, herringbone and beams. The leaves are used for roofing as well as in the manufacture of objects such as brooms, baskets and fans. In the North of the country, particularly around Tamale, the palm

is tapped for wine. In the Southeast, occupied by the Ga and Ewe ethnic groups, *Borassus aethiopum* is felled and processed into planks. This palm is used for the same purpose in the middle belt of the country (Brong-Ahafo Region) by the Bono ethnic group and in the extreme North-East by the Gurune. Recently, Asante et al. (2011) studied the uses and conservation of the species by the Ewes in Volta Region. The fruits of this palm are sometimes eaten by children in the area of Bolgatanga (Northeast). In addition, *B. aethiopum* is used as an ornamental plant in home gardens and along avenues in the cities of Accra and Kumasi. Vernacular names: *agogo* (Ga), *agoti* (Ewe), *emaakube* (Twi) *malekwe* (Nzema) *karkouangnanga* (Gurune), *kinkparugu* (Hanga), *kongkong* (Dagaari), *tuie* (Bono). The species is well represented in protected areas such as Mole National Park and the Shai Hills Resource Reserve. The main threats identified include felling for timber, extraction of palm wine in the North (fatal to the plant) and illegal logging in protected areas. During our visit to the Shai Hills Resource Reserve we had the opportunity of seeing many illegally exploited planks confiscated by the park rangers.

In the middle belt of the country (Brong-Ahafo Region) *Borassus aethiopum* is intercropped with cassava (*Manihot esculenta* L.), watermelon (*Citrullus lanatus* (Thunb.) Matsum & Nikai), banana (*Musa paradisiaca* L.) and cashew (*Anacardium occidentale* L.). Intercropping with

3. Palm nuts boiled for processing into red oil in the town of Agbozume (Volta region).



these crops often leads to the clearing and removal of all palm seedlings. Cashew is a perennial tree crop, and seeds of the palms that successfully germinate after the effect of fire may have some chance to survive and further develop. In this region, the mature trees are also used for frame construction. The selection of trees to be felled in order to get the best material for frames is based first on the usable length of the bole and diameter of the individual, and secondly and more interestingly, on its sex. The male individuals are believed to be more resistant to insect attacks and, as a consequence, exploited more than female ones. Harvesters do not take into account any rough estimation on the sex ratio displayed by the population when making the selection of trees to chop down. Therefore, the probability is that the only males providing pollen to all surrounding females in a given subpopulation may be felled thereby decreasing the potential of fruit production. Thus, the survival of these populations becomes threatened. Asante et al. (2011) reported that in the Agotime traditional area (Volta Region), 68% of farmers did not protect the *Borassus* palms found in their farmlands. Despite all these threats, good representation of the species in protected areas somehow contributes to its survival. Based on our observations we propose the status of LC for *Borassus aethiopum* in Ghana.

Beside the close socio-economic relationships between local populations and this palm in Ghana, we also identified some strong cultural links. For example, the Agotime people (a subgroup of Ewe ethnic group in Volta Region) owe their name to *Borassus* trees. Agotime literally means “inside the *Borassus* forest” and it has been reported that this name had been given to the Leh people (now Agotime) when they settled in this area.

***Calamus*:** Only one species reported to be native in the country.

***Calamus deerratus* G. Mann & H. Wendl.**

The canes of *Calamus deerratus* are believed to be of poor quality compared to other rattan species reported in the country. Indeed, artisans use them only as substitutes to *Laccosperma secundiflorum* or *Eremospatha macrocarpa*. The stems of this palm are processed for manufacturing furniture, baskets and fish traps. Abbiw (1990) reported that seedlings were consumed, the ash obtained after root incineration used as salt and the leaves used for roof thatching. Vernacular

names: *demmere* (Twi), *ayeka* (Anufo), *ayeka* (Sefwi), *keteku* (Ewe), *ayeke* (Nzema).

Although *Calamus deerratus* has been reported in five regions of the country, it was not frequently found in the different types of vegetation visited in the course of our research. In fact, it is mostly restricted to protected areas. The major threats to the plant are the loss of its natural habitat and illegal harvesting in the protected areas. For these reasons, the status of NT is proposed for this palm in Ghana.

***Cocos*:** One species reported to be widely cultivated in the country, especially in coastal areas.

***Cocos nucifera* L.**

The coconut palm *Cocos nucifera* ranks among the most economically exploited species in the country, only second to the widespread oil palm *Elaeis guineensis*. The fruits of this palm are not only highly appreciated for the juice and the flesh, but also for its oil, which is extracted from fresh mature nuts or dry nuts called copra. The fruits are sold as export products in Europe and Nigeria (Bene et al. 2009). In the streets of Accra, Cape Coast and Kumasi coconuts are frequently commercialized and represent a flourishing trade (Fig. 2). Vernacular names: *ako* or *kooshi* (Ga), *kokosi* (Twi), *kikwe* (Nzema), *ene* or *yevune* (Ewe).

This palm is cultivated and is not directly threatened by human activities. However, Ghanaian plantations have been reported as strongly affected by the lethal yellowing disease of coconut (LYD), also known as Cape Saint Paul wilt disease. According to Bene et al. (2009) this disease has a very negative impact on the coconut industry in Ghana. Local people interviewed in the coastal regions attribute the disappearance of coconuts from many beaches in the country to this disease. Despite this threat at a local population level the status of LC is proposed for this palm because intensive cultivation ensures the survival of the plant.

***Elaeis*:** One species reported to be widely cultivated in the country. Wild stands can be observed throughout Ghana.

***Elaeis guineensis* Jacq.**

The oil palm may be regarded as one of the benchmark plants of Ghana, not only because it is spread throughout the country, but also because it is intensively used by almost all ethnic groups. The palm oil is widely used and highly appreciated in cooking sauces whereas

the kernel oil is mostly used for the treatment of many diseases or indirectly as a vehicle for the application or ingestion of traditional medicines. Traditionally palm oil is prepared either spiced (with salt, ginger, etc) or non-spiced. The spiced palm oil (called *dzomi*) is the preferred choice for cooking (Fig. 3). Palm oil is used in traditional religious practices such as voodoo, particularly among the Ewe ethnic groups of south-eastern Ghana, Togo and Benin. Strictly, only the non-spiced palm oil is used for such rituals. The palm kernel oil is also used in cosmetics and as fuel for traditional oil lamps (Abbiw 1990). The two types of oil are included in the production of a local soap, which is widely used by the poorest populations. Carbonized palm kernel shells are used as the source of heat in the furnace of local blacksmiths. The terminal bud of this palm (palm heart) is also occasionally consumed. Palm wine is made from the extraction of the sap of the palm, and the leaves are used for making roofs. The leaflet midribs are used for making brooms, brushes and baskets. The roots and young leaves are used in the pharmacopoeia. Ghana is the most important African oil palm producer, second only to Nigeria (Beugré et al. 2011). The Oil Palm Research Centre in Kusi produces 2–5 million seedlings per year for farmers of this palm (Abbiw 1990). Vernacular names: *abe* (Twi), *abe* (Fante), *n'me* (Ga), *ede* (Ewe), *aye* (Sefwi).

Human activities do not threaten this palm as it is widely cultivated. On the contrary, the intensive cultivation of this species throughout the country, which causes the rapid loss of natural forests, represents an important threat to other palms, in particular species of rattans. For these reasons the status of LC is proposed for *Elaeis guineensis* in Ghana.

***Eremospatha*:** Three species reported to be native in the country, all of them useful for local populations.

***Eremospatha dransfieldii* Sunder.**

Most people in Ghana are not able to differentiate this species from *Eremospatha macrocarpa*, and when the latter is scarce, *E. dransfieldii* is used for the same purposes. This species is considered as a “large diameter” rattan and therefore the canes are usually longitudinally split into several ribbons. These ribbons are used to attach the frames of furniture, used as rope when roofing, making baskets, sieves, and in setting traps. Vernacular name: *m'fia* (Twi).

According to Johnson (2010) this is a threatened African palm. This is a very rare palm and the loss of its natural habitat (evergreen forests) is a major threat to its survival. Hence, the status of VU is proposed for this species in Ghana.

***Eremospatha hookeri* (G. Mann & H. Wendl.) H. Wendl.**

This species is not actively harvested by cane collectors; however, because of its small diameter it can replace *E. macrocarpa* when the latter becomes scarce. Vernacular names: This species is called *m'fia*, which is also the name employed for *Eremospatha dransfieldii* and *Eremospatha macrocarpa*.

The species disappears with the destruction of the forests and is not found in agro-ecosystems. Moreover, the palm is not abundant in areas where we found it. The status of VU is proposed for *Eremospatha hookeri* in Ghana.

***Eremospatha macrocarpa* (G. Mann & H. Wendl.) H. Wendl.**

This is the most treasured rattan species in Ghana, reputed to be the best cane producer. The canes of this palm are said to be strong, durable and flexible, and comparable to Southeast Asian small diameter rattans (Sunderland 2007). In Ghana this species is used for the manufacture of chairs, baskets, bracelets and many other handicrafts. It is also used in house construction. Some previous studies reported that a powder obtained from the root was used for the treatment of syphilis by the Ashanti ethnic group (Irvine 1961, Abbiw 1990). Vernacular names: *m'fia* (Twi), *nene* (Nzema).

The species is intensively sought and harvested from natural populations. It was never observed in agro-ecosystems and rapidly disappears with the destruction of the forests. Non-selective logging, mining and agriculture are serious threats to the plant. The status of EN is therefore proposed for *E. macrocarpa* in Ghana.

***Hyphaene*:** Two native species in the country, both reported to be useful for local populations.

***Hyphaene guineensis* Schumach. & Thonn.**

The stem of this solitary palm is used for the frame of houses, and the leaves are used to make hats and fans. In comparison with its use in other West African countries, it is used

only rarely in Ghana, most probably due to loss of traditional knowledge about the species during the past 30 years. The Zume people (a subgroup of Ewe ethnic group settled in the town of Agbozume and its surroundings) maintain the legend that the V-shape of *Hyphaene guineensis*, meaning the development of two stems apparently sprouting from the same fruit, represents the horns of a ram. In fact, some of them believe that the first *Hyphaene guineensis* displaying this V-shape sprouted from a spot where a ram was buried in the sacred grove of the village. According to them, this sacred grove was created and the sacrifice of a ram made when the Zume were fleeing their enemies. The Zume people had moved to their current location, with the hope of being in peace forever. Vernacular names: *soku*, *sokutie* (Ewe).

Management in agro-ecosystems

The species has a restricted distribution in Ghana, exhibits a rather scattered population and is not represented in any of the protected areas of the country. The survival of juveniles of this palm in agro-ecosystems is not guaranteed because they are severely damaged

during the establishment and clearing of the fields for cultivation of food crops. On our visit to natural populations of this palm in the coastal savannahs in the south-east portion of the country, not far from the border with Togo, we were shocked by the advanced age of the plants and the low rate of regeneration within the population. In the surrounding areas of the town of Agbozume (Volta Region), where the largest populations of *Hyphaene guineensis* could be found, almost all of the lands are used for agriculture. The main crops are cassava (*Manihot esculenta*), eggplant (*Solanum melongena* L.), corn (*Zea mays* L.) and tomato (*Solanum lycopersicum* L.). These crops are grown either in monoculture or intercropped with others. Although the establishment of the fields apparently did not directly threaten the adult individuals of *H. guineensis* producing flowers and fruits, the seedlings and juveniles were severely damaged. As explained by the local people, before each growing season the land is periodically cleared and burnt. The ravage of fire destroys seedlings and juveniles, and the seeds lose their viability.

The current agricultural practices are heavily threatening the populations of the palm as

4. Basket made from the leaf rachis of *Raphia hookeri*.



seedlings and juveniles are unable to develop fully into reproductive adults. The scarcity of land is so high that the fallows (if any) are left for only a short period (under three years), implying that the destruction of seedlings and severe damage to juveniles is a continuous phenomenon. For all these reasons, we propose the CR status for *Hyphaene guineensis* in Ghana.

***Hyphaene thebaica* (L.) Mart.**

This palm is found especially in the northern, very warm regions of Ghana. They are deliberately left or planted near the homes and in some cultivated fields serve as shade trees. In the city of Bolgatanga, the petioles and blades of this palm are processed into fibers and used for the manufacture of clothes, hats and fans (see figure, p. 55). A wide array of children's toys is also manufactured from these parts. Most of these products are sold in the Bolgatanga Craft Village. The stems of this palm, regarded as highly resistant to wood-boring insects, are used as firewood and building materials. As observed in the case of *Borassus aethiopum*, male individuals are believed to be more durable than the female ones and hence intensively exploited. The fruits are eaten by children. Vernacular names: *karkouandaha* (Gurune).

This species has a patchy distribution in the country and is poorly represented in protected areas. In agro-ecosystems, the management practices are as stated for *Hyphaene guineensis*. These palms were observed in fields of millet (*Pennisetum glaucum* (L.) R. Br), sorghum (*Sorghum bicolor* (L.) Moench.), maize (*Zea mays*) and yam (*Dioscorea alata* L.), where they not only provide shade for shade-tolerant crops during their early stages of development, but also provide shade and protection to the farmers as well. Based on these observations we propose the category of VU for *Hyphaene thebaica* in Ghana.

***Laccosperma*:** Four native species in the country, all of them reported to be useful for local populations.

***Laccosperma acutiflorum* (Becc.) J. Dransf.**

Based on morphological resemblance, local people confuse this species with *L. secundiflorum* and therefore it is basically used for the same purposes. The study by Oteng-Amoako & Obiri-Darko (2002) however, argues that the canes of *L. acutiflorum* display a poorer quality. Vernacular names: *ayie* (Twi), *ayike* (Nzema).

The species is not abundant in the country and so far only represented in protected areas. The increasing loss of natural habitats in Ghana may present a major threat for this species. Based on available data the category of NT is proposed for *L. acutiflorum* in Ghana. Conservation of the species requires close monitoring since the cane harvesters often confuse this palm with *L. secundiflorum*.

***Laccosperma laeve* (G. Mann & H. Wendl.) H. Wendl.**

With respect to other rattan species the canes of this palm are rarely utilized because of their apparently poorer quality. Vernacular names: *Nguni* (Wasa), *tenan muhunu* (Twi). Habitat loss is the major threat for this species. The conservation of protected areas may contribute to the survival of the palm. The category of LC is proposed for *L. laeve* in the country.

***Laccosperma opacum* (G. Mann & H. Wendl.) Drude**

The canes of this species are not highly sought for by collectors and processors as the quality is apparently inferior to the canes of other rattan species. However, *L. opacum* can be used as a substitute when better quality rattans are unavailable or completely extinct. The canes of this palm are sometimes used in the manufacture of baskets by Akan-Ashanti people. Vernacular names: *eholobaka* (Nzema), *nwatia* or *sayai* (Twi).

Habitat loss can be identified as the main threat for the survival of *L. opacum* in the country. Our study of herbarium samples of this palm gathered over the past 50 years in the country shows that the species was fairly well represented in the Ashanti Region (semi-deciduous forest). However, during our fieldwork in 2011 we did not see any individual of the species, not even in the Bobiri Forest Reserve, one of the best-managed conservation areas of this region. Thus, the category of NT is proposed for the species in Ghana.

***Laccosperma secundiflorum* (P. Beauv.) Kuntze**

This is the most widely used, large diameter rattans in the manufacture of furniture in Ghana. The canes are used in the construction of frames for chairs, armchairs and beds, and are also reported to be useful in the manufacture of fish traps and baskets. Abbiw (1990) pointed out that the Akan-Ashanti people drink a decoction made from the young



5. Mat production from leaflets of *Raphia sudanica* at Murugu village (Northern region).

shoots against intestinal worms. Vernacular names: *ayie* (Twi), *ayike* (Nzema).

The species is actively sought and harvested from wild populations. The loss of natural habitats and the over-exploitation represent the main threats to the survival of the species. Based on these factors we propose the category of VU for *L. secundiflorum* in Ghana.

Phoenix L.: Two species have been reported in the country, one native (*P. reclinata*) and one in cultivation as an ornamental plant (*P. dactylifera*). The wide diversity of lifeform and vegetative morphology observed in West African populations of *P. reclinata* may partially explain its still incompletely understood taxonomic identity.

***Phoenix reclinata* Jacq.**

This palm provides important firewood in the areas where it is naturally distributed. Abbiw (1990) reported that the stem of this species is used in the construction of a drum called *mid* by the Ga ethnic group in the Greater Accra Region. Vernacular names: *ametrobi* (Ga) *elehyia* or *melehyia* (Nzema), *nykeresia* (Fante) *nkeresia* (Twi), *ayidi* (Ewe).

This palm species is poorly represented in protected areas, and its survival is threatened by uncontrolled urban expansion. The main areas of distribution of this palm (Cape Coast and the Elubo-Cape Coast axis) correspond to high demographic development. Based on these factors the category of VU is proposed for *P. reclinata* in Ghana.

***Raphia* P. Beauv.:** Three species naturally distributed in Ghana, all of them extremely useful for local populations.

Raphia palms rank among the most appreciated native palm species with respect to building material. In southwestern Ghana, in particular around the Ankasa Conservation Area, most of the villages inhabited by the Nzema ethnic group have their huts and sheds built with petiole and rachis of *Raphia hookeri* and *Raphia palma-pinus*. A spectacular example is Nzulezu stilt village on the Amazuri Lake in the Jomoro District. In the north of the country these two species are mainly absent, and the *Raphia* petioles used as construction material are harvested from *R. sudanica* (Ouattara et al. 2014). Based on the relatively high, yet so far never quantified, availability

of this resource, in rural areas of the country the *Raphia* petioles are intensively used in almost all the stages of house construction. The petioles are used to establish the structure of the wall of the dwelling, as well as the framework to the roof. These petioles are arranged in parallel rows at the top of the wall and bound by ropes or nailed. The framework supports the thatch of the hut, which is also made of leaflets of these *Raphia* species. It is important to point out that given the choice, the local populations would prefer to use the petioles of *Raphia hookeri* to those of *Raphia palma-pinus* as the former is more resistant to insect attack. The petioles and rachis of *Raphia* palms are also used to construct fishing traps and baskets, while their fruits are used for preparing a poison employed by fishermen inhabiting the lagoon areas in southern Ghana. In the Ashanti Region (middle belt of Ghana) the demand for palm wine is rather oriented towards the wine of *Raphia hookeri*, whereas the sap of the oil palm (*Elaeis guineensis*) is fermented and distilled into a highly alcoholic beverage called *akpeteshi*. Interestingly, in the Central Region people have another opinion in the sense that both, palm wine and *akpeteshi* are produced mainly from the oil palm (*Elaeis guineensis*).

***Raphia hookeri* (G. Mann & H. Wendl.) H. Wendl.**

Raphia hookeri is the most useful *Raphia* palm species in Ghana. One of the most common and important uses of this palm, representing also an important threat to its wild populations, is the extraction of its sap into palm wine. This natural wine can be further fermented and distilled in order to produce a more alcoholic beverage called *akpeteshi*. These drinks are widely consumed by Ghanaians and reputed to serve as a vehicle for the ingestion of traditional drugs. In addition to the uses mentioned above the ribs of the leaflets are used for making brushes, brooms and baskets (Fig. 4). Vernacular names: *adobe* (Twi), *adobe* (Fante), *doka* (Sefwi), *doka* (Nzema), *nomilê* (Wassa).

The main threats to *R. hookeri* include the uncontrolled harvesting of leaves for building purposes, the extraction of palm wine and the conversion of *Raphia* swamps into rice fields or traditional gold mining activities. The damage to the natural habitats of this species occurs mostly in the Ashanti Region. This palm displays certain regenerative abilities in man-made environments, and small isolated populations were observed in some agro-

6. Farm hut roofed with *Sclerosperma profiziana* leaf blades near Ankasa Conservation Area (Western region).



ecosystems. The harvest of palm wine is destructive to the individuals exploited. For all these reasons, the category of NT is proposed for *R. hookeri* in Ghana.

***Raphia palma-pinus* (Gaertn.) Hutch.**

The petioles of this species are used as construction material, but they are apparently less resistant than the ones of other *Raphia* species. Due to the lack of an aerial, well-developed stem, this species does not provide any palm wine. Vernacular names: *Adzor* (Nzema), *Adzor* (Sefwi).

According to Ouédraogo (2010a) there is insufficient data to attribute a conservation category for this West African endemic species. In Ghana, the palm is intensively exploited from natural populations. Although *R. palma-pinus* shows a restricted distribution, we could count on large populations of the palm in at least two large protected areas of the country (Ankasa Conservation Area and Kakum National Park). Based on all these factors the category of NT is proposed for *R. palma-pinus* in Ghana.

***Raphia sudanica* A. Chev.**

This savanna species is found in and around the Mole National Park (Northern Ghana). Outside the park the palm was observed near the village of Murugu, where the Hanga ethnic group had settled. Besides providing building material, the petioles of this species are used for the manufacture of traditional mats called *tara* (Fig. 5). Contrary to what has been reported in other West African countries, for example in Senegal (Sambou et al. 2002.), *R. sudanica* is not used for palm wine tapping in Ghana, and this fact has certainly contributed to the survival of the species. Indeed, people seem to prefer *Borassus aethiopum* for palm wine extraction as this species seems more abundant. Vernacular names: *kpataha* (Hanga), *alafu* (Ewe).

According to Ouédraogo (2010a) there is not sufficient data to attribute a conservation category for this species. As mentioned before, *R. sudanica* has a very irregular distribution restricted to small stands in the Mole National Park, where the populations of this palm are relatively protected. Outside this conservation area the palm is actively exploited from the wild, which heavily threatens the survival of the species (Ouattara et al. 2014). For these reasons, we proposed the category of VU for *R. sudanica* in Ghana.

***Sclerosperma* G. Mann & H. Wendl.**

This African palm genus has a disjunct distribution and only one of the three species currently recognized by van Valkenburg et al. (2008) is naturally distributed in Ghana.

***Sclerosperma profiziana* Valk. & Sunderl.**

The leaves of this palm are used particularly for roofing (Figs. 6 & 7). Indeed the extremely large, almost entire leaf blades constitute a good material for this purpose. Vernacular name: *etuan* (Nzema). The destruction of natural habitats due to the establishment of plantations of cocoa, rubber and oil palm presents the main threat for the survival of the species (Fig. 8). *Sclerosperma profiziana* occurs in a very small portion of southwestern Ghana. Recent fieldwork in western Côte d'Ivoire in search of this palm could not confirm its presence. We noticed illegal harvesting of the leaves and heavy destruction of the natural habitat of this palm in the Ankasa Conservation Area; sole conservation area harboring the species. Leaf harvest seems to have some influence on the reproductive behavior of this species. Frequent removal of leaf blades may favor a vegetative rather than sexual reproduction, which in turn may significantly reduce the population's genetic diversity. For all these reasons, the category of EN is proposed for *S. profiziana* in Ghana.

Discussion

With 18 species, the Ghana palm flora ranks among the richest in West Africa (Ouattara 2012, Stauffer et al. 2014). The uses of palms by Ghanaians are extremely diverse (Tab. 1), and the demand for palm products is steadily increasing in the country. To meet the high market demand, harvesting is done from wild populations, and this raises questions about their survival and sustainability. Today, the majority of native palms of Ghana are exposed to multi-factorial threats (Tab. 2), and about 90% of them are not cultivated. Although some species can be found in agro-ecosystems (i.e., *Borassus aethiopum*, *Hyphaene guineensis*), their management in these farmlands is not sustainable. Despite the fact that rattans contribute to about 20% of the total revenue from Non-Timber Forest Products (NTFPs) in Ghana (Oteng-Amoako et al. 2002), they rapidly disappear when the forests are cleared for agriculture or other purposes. The adoption of agroforestry strategies involving rattans is necessary to ensure the sustainable harvest of these NTFPs. In Asia, agroforestry strategies



7. Privy constructed with *Sclerosperma profiziana* leaf blades near Ankasa Conservation Area (Western region).

have integrated rattan species such as *Calamus manan* in rubber (*Hevea brasiliensis*) plantations (Mohamad & Nor 1986) with satisfactory results. Such techniques could be transferred to Ghana in rubber plantations and even tested in oil palm plantations.

The conservation status of most West African palms, including those present in Ghana, have not been assessed. Indeed, some information is available for only two (*Raphia palma-pinus* and *R. sudanica*) out of the 18 species reported to be native in the country. These two species are listed in the category of Data Deficient. Evidence, however, clearly indicates that these palms are in danger of extinction due to increasing, unregulated human impact (Ouédraogo 2010a, 2010b). On a national scale, our analysis revealed that 50% of the species studied can be included in categories of serious threat (VU, EN and CR). In particular palms such as *Sclerosperma profiziana*, *Phoenix reclinata* and *Hyphaene guineensis* need urgent

conservation measures given the small-size of their populations, absence in protected areas and high pressure from human activities in their natural habitats.

The presence of *Borassus aethiopum* in several protected and non-protected areas may suggest that this palm stands the lowest risk of disappearance among all the native palm species in Ghana. The largest populations of *B. aethiopum* in the country (151 individuals per hectare on average) are found in the Volta Region (Asante et al. 2011). In addition, studies conducted by these authors have not reported palm wine tapping among the uses of this palm by the local people, and this may contribute, to some extent, to the survival of the species in that region. The techniques employed for palm wine extraction in Ghana (Northern and Brong Ahafo regions) usually lead to the death of the individuals. These unsustainable practices have been observed in countries such as Côte d'Ivoire (Mollet et al.

Table 1. Use categories identified for the Ghanaian palms.

Use category	Species (part used)	General remarks on the use and survival of individuals
Food	<i>Elaeis guineensis</i> (mesocarp)	The extraction of the fruits apparently does not cause the death of the individuals.
	<i>Cocos nucifera</i> (fruit)	
	<i>Hyphaene guineensis</i> (endosperm)	
	<i>Hyphaene thebaica</i> (fruit)	
Palm wine & Akpeteshi		
	<i>Borassus aethiopum</i> (sap)	Palm wine extraction causes the death of the individuals exploited.
	<i>Elaeis guineensis</i> (sap)	
	<i>Raphia hookeri</i> (sap)	
Building material	<i>Borassus aethiopum</i> (stem)	Leaf exploitation apparently does not cause the death of the individuals but the reproductive biology of the population may be severely affected.
	<i>Hyphaene guineensis</i> (leaf blade, stem)	
	<i>Hyphaene thebaica</i> (leaf blade, stem)	Stem exploitation causes death of individuals in species of <i>Borassus</i> and <i>Hyphaene</i> .
	<i>Raphia hookeri</i> (petiole, leaflets)	
	<i>Raphia palma-pinus</i> (petiole, leaflets)	
	<i>Raphia sudanica</i> (petiole, leaflets)	
	<i>Sclerosperma profiziana</i> (leaf blade)	
Furniture & crafts	<i>Eremospatha macrocarpa</i> (cane)	Cane exploitation apparently does not cause the death of the individuals but the reproductive biology of the population may be severely affected.
	<i>Hyphaene guineensis</i> (leaf blades)	
	<i>Hyphaene thebaica</i> (leaf blades)	
	<i>Laccosperma secundiflorum</i> (cane)	
	<i>Raphia</i> spp (petiole)	
Fishing material	<i>Raphia hookeri</i> (petiole and fruit)	The petioles are used to make fish traps. The fruits are used to make a poison that can kill fish.
	<i>R. palma-pinus</i> (petiole and fruit)	
Drugs & cosmetics	<i>Borassus aethiopum</i> (sap)	Used as a vehicle for the treatment of some diseases. Information on specific medicinal value of palm parts was difficult to assess in some of the communities visited as the locals are reluctant to give information.
	<i>Elaeis guineensis</i> (fruit, sap)	
	<i>Raphia hookeri</i> (sap)	



8. The natural habitat of *Sclerosperma profiziana* adjacent to the Ankasa Conservation Area (Western region) is threatened by expansion of rubber (*Hevea brasiliensis*) plantation development.

2000) and Guinea (Sambou et al. 2002). On the contrary, non-destructive methods of palm wine extraction involving *Borassus* are known from Senegal, Burkina Faso and some Asian countries (Giffard 1967, Sambou et al. 1992, Herzog et al. 1996, Bayton & Ouedraogo 2009). The transfer of these techniques in areas where destructive methods are practiced could contribute significantly to the conservation of palms and sustainability of palm wine trade. In Ghana, palm wine is tapped mainly for direct consumption or for processing into high-alcoholic beverages such as *akpeteshi*; however, it is clear that more research should be addressed towards the development of derived products potentially interesting to new markets. Mintah et al. (2011) have already explored the possibility of producing syrup and “malt-like” drink from *Raphia hookeri* in Ghana. In other regions of the world palm sap is used as raw material for sugar production (Johnson 2010), and the potential use of palm wine as main source of energy in animal production appears very promising (Dalibard 1999).

The diversity of the palm flora identified in Ghana is relatively low in comparison with other tropical countries in South America and Southeast Asia. However, our study shows that

almost all native species in the country display an undeniable importance from socio-economic and cultural perspectives. Apart from the coconut and the oil palm, the palm family in Ghana is exposed to many threats, and government policies should be reinforced in order to guarantee the survival of this important plant resource for the next generations (Tab. 2). The first-hand information provided by our study aims to contribute to these efforts.

Acknowledgments

This study was funded by the Foundation Council of the Swiss Center of Scientific Research in Côte d'Ivoire (CSRS). We would like to thank the head of the herbarium CCG at the University of Cape Coast and Mr Richard Ninnoni at RMSC Kumasi for having kindly provided the ecological map of Ghana. The heads of the herbaria BM, FI, G, K, P and WAG are greatly acknowledged for providing access to their collections. Thanks also go to John Amponsah, Amos Asase and all the Ghanaian young people who supported our fieldwork. Our gratitude also goes to Professor Gabriel Ameka, Head of Department of Botany, University of Ghana for permission to work on the project and granting access to the collections of the Ghana Herbarium.

Table 2. Conservation of Ghanaian palms. Notes on their main threats, recommended action plans and research perspectives (species with asterisk require urgent measures).

Species (Proposed status)	Main threats	Action plans	Research perspectives
<i>Borassus aethiopicum</i> (LC)	Severe destruction of juveniles in agro-ecosystems. Apparently not threatened in protected areas.	Promote cultivation and conservation in agro-ecosystems.	Studies aiming at reducing its reproductive cycle.
<i>Calamus deerratus</i> (NT)	Uncontrolled harvesting from natural populations. Poorly represented in protected areas. Heavy destruction of natural habitats.	Incorporation in silvicultural systems.	Strong need to study the reproductive biology of the species
<i>Cocos nucifera</i> (LC)	Lethal yellowing disease.	Control of lethal yellowing disease.	Development of local resistant varieties
<i>Elaeis guineensis</i> (LC)	Widely cultivated	No urgent action.	Numerous national research programs promoting plantation development.
<i>Eremospatha dransfieldii</i> (VU)	Represented only in few protected areas of the country.	Incorporation in silvicultural systems. Urgent need of <i>ex situ</i> conservation.	Unclear taxonomic identity. Strong need of fertile herbarium samples. Molecular studies are required to compare this species with <i>E. hookeri</i> .
<i>Eremospatha hookeri</i> (VU)	Rare species, found in few protected areas of the country.	Incorporation in silvicultural systems.	Urgent need of <i>ex situ</i> conservation. Strong need to study the reproductive biology of the species.
<i>Eremospatha macrocarpa</i> *(EN)	Intensively harvested from natural populations	Incorporation in silvicultural systems. Urgent need of <i>ex situ</i> conservation.	Strong need to study the reproductive biology of the species.

Table 2. Conservation of Ghanaian palms. Notes on their main threats, recommended action plans and research perspectives (species with asterisk require urgent measures).

Species (Proposed status)	Main threats	Action plans	Research perspectives
<i>Hyphaene guineensis</i> * (CR)	Not represented in any protected area. Threatened by extensive agriculture. Reduced extent of occupancy (EO)	Need of <i>ex situ</i> conservation. Urgent need to create a protected area including the species.	Urgent need to study the germination and reproductive biology. Hybridization assays with <i>H. thebaica</i> . Need of studies on population genetics and phylogeography.
<i>Hyphaene thebaica</i> (VU)	Not represented in any protected area. Threatened by extensive agriculture.	Need of <i>ex situ</i> conservation. Urgent need to create a protected area including the species.	Urgent need to study the germination and reproductive biology of the species. Hybridization assay with <i>H. guineensis</i> .
<i>Laccosperma acutiflorum</i> (NT)	Poorly represented in protected areas. Serious threat to its natural habitat.	Incorporation in sylvicultural systems. Urgent need of <i>ex situ</i> conservation.	Unclear taxonomic identity. Strong need of fertile herbarium samples.
<i>Laccosperma laeve</i> (LC)	Severe destruction of its natural habitat.	Incorporation in sylvicultural systems. Urgent need of <i>ex situ</i> conservation.	Molecular study needed to differentiate this species from <i>L. opacum</i> .
<i>Laccosperma opacum</i> (NT)	Severe destruction of its natural habitat.	Incorporation in sylvicultural systems. Urgent need of <i>ex situ</i> conservation.	Unclear taxonomic identity. Strong need of fertile herbarium samples.
<i>Laccosperma secundiflorum</i> * (VU)	Uncontrolled harvesting from natural populations. Severe destruction of its natural habitat.	Incorporation in sylvicultural systems. Urgent need of <i>ex situ</i> conservation. Encourage harvesters to make selective cuts.	Studies on genetic diversity are required.
<i>Phoenix reclinata</i> * (VU)	Not represented in protected areas. Threatened by agriculture and urbanization.	Urgent need to create protected areas including the species.	The complex taxonomic identity of this species requires further study. Urgent need to study its reproductive biology.

Table 2. Conservation of Ghanaian palms. Notes on their main threats, recommended action plans and research perspectives (species with asterisk require urgent measures).

Species (Proposed status)	Main threats	Action plans	Research perspectives
<i>Raphia hookeri</i> (NT)	Intensively exploited. Serious threat of <i>Raphia</i> swamps from uncontrolled rice cultivation.	Urgent need to protect the <i>Raphia</i> swamps. Encourage sustainable exploitation.	Regeneration studies at population level are strongly needed.
<i>Raphia palma-pinus</i> (NT)	Uncontrolled harvesting from natural populations. Rarely maintained in agro-ecosystems.	Urgent need to protect areas harboring the species.	Regeneration studies at population level are strongly needed.
<i>Raphia sudanica</i> * (VU)	Poorly represented in protected areas. Uncontrolled harvesting from natural populations. Severe threats to its natural habitats.	Urgent need to protect areas harboring the species.	Regeneration studies at population level are strongly needed.
<i>Sclerosperma profiziana</i> * (EN)	Restricted distribution. Severe threats to its natural habitats.	Urgent need of <i>ex situ</i> conservation.	Urgent need to study the germination and the reproductive biology of the species. Molecular study needed to differentiate this species from <i>S. mami</i> with which it has long been confused. Need of studies on genetic diversity and phylogeography.

LITERATURE CITED

- ABBIW, D.K. 1990. Useful plants of Ghana: West African uses of wild and cultivated plants. Intermediate Technology Publications and the Royal Botanic Gardens, Kew. 337 p.
- ADU-ANNING, C. 2004. The rattan industry in Ashanti and Western regions of Ghana, p 263–277, In CIFOR (ed). Forest products, livelihoods, and conservation: case study on non-timber forest product systems. Vol. 2.
- ANDEL, T.R., B. MYREN AND S. VAN ONSELEN. 2012. Ghana's herbal market. Journal of Ethnopharmacology 140: 368–378.
- ASAFU-ADJAYE, O.A., M.K. FRIMPOG AND N.A. DARKWA. 2013. Assessment of the effects of density on the mechanical properties variations of *Borassus aethiopum*. Archives of Applied sciences Research 5 (6): 6–19.
- ASANTE, W. J., N. B. BAATUWIE AND M. AVORGAH. 2011. Indigenous knowledge on the conservation and utilization of *Borassus aethiopum*: a case study in the Agortime traditional area of the Volta Region, Ghana. International Journal Current Research 3: 173–175.
- AYARKWA, J. 1997. Potential for utilisation of *Borassus aethiopum* (Fan Palm) in construction in Ghana. Forestry Research Institute of Ghana. Wood News Journal 6 (4): 15–18
- BARROW, S. 1998. A monograph of *Phoenix* L. (*Palmae: Coryphoideae*). Kew Bulletin 53: 513–575.
- BAYTON, R.P. 2007. A revision of *Borassus* L. (*Arecaceae*). Kew Bulletin 62: 561–586.
- BAYTON, R.P. AND A. OUEÐRAOGO. 2009. Discovering Africa's newest palm. Palms 53: 37–45.
- BENE, S., P. COURBET, A. DZIWORMU, J. SALINIER AND A. MENSAH-BONSU. 2009. La filière du cocotier au Ghana et au Nigéria. OCL 16: 87–96.
- BEUGRÉ, M., K.E. KONAN, K.R. KOUAMÉ, M. KONÉ, Y.J. KOUADIO AND T.H. KOUAKOU. 2011. Influence des conditions de stockage et de la durée de chauffage sur la capacité de germination des graines du palmier à huile (*Elaeis guineensis* Jacq.). Journal of Applied Biosciences 41: 2780–2787.
- BURKILL, I.H. 1997. The Useful Plants of West Tropical Africa. Vol. 4. Families M–R, pp. 347–376. Royal Botanic Gardens, Kew, UK.
- DALIBARD, C. 1999. Overall view on the tradition of tapping palm trees and prospects for animal production. Livestock Research for Rural Development 11 (1). Online edition: <http://www.lrrd.org/lrrd11/1/dali111.htm>.
- DINIZ, M.A. AND E.S. MARTINS. 2002. Palms of Guinea-Bissau: their utilization. Garcia de Orta. Série de Botânica 16: 39–49.
- EBANYENLE, A. AND A. OTENG-AMOAKO. 2003. Anatomy and identification of five indigenous rattan species of Ghana. Ghana Journal of Forestry 11: 77–90.
- GÄRDEFORS, U. 2001. Classifying threatened species at national versus global levels. Trends in Ecology and Evolution 16: 511–516.
- GIFFARD, P.L. 1967. Le palmier rônier *Borassus aethiopum* Mart. Bois et Forêts des Tropiques 116: 3–12.
- GRUCA, M., T.R. VAN ANDEL AND H. BALSLEV. 2014. Ritual uses of palms in traditional medicine in sub-Saharan Africa: a review. Journal of Ethnobiology and Ethnomedicine 10: 60. <http://www.ethnobiomed.com/content/10/1/60>.
- HALL, J.B. AND M.D. SWAINE. 1976. Classification and ecology of closed-canopy forest in Ghana. Journal of Ecology 64: 913–951.
- HAWTHORNE, W. D. AND C. JONGKIND. 2006. Woody Plants of Western African Forests. A Guide to the Forest Trees, Shrubs and Lianas from Senegal to Ghana. Kew Publishing, Royal Botanic Garden, Kew. 1023 p.
- HERZOG, F., D. GAUTIER-BEGUIN AND K. MULLET. 1996. Uncultivated plants for human nutrition in Côte d'Ivoire, p. 40–50, In: LEAKEY, R.R.B., A.B. TEMU, M. MELNYK AND P. VANTOMME (eds), Non-Wood Forest Products 9. Domestication and Commercialization of Non-Timber Forest Products in Agroforestry Systems. Proceedings of an international conference held in Nairobi, Kenya, 19–23 February 1996. FAO.
- IRVINE, F.R. 1961. Woody Plants of Ghana with Special Reference to their Uses. Oxford University Press, London. 867 p.
- IUCN. 2003. Lignes directrices pour l'application, au niveau régional, des critères de l'UICN pour la Liste Rouge. Commission de la sauvegarde des espèces de l'UICN. UICN, Gland, Suisse et Cambridge, Royaume-Uni. ii + 26 p. [<http://www.uicn.fr/>]

- IMG/pdf/UICN_2003_Application_regionale_des_criteres_Listes_Rouges.pdf]
- JOHNSON, D.V. 2010. Tropical Palms 2010 version. Non-Wood Forest Products. 10/Rev.1. FAO, Rome. 256 p.
- LATHAM, P. AND A. KONDA KU MBUTA. 2007. Plantes Utiles du Bas-Congo, République Démocratique du Congo. Mystole Publications, 344 pp.
- MINTAH, B.K., A.E. ELIASON, J. BARIMAH AND J.H. OLDHAM. 2011. Development of syrup and "malt-like" drink from *Raphia hookeri* sap. AJFAND 11: 5203–5219.
- MOHAMAD, A.B. AND N.S.B.M. NOR. 1986. Intercropping of rotan manau (*Calamus manan*), with rubber (*Hevea brasiliensis*). Pertanika 9: 161–165.
- MOLLET, M., F. HERZOG, Y.E.N. BEHI AND Z. FARAH. 2000. Sustainable exploitation of *Borassus aethiopum*, *Elaeis guineensis* and *Raphia hookeri* for the extraction of palm wine in Côte d'Ivoire. Environment, Development and Sustainability 2: 43–57.
- MOONEY, J.W.C. 1961. Classification of the vegetation of the high forest zone of Ghana, p. 85–86, In: Tropical Soils and Vegetation – Proceedings of the Abidjan Symposium. UNESCO, Paris.
- OTENG-AMOAKO, A. AND B. OBIRI-DARKO. 2002. Rattan as a sustainable cottage industry in Ghana: the need for development interventions, p. 105–114, In: SUNDERLAND, T.C.H. AND J.-P. PROFIZI (eds.) New research on African rattans. Proceedings No.9. International Network for Bamboo and Rattan (INBAR), Beijing, China.
- OTENG-AMOAKO, A., B. OBIRI-DARKO, S. BRITWUM, J. K. AFFUL-MENSAH, J. ASIEDU AND E. EBANYENLE. 2002. A study of the production-to-consumption System of rattan in Ghana. <http://www.fcghana.com/baradep>.
- OUATTARA, N.D. 2012. Etude floristique, phytogéographique et ethnobotanique des palmiers (Arecaceae) natifs du Ghana, avec notes sur leur conservation. Master, Faculté des Sciences, Université de Genève.
- OUATTARA, N.D., F.W. STAUFFER AND A. BAKAYOKO. 2014. Lectotypification de *Raphia sudanica* A. Chev. (Arecaceae, Calamoideae) et commentaires sur la biologie et la conservation de l'espèce. Adansonia 36: 53–61.
- OUÉDRAOGO, L. 2010a. *Raphia palma-pinus*. IUCN Red List of Threatened species. Version 2014.3. <www.iucnredlist.org>
- OUÉDRAOGO, L. 2010b. *Raphia sudanica*. IUCN Red List of Threatened species. Version 2014.3. <www.iucnredlist.org>
- SAMBOU, B., J.E. KAWESSON AND A.S. BARFORD. 1992. *Borassus aethiopum*, a threatened multiple purpose palm in Senegal. Principes 36: 148–155.
- SAMBOU, B., A. GOUDIABY, F. ERVIK, D. DIALLO AND M.C. CAMARA. 2002. Palm wine harvesting by the Bassari threatens *Borassus aethiopum* populations in northwestern Guinea. Biodiversity and Conservation 11: 1149–1161.
- STAUFFER, F.W., D. OUATTARA AND A.L. STORK. 2014. Palmae, p. 326–354, In: LEBRUN, J.-P. AND A.L. STORK (eds.). Tropical African Flowering Plants: Monocotyledons 2, vol. 8. Conservatoire et Jardin botaniques de la Ville de Genève, Switzerland.
- SUNDERLAND, T.C.H. 2003. Two new species of rattan (*Palmae: Calamoideae*) from the forests of West and Central Africa. Kew Bulletin 58: 987–990.
- SUNDERLAND, T.C.H. 2007. Field Guide to the Rattans of Africa. Royal Botanic Gardens, Kew. Kew Publishing 66 p.
- SUNDERLAND, T.C.H. 2012. A taxonomic revision of the rattans of Africa (Arecaceae: Calamoideae). Phytotaxa 51: 1–76.
- TAYLOR, C.J. 1952. The vegetation zones of the Gold Coast. Bulletin of the Gold Coast Forestry Department 4: 1–12.
- TULEY, P. 1995. The Palms of Africa. The Trendrine Press, Zennor, Cornwall. 189 p.
- VAN VALKENBURG, J.L.C. H., T.C.H. SUNDERLAND AND T.L.P. COUVREUR. 2008. A revision of the genus *Sclerosperma* (Arecaceae). Kew Bulletin 63: 75–86.



LODOVICO WINTER
BOTANICO E PAESAGGISTA
PIONIERE DELLA FLORICOLTURA
HEIDELBERG 1846 - BAD NÄUHEIM 1912