Towards a Revision of *Attalea* in Western Amazonia

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Despite steady progress in the taxonomy of South American palms over the last two decades, the genus *Attalea* remains incompletely understood (Henderson 1995, Pintaud 2008, Noblick et al. 2013). This situation creates serious difficulties in the correct identification of species, in particular in the western Amazon.

Knowledge of western Amazonian *Attalea* species progressed considerably with the taxonomic treatment of Glassman (1999). This author, however, was the last to consider the separate genera *Attalea* (*sensu stricto*), *Scheelea*, *Orbignya*, *Ynesa* and *Maximiliana*. Zona (2002) made the nomenclatural changes needed to align Glassman's monograph with the more widely accepted concept of a single, broad genus *Attalea* (Henderson 1995, Henderson et al. 1995, Dransfield et al. 2008). Glassman described three new species in the genus *Scheelea* for western Amazonia, later transferred to *Attalea*, as *Attalea moorei*, *A. plowmanii* and *A. salazarii*. Although still incomplete, Glassman's monograph facilitated enormously the understanding of this complex genus and set the stage for a complete taxonomic assessment of *Attalea* in the region, now in progress.

Searching for *Attalea* in Western Amazonia

Western Amazonia, as defined by Montúfar and Pintaud (2006), is the region comprising the eastern Andean foothills below 500 m elevation in southern Colombia, Ecuador, Peru

1. *Attalea tessmannii* in its type locality near Soledad village, lower Itaya river valley, Loreto, Peru, now survives in secondary forest around agricultural plots.

and northern Bolivia, along with the adjacent Amazon lowlands of south-eastern Colombia, eastern Ecuador, eastern Peru, north-western Bolivia and the western part of the Brazilian Amazon, including most of the state of Acre except the easternmost part, and the state of Amazonas west of Tefé. In addition, many Amazon elements enter the eastern inter-Andean valleys and grow over a relatively extended altitudinal range, exemplified by *Attalea*, in particular by *A. princeps* (150–1000 m), *A. moorei* (150–1100 m) and *A. weberbaueri* (250–1400 m) from northern Bolivia to Central Peru.

Attalea is diverse and omnipresent in the region, abundant in most forest types and with a diversity of life forms ranging from relatively small acaulescent species to gigantic emergent ones. It would be, however, obvious to any student of palms that there are far more names for *Attalea* in Western Amazonia and adjacent Andes than actual species and that the taxonomic work consists in making the link between existing species names and particular palms and deciphering synonymy, more often than describing new species.

Visit to type localities and herbaria

In this palm genus, often poorly represented by herbarium specimens, with many types lost and old descriptions scarcely informative, visiting type localities is the necessary complement to literature and herbaria studies in order to determine the correct application of a species name (Stauffer & Fariñas 2006, Noblick et al. 2013).

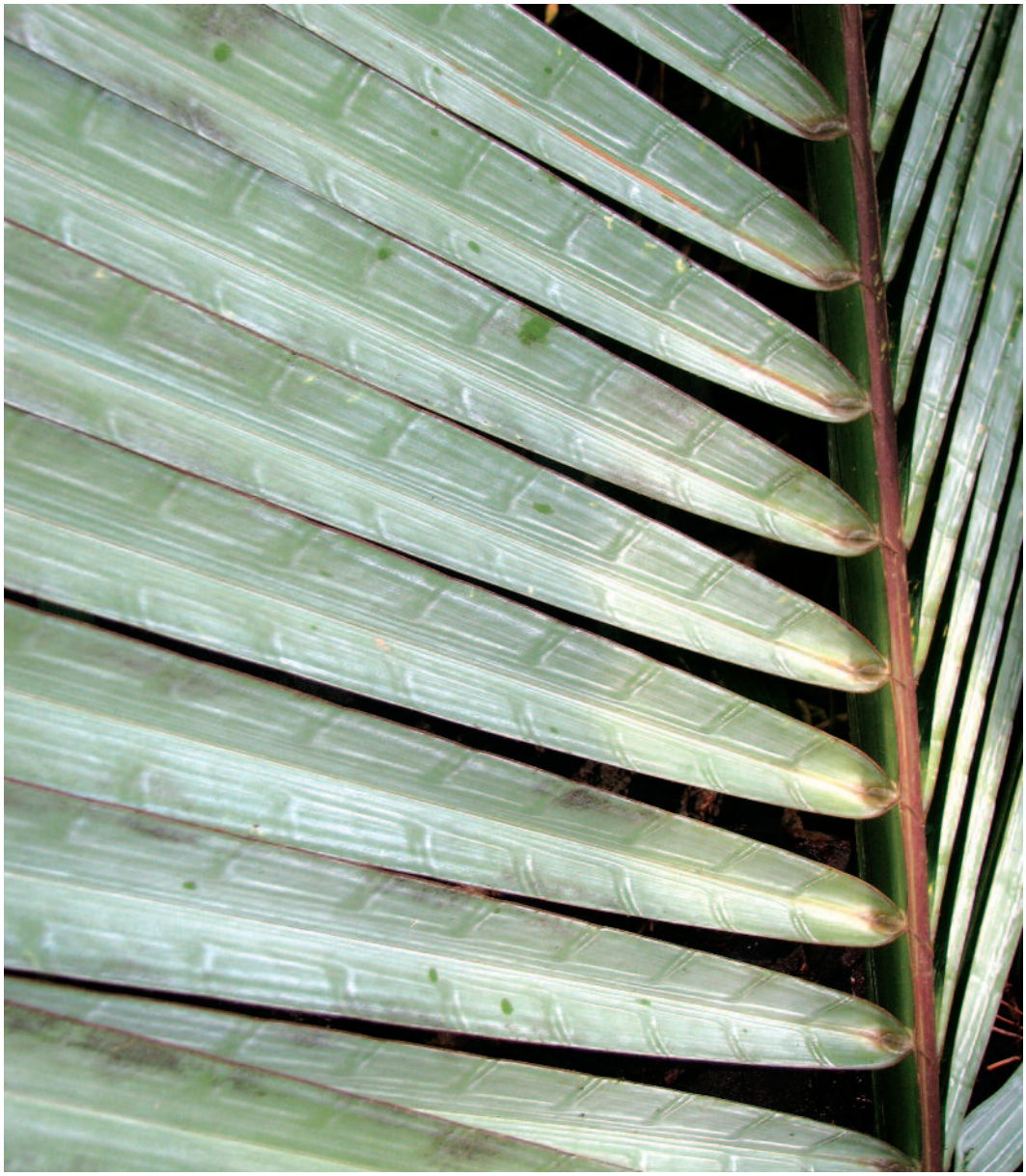
In consideration of this fact, we began to set up a series of journeys in the footsteps of illustrious predecessors, including A.D. d'Orbigny, A. Weberbauer, G. Tessmann, H.E. Moore Jr. and F. Kahn, in parallel with physical and virtual herbarium studies in South America, Europe and USA, along with extensive literature compilation.

Our first aim was to determine the actual diversity of the former genus *Scheelea* in the Peruvian Amazon, by far the most diverse component of *Attalea s.l.* in this sector, and updated by S. Glassman in 1999, with the description of three new species.

In December 2009, the IIAP and IRD authors organized a first trip by motor-boat to visit various type localities or areas close by, corresponding to several species names associated with specimens collected in the Iquitos region. We wanted to clarify the taxonomic questions, as well as obtain DNA material for the phylogenetic analysis we reported (Rodriguez et al., in press).

We first visited Soledad village in the lower Itaya river valley, near Iquitos in Peru, a classical area for botanical collection in general, but especially for palms, having given its name to the genus *Itaya* (Moore 1972). Soledad in particular is a hotspot for *Attalea* names, because Burret described three species in 1929 (*Attalea tessmannii*, *Scheelea brachyclada* and *S. stenorhyncha*) using as type material the collections made by G. Tessmann during his trip to Soledad in June–July 1925. Arriving there, we were immediately disappointed by the highly disturbed state of the vegetation and the absence of old growth forest remnants. The surroundings of the village are intensively used for shifting cultivation with relatively short rotation times, allowing the growth of only secondary forest. However, *Attalea* species are in general resilient to this practice, and we soon spotted one of the species described by Burret, *A. tessmannii*, represented by scattered, gigantic old trees in secondary forest, at the edge of a cultivated plot (Fig. 1). This species is well characterized, very distinctive, with the holotype and three isotypes still conserved in herbaria and displaying the key characters for species identification. Although there is no problem with this species, it was a great excitement for us to see maybe the same palms that Tessmann collected almost a century ago, which are left each time the surrounding vegetation is cut for the shifting-cultivation cycle. While there is good regeneration of *A. tessmannii* in the secondary forest, the rotation time is too short to allow the establishment of trunked individuals that could be spared in the process of shifting agriculture, and consequently there are no intermediate age classes between the old adults and the trunkless juveniles, which means that the population is not viable in these conditions. We found this situation very sad, in light of the botanical and historical significance of the place.

We nevertheless continued to explore the forests in the area, but we found only one additional species, the common *A. maripa*. We did not see any palm that would allow us to clarify the status of *Scheelea brachyclada* and *S. stenorhyncha*, which were reduced in synonymy of *S. bassleriana* by Glassman (1999), the latter transferred to *Attalea* by Zona (2002). Tessmann's field notes indicated that these palms were found in tall, old-growth



2. A palm, locally known as *shebón*, and that would appear to be *A. bassleriana*, has a very distinctive waxy-glaucous indumentum on the under surface of pinnae, nicely contrasting with the ferruginous scaly indumentum of the rachis.

terra firme forest on hills, a habitat that no longer exists in the type locality. Sadly again, the present state of the vegetation in Soledad does not allow the persistence of these palms at their type locality. The fate of *Scheelea brachyclada* and *S. stenorhyncha* has not been much better in herbaria, since the holotypes associated with both species names were part of the 140 palm types destroyed in Germany during WWII (Henderson 1995). Fortunately, both collections are still represented by isotypes, and one for each species is kept in the herbarium of Conservatory and Botanical Garden of Geneva (G), Switzerland. Study of these precious specimens, with the help of Fred Stauffer, palm specialist at G, allowed us to confirm the conclusion of Glassman (1999) that both names correspond to the same species, and even the same population, *S. brachyclada* being based on an androgynous inflorescence and *S. stenorhyncha* on a staminate one. Glassman reduced both names in synonymy of *S. bassleriana*, the type of which is from another locality.

Returning to the village of Soledad, we were, however, rewarded by the sight in the distance of an immense *A. salazarii*, a species described by Glassman (1999) from a collection made by H.E. Moore Jr. in May 1960, precisely during his famous trip to the lower Itaya river valley, below the nearby village of Munichi. Approaching the palm, we found it in the same

3. A palm locally known as *shapaja*, and that would appear to be *A. huebneri*, has a surprising intra-individual polymorphism, with some androgynous inflorescences having elongate rachillae, and other having extremely short ones, giving the inflorescence an almost spicate appearance. Length of rachis strikingly differs in the two co-occurring inflorescences types.

disturbed surroundings as the towering *A. tessmannii* individuals previously seen, as spectacular remnants of the vanished forests that attracted botanists so much at the beginning of the 20th century. This specimen of *A. salazarii* was over 30 m tall, but we could distinctly see the long petioles, which are characteristic of the species and give the crown a distinctive and gracious shape. But again, study of herbarium material, in particular photographs of type specimens at NY kindly sent by Andrew Henderson, palm specialist at the New York Botanical Garden, allowed us to match without ambiguity this species with an older name from Burret's 1929 monograph, *Scheelea tessmannii*. This name is not applicable in the genus *Attalea*, since there is already *A. tessmannii*, and therefore Zona (2002) established the new name *Attalea peruviana* for this species. This is, therefore, the correct name for *A. salazarii*. *Attalea peruviana* is extremely close to *A. butyracea* and has been generally considered as conspecific (Henderson 1995). *Attalea butyracea sensu stricto* has sessile leaves and occurs in Colombia, Venezuela and northeastern Ecuador. In Peru, we have no evidence of the existence of this species despite countless reports of it in herbaria and publications.

Another aim of the trip was to observe a second species described by Glassman (1999) from material of the Iquitos region, *A. plowmanii*. We observed it in detail in the lower Tamshiyacu river valley. This species has also been previously confused with *A. butyracea* from which, however, it differs markedly, and was already suspected to be a distinct species by Henderson (1995). It is a subacaulescent species with a small inflorescence but large fruits (10–6 cm long) that remain brown at maturity (in contrast to the fruits of *A. butyracea* and *A. peruviana* that are small and orange at maturity), and are borne on very short rachillae (elongate in *A. butyracea* and *A. peruviana*). *Attalea plowmanii* is common in northeastern Loreto, Peru, and reaches Colombia (Galeano & Bernal 2002) and the western margin of the Amazonas state in Brazil (Lorenzi et al. 2010). In the Allpahuayo forest reserve near Iquitos, it dominates the understory along with *A. racemosa* (Vargas et al. 2012), the two species being virtually indistinguishable in the vegetative state but conspicuously different in reproductive morphology (see key to species).

Finally, we visited the swamp forest of Bagazan, along a tributary of the lower Ucayali river,

4. Traditional indigenous houses in Lamas village, San Martín, Peru. The rooftop line is made of long segments of *Attalea moorei* leaves and the sides are thatched with *Phytelephas macrocarpa* leaves.

5. The characteristic broken geomorphology of Cordillera Escalera denotes the magnitude of tectonic forces acting at the eastern Andean deformation front.

downstream from Jenaro Herrera, where two very large *Attalea* species were reported, locally known as *shapaja* and *shebón*. Penetrating the swamp was not easy, not only because of the muddy soil but also for the countless aggressive mosquitoes. Then, differentiating *shapaja* from *shebón* did not appear obvious at all to us, contrary to our local guide, who, amazingly, could distinguish them within a fraction of second at any stage of development, from young juveniles to adults. The guide could not clearly explain his criteria, but we eventually found two reproductive characters to distinguish the species. *Shapaja* has an almost spicate infructescence and fruits compressed and angled by mutual pressure, with few large clusters of fibers detaching from the endocarp while *shebón* has an infructescence with elongate rachillae bearing several broad ellipsoid fruits, which have numerous small fiber clusters in the endocarp. However, we could not readily put a name on either of these palms. The *shapaja* somewhat resembled *A. moorei*, the third new species of western Amazon *Attalea* described by Glassman (1999), but had unusually large fruits to 12 cm long and with a thick juicy orange mesocarp, while those of *A. moorei* do not exceed 10 cm long and have a white and dry mesocarp. In addition, *shapaja* is a much taller palm (to 45 m) than *A. moorei* (15 m) and has the basal pinnae arranged in two planes instead of one in *A. moorei*. The two species did share a thick woody endocarp with large fiber clusters and a unilateral arrangement of staminate flowers on the rachillae, which allowed us to assign them to the *Attalea phalerata* complex (Pintaud 2008, Rodriguez et al., in press). The *shebón* was more puzzling because it had fruits structurally identical to those of *A. plowmanii*, with a thick fibrous exocarp, a moderately developed parenchymatous mesocarp with some isolated longitudinal fibers included, a thick endocarp with several circles of small fiber bundles progressively increasing in size centripetally and thin, closely arranged seed cavities. There are some differences in details, however; *A. plowmanii* fruit have some large fibers in the inner mesocarp and a characteristic pale and irregularly grooved endocarp. Moreover, *A. plowmanii* is a small subacaulescent species, while *shebón* is a massive palm exceeding 35 m tall with a trunk of easily 40 cm in diameter and a unique waxy-

6. In the seasonally dry forest of the Central Huallaga River Valley, an association of local people works hard to conserve the forest and a spectacular grove of *Attalea moorei*.

glaucous cover on the underneath of leaflets, contrasting beautifully with the dark reddish-brown lepidote leaf rachis (Fig. 2). We did not find floral material of *shebon* that could have helped identification.

At that point we had to come back to Iquitos, glad to have made thorough observations of three species, *A. tessmannii*, *A. peruviana* and *A. plowmanii* in or close to their type localities but somewhat dissatisfied about the two still unnamed species of Bagazan.

It was not until five years later, however, that we tackled these questions again from the very point we had dropped them in 2009, due to other research priorities at IIAP and IRD in the intervening time.

In June 2014, we were heading to Jenaro Herrera to revisit the Copal site, where Kahn and Mejía (1991) set the highest record ever of local palm diversity in the whole Amazon region, with 34 species in 19 genera within only 0.5 ha. We were particularly intrigued by the report of *Attalea bassleriana* in this study, a species that we could not positively identify to date. The name of the place comes from Quebrada Copal, a small tributary of the Ucayali River, accessible from the Jenaro Herrera-Angamos road project, which aimed to connect Iquitos with Brazil. The road track was initially cleared in the late 1970s for over 100 km, connecting the Ucayali and Javari rivers, but the project was soon abandoned and only the first 15 km remained passable by four-wheel drive vehicles.

Guided by Leonardo Macedo, the very field assistant who helped Francis Kahn and Kember Mejía 25 years before, we reached km 12 of the old road and from there, the exact location where the 0.5 ha plot was set, along the Quebrada Copal. We could see two sympatric species of *Attalea*, an acaulescent one and a tall arborescent one. The acaulescent one was not flowering at that time, so it was not possible to identify it with certainty, but according to the Kahn and Mejía (1991) listing, it had to be *A. polysticha*, a species common in that area. The tall one was flowering, and we could readily identify it as *A. peruviana*. At the time the Copal study was made, the status of this species was totally unclear, so it was indeed impossible to Francis Kahn and KM to identify it correctly, and they attributed it to *A. bassleriana*. We were also puzzled by the

7. Between Tingo Maria and Aguaytia, our expedition stops in one of the surrealistic places featured on the 5N road.

similarity of the acaulescent juveniles of *A. peruviana* and sterile adults of *A. polysticha*, growing together in the forest understory. In order to clarify the determination of these palms vegetatively, we asked our guide to cut leaves of both species for direct comparison, in an open area along the road. Both species have regularly arranged leaflets spreading in one plane, so that leaflet insertion did not appear to be a good distinguishing character, neither was the similar scaly reddish-brown indumentum of petioles and rachis. Finally, after scrutinizing these leaves, we discovered that the definitive character was the shape of the asymmetrical tip of the leaflets. We found that the shape of this peculiar leaflet region was strikingly different in *A. peruviana*, in which the leaflets have a narrowly subulate unilateral terminal projection, and in *A. polysticha* in which the projection is broadly lanceolate.

These new observations expanded the known geographic distribution of *A. peruviana* to the south and pointed out new, poorly explored diagnostic characters, but the elusive *A. bassleriana* still remained unclear to us. The next step should have been to visit its type locality in Yarinacocha, near the city of Pucallpa, higher up on the Ucayali river, but at that time we had instead planned to go downstream back to the Bagazan swamp forest, to see if with the time elapsed since the first visit in 2009, we would be more inspired in the determination of *shapaja* and *shebón*.

This time, the access to the swamp was very complicated because it was flooded in many parts. We tried to access the swamp forest directly with a canoe, but the vegetation was impenetrable. Finally, we found unflooded access and could walk into the forest. There, with the criteria we had defined on the last visit, we searched on the ground for old infructescences: spicate ones with compressed-angled fruits in *shapaja versus* elongate rachillae and widely ellipsoid fruits in *shebón*. We did find both kinds easily and arranged them on the ground for comparison. We were contemplating the straightforward result when our guide objected: "Well, YOU are the palm specialists, but in MY opinion, there is no *shebón* in that swamp and everything you are looking at are variations of the *shapaja*." He said that he could show us one plant of *shebón* right away in his backyard. Unfortunately, we

8. The adventure continues as the 5N road reduces to a hazardous trail on the way to Puerto Bermudez.

had no time for this additional activity, but we took very seriously his objections and came back to our observations in this and another nearby swamp. We finally reached the disturbing conclusion that, indeed, all the material that we had collected corresponded to the *shapaja* form, with an extraordinary polymorphism in infructescence architecture (Fig. 3). In fact, local people are well aware of the difference between *shapaja* and *shebón* because the two species are used for roof thatching but have different mechanical properties. Upon drying, the soft leaflets *shapaja* become inrolled and loose waterproofing efficiency, while the stiff ones of *shebón* remain perfectly flat when dry and give a better result. A few decades ago, the *colonos* of the lower Ucayali river were little aware of *shebón* and used to thatch with the more common *shapaja*, but thereafter, a nomadic indigenous community (Matsés) arrived from Brazil and settled there for some time, beginning with the construction of a large common house or *maloca*. For roofing the house, they searched specifically for *shebón* and had no interest in *shapaja*, and then the *colonos* learned from the Amerindians about the superior properties of *shebón* over *shapaja*. All this was fascinating, but meanwhile we had lost our distinguishing characters between the two species and did not find any *shebón* to look at in detail during that trip. Back to Iquitos, we could only look again and again at our 2009 photographs to convince ourselves that the *shebón* of Bagazan was real and not just the product of confusion in our minds.

The following month, however, we had the opportunity to clarify this horrible mystery. In July 2014, we set up a terrestrial trip aiming primarily at documenting *Attalea moorei*, *A. cephalotus* and *A. weberbaueri*, the three species reported in the inter-Andean valleys of central-eastern Peru. This trip would also be the occasion to make a short visit near Yurimaguas, where there had been reports of *shapaja* and *shebón*.

Our trip aimed at driving a four-wheel drive vehicle all along the Mayo and Huallaga inter-Andean valleys, from Moyobamba and Yurimaguas in the north to Tocache (purportedly type locality of *A. cephalotus*), Tingo Maria (type locality of *A. moorei*) in the south, then crossing the Cordillera Azul in direction of Pucallpa and coming back to the Andes crossing the Cadena Cerro de la Sal to enter the Chanchamayo valley (type locality of *A. weberbaueri*). This makes an itinerary of nearly 2000 km, that we aimed at completing in just eight days, as part of a Lima to Lima round trip that we had begun a week earlier, and set to cover 3500 km in 15 days. We were prepared for an adventurous trip in central-eastern Peru, along the emblematic 5N road ("Carretera Marginal de la Selva"), a little worried altogether about some recent bad security reports along that route, but the draw of the *Attalea* quest was stronger than any fear. We had, anyway, light relief by beginning our travel in Tarapoto, with a visit to the quiet, enchanting and touristic Mayo valley. We first headed to Ciudad del Triunfo de la Santisima Cruz de los Motilones de Lamas, or more simply known now just as Lamas, a small city with a rich and unusual history. Lamas can be reached after driving a steep, narrow, zigzagging mountain road coming from the bottom of the Mayo valley. The place is the traditional territory of the Lamas indigenous people, and the city is one of the first settlements of the Spanish colony in the region, founded on 10th of October 1656, strategically situated on a peak offering a view embracing the whole Mayo river valley. Interestingly, the coexistence of the two cultures was fairly successful, and a large part of the city is actually composed of the Lamas indigenous settlement itself, mixing traditional

9. *Attalea weberbaueri* dominates the deforested landscape of valleys and hills near Villa Rica, Pasco, Peru.

housing with European-style village design. The Lamas people, with their rich traditions and openness, are now actively involved in tourist development in the region. Adding to the cachet of Lamas City, is a bizarre medieval-style castle, constructed by an eccentric owner of the place. More interesting for us was the construction methods of the Lamas indigenous houses, which are based on the use of palm materials and in particular the leaves of *A. moorei*, along with those of *Phytelephas macrocarpa* for roofing (Fig. 4). We found the persistence of these practices in the heavily modified, agricultural environment of the lower Rio Mayo River valley very interesting, especially in close proximity to the rapidly developing urban centers of Moyobamba and Tarapoto, and altogether very smart the way Lamas indigenous people conserve and value their culture in this modern context. The Lamas mountain also interested us for the high elevation (1100 m) that *Attalea moorei* reaches there, the highest record for this species. After a sumptuous lunch in the panoramic restaurant of Lamas city, featuring regional gastronomy, we continued our trip to the north of the valley, in order to determine the northern limit of occurrence of *A. moorei*. En route, we noticed that the whole landscape of the region was clearly anthropogenic, without any remnants of primary forest, but a mosaic of secondary forest patches and cultivated plots of maize and plantain banana, and pastures maintained by the frequent use of fire. However, *A. moorei* was clearly thriving very well in this environment and was even invasive, with many juveniles deeply anchored in the ground thanks to their "saxophone" type growth (Tomlinson 1990), resistant to any kind of land treatment. Along the lower Rio Mayo valley it also appeared clear to us that *A. moorei* was typically associated with seasonally dry tropical forest and with other classic palms of this ecosystem including *Syagrus sancona* and *Aiphanes horrida* (IIAP 2014). Indeed the northernmost population of *Attalea moorei* found in the Mayo valley, near the village of Jepelacio, south of Moyobamba, corresponded to the uppermost patch of seasonally dry tropical forest. Higher up in the valley, the climate becomes more humid in the direction of the famous cloud forests of the protected area of Alto Mayo. Coming back to the south and to our base in

10. Two closely related but neatly distinct species of the *Attalea phalerata* complex growing together on alluvial terrace of the Rio Madre de Dios. On the first plane in the center, *Attalea* sp. "Acre" with straight leaves and clustered pinnae; on the second plane and in the right, the larger *Attalea moorei* with twisted leaves and regularly arranged pinnae.

Tarapoto, we could see that many *Attalea moorei* individuals in the Cumbaza valley had their infructescences cut, indicating a significant activity of seed harvest, these being very oily and edible, and sold toasted in local markets. The growth demography of *A. moorei* in the anthropogenic landscapes of the lower Mayo valley, together with the important use of its products (leaves and seeds) led us to the conclusion that this species has a great potential as a non-wood forest product (NWFP) in the area, and we are raising awareness of this fact in the regional government of San Martín in order to implement appropriate development policies.

After a deserved rest in the city of Tarapoto, we began our long trip along the Huallaga river valley. Huallaga is one of the main tributaries of the upper Amazon River (called Marañon). This river has a long course in an inter-Andean valley, delimited to the west by the Cordillera Oriental, and to the east by the Cordillera Escalera and the Cordillera Azul, the last mountain chains before the Amazon lowlands. The Huallaga valley expands to vast plains along its middle inter-Andean course, where the first African oil palm plantations in Peru where established. The river finally finds a narrow and tumultuous escape from the mountains, in the form of a spectacular canyon in the Cordillera Escalera, to reach the Amazon lowlands where it peacefully terminates its course, meandering into the plains of Yurimaguas and along the last hills to the west of the immense Pacaya-Samiria swamps, until reaching the Marañon river.

For our part, we first went downstream from Tarapoto, crossing the spectacular Cordillera Escalera in direction of Yurimaguas (Fig. 5). Seen from within the Mayo valley, Cordillera Escalera is such a continuous and massive geological barrier that a tunnel had to be carved through it for the road to pass. On the outer side, it descends so abruptly to the Amazon plain that the road changes from very steep to perfectly flat within meters at the boundary of the sub-Andean deformation front. On the way to Yurimaguas, we could

see *Socratea salazarii*, described by Moore on this same itinerary, also the endemic *Astrocaryum huicungo* and a curious distichous mutant specimen of *Mauritia flexuosa*. After another spectacular lunch featuring Amazon gastronomy in a panoramic restaurant over the Huallaga river in Yurimaguas, we took a dry and hot dust road to reach the lower Rio Paranapura, where we had a contact in an indigenous village, to make a brief canoe exploration of alluvial forests on the banks. Our guide brought us directly to a stand of *Attalea* comprising again *shapaja* and *shebón*. Although we were extremely excited about this after our recent deception in Bagazan, we could not readily see the difference between them from a distance, all palms on sight having large leaves with regularly arranged pinnae. Just as in Bagazan on the past two occasions, the difference was obvious to our guide, pointing out the stiffer aspect of the leaves of *shebón*, with wider pinnae than those of *shapaja*, and much more appropriate for roof thatching, as we already knew. Accessing directly the palms shortly after, we could see that here *shapaja* was *A. moorei*, and not the *shapaja* of Bagazan, so that we urgently needed a scientific name for the latter species. The most important characteristic of *A. moorei* is that it has extremely regularly arranged pinnae all along the rachis, while the *shebón* and the *shapaja* of Bagazan have clustered basal pinnae, not readily visible from a distance because middle and upper series of pinnae are regularly arranged. In fruit, *Attalea moorei* is also unique because of the dry, white, spongy mesocarp not found in any other species. Our guide also told us that while the two species are sympatric in this particular spot, *A. moorei* rapidly disappears downstream and is replaced by large stands of pure *shebón* in more inundated places, a statement consistent with our observations of the affinity of *A. moorei* for dryer places and of *shebón* for swamp forest. This time we could observe without doubt the peculiarities of *shebón* in leaf, inflorescence architecture and fruit morphology, but we still lacked flowers and altogether this did not help us in assigning a name to it. However, we thought that at this point we had sufficient knowledge to identify these palms, comparing our field observations with herbarium and literature information. Indeed, the illuminating visit made by JCP to Fred Stauffer at Geneva a few months later, in January 2015, did allow clarification of these questions. Examination of the precious isotype of *Scheelea brachyclada* immediately reminded JCP of a collection made much earlier by him with Betty Millán in Pantoja, Peru, on the upper Rio Napo river, in August 2006, identified at that time as *A. butyracea*. Large populations of these palms in alluvial terraces of Rio Napo were reported and illustrated under that name by Pintaud (2008). Now, it was clear that this palm is the *shebón* and that its correct name is *A. bassleriana*. An illustration of a cross-section of fruit from the type of *A. bassleriana* in Glassman (1999) confirms that this material belongs to the same species known as *S. brachyclada* from androgynous rachillae and *S. stenorhyncha* from staminate rachillae. Altogether, the three types give an unusually complete representation of the species, considering the scarcity of information often associated with Burret's palm names. Nevertheless, reading a copy of Burret's 1929 monograph of *Attalea* at Geneva easily allowed JCP to find the name of the *shapaja* of Bagazan. It is *A. huebneri* (= *Scheelea huebneri*), a species unambiguously characterized by the combination of very tall habit, short androgynous rachillae, and large fleshy fruits with fiber clusters in the endocarp. The type locality on Rio Purus, in Acre, Brazil, is not far from populations in Peru. This species was also documented and illustrated by Galeano and Bernal (2010) under the name of *A. phalerata*, from the vicinity of Leticia in Colombia.

11. Mesocarp of a still undescribed species, segregated from *Attalea phalerata*, has curious amber-like inclusions

After the enjoyable and rewarding trip on the Rio Paranapura, we came back very late at night to Tarapoto. After a rest in the city, we headed this time towards the upper Huallaga, having planned first a stop in the central Huallaga seasonally dry forest. It is a tall forest dominated by legume trees, deciduous during the dry season, with a curious mixture of cacti and palms in the understory. This forest is of high biological and biogeographical interest, and at the same time highly threatened by deforestation, so we are engaged, with various collaborating institutions, in its study and conservation. Although we were supposed to visit the forest during the dry season, we experienced heavy rain, rendering the small dust road leading to the village of Mamonaquihua muddy, slippery and hardly passable. So we visited a dry forest in the dry season in heavy rain, a rather odd situation (effect of the global climate change?) but very interesting for palms. In the driest parts of the forest, the canopy is dominated by *Syagrus sancona* and the midstory by *Aiphanes horrida*, while the more humid valley bottoms and small alluvial terraces are colonized by *Attalea moorei*, *Phytelephas macrocarpa* and *Astrocaryum faranae*, forming dense palm groves. To the south of this locality, we are working with an association of local inhabitants that run an Area of Concession for Conservation, Ojos de Agua, for the conservation of the forest and of a spectacular grove of *Attalea moorei* (Fig. 6).

After passing through the dry forests, we stopped at the city of Juanjui, which is famous as a gate to access the Rio Abiseo National Park, with its vast extension of largely unexplored Andean forest and hidden archaeological remnants of the enigmatic Gran Pajaten lost city of the Chachapoyas civilization. This extraordinary and little known region had been visited on several occasions in the first half of the 20th century by August Weberbauer, who collected a number of unusual plant species (León 2002). After enjoying again the regional gastronomy, we continued our way in direction of Tingo Maria, passing through the vast and flat often swampy alluvial plain of the middle Huallaga valley, with its stands of *Astrocaryum carnosum*, a species endemic to that area, while *Attalea moorei* was a constant sight in the dryer parts of the landscape. This section of the itinerary was long and included portions of difficult unpaved road, and as we decided not to drive at night for security reasons in this troubled area, we had to stop in a not-so-highly recommended village. However, we had no problem at all there, and after smoothly passing through a police checkpoint, we rapidly arrived at the town of Tocache and found good road again. On the way, we were looking, without great hope, to see if we could locate something that could match *Attalea cephalotus*, which is supposed to occur in that area. *Attalea cephalotus* is a complete mystery. It was named and described in great detail by Poeppig in "*Palmetum Orbignyanum*" (Martius 1844) but no type specimen was designated and no illustration provided. The type locality was described as "upper Maynas," which is not very clear, Maynas now being the province of Iquitos and upper Maynas supposed to correspond to the Huallaga valley. Glassman considered that the type of *A. cephalotus* was probably the collection *Poeppig 2000*. From the purported holotype, there is nothing left but a photograph in Dahlgren's Index of American palms (1959), which consists of a handful of *Scheelea*-type flowers associated with a leaf fragment that looks to belong to *Oenocarpus bataua*. An isotype in Belgium (BR) is similarly mixed, but with an Iriarteeae leaf fragment. This scarce and doubtful information suggested that there was little probability of finding this palm that was probably a mere artefact of palm taxonomy, and indeed we did not see anything more than the common *A. moorei*.

Finally we reached Tingo Maria, with its spectacular karstic outcrops, with large caves inhabited by oil-birds and bats, resurgences of turquoise and thermal waters, and the famous line of crest against the sky resembling a silhouette of the Sleeping Beauty. However, our interest again was defined; we wanted to visit the seemingly unimportant village of Naranjal, a small rural settlement a few kilometers away from Tingo Maria. Here, in May 1960, H.E. Moore on flat alluvial terrace, collected the specimen that would later constitute the type of *Attalea moorei*. In 1960–1970, this area was the main place of production of oranges for Lima, but thereafter, an outbreak of disease eradicated the cultivation of orange trees, and the market shifted to the Chanchamayo valley, closer to Lima. Now there is not a single orange tree left, this former activity being only remembered in the name of the village of Naranjal (orange orchard in Spanish). *Attalea moorei* is still there, however, in great abundance, incorporated in an agroforestry system, associated with crops such as banana,

12. An adult palm of *Attalea princeps* close to cattle ranches in northwestern Bolivia. Near the leaf crown grows a young plant of *Ficus* sp., which develops into a tree and strangles the palm; this is a frequent relationship found in natural stands.

cacao and breadfruit trees, and it was with great emotion that we collected it again at the very place where H.E. Moore made the type collection. The palm population is managed and used as a source of leaf material for roof thatching. The gigantic leaves (12 m long) are much appreciated to cover large roofs, and up to 18 of them can be harvested from a single

palm without affecting its survival, according to local harvesters. As far as we could see, *Attalea moorei* showed little variation in morphology, ecology and use, all along the Huallaga-Mayo valley.

After a rest in a tourist hotel in Tingo Maria, enjoying again the regional cuisine (and the swimming pool), we had to cross the Cordillera Azul, the last barrier before the Amazon lowlands towards the Atlantic. Ascending from Tingo Maria, the road surprisingly rapidly reaches the cloud forest at 1650 m elevation, with its distinctive Andean palms, in particular *Ceroxylon echinulatum*, *Wettinia maynensis* and *Geonoma undata* but also *Astrocaryum faranae*, which is more usually associated with lower elevation forest, and beautiful and often rare and shy understory species such as *Prestoea carderi*, *Aiphanes weberbaueri*, *Hyospathe peruviana* and *Geonoma peruviana*. After passing La Divisoria pass, one of the most famous botanizing spots in Peru and the type locality of many plant species, the 5N road almost disappears in the descent of the cordillera Azul towards Pucallpa, destroyed in many points by landslides running through the precipitous slopes dangerously overlooking the Rio Aguaytia, and nevertheless unceasingly transited by heavy trucks going back and forth along the Pucallpa-Lima route, carrying Amazon wood. The road finally gets out of the Cordillera through the grandiose Boquerón del Padre Abad, a narrow canyon bordered by huge vertical rocky walls harboring many cascades that looked like the threshold to another world, as shown by the strange indications on the roadside such as "UFO Snack Bar " or "end of the acceleration strip" (Fig. 7). As a matter of fact, the 5N road soon after shrinks into a narrow trail in the middle of nowhere, with temporary wooden bridges and improvised toll points made by the local inhabitant themselves on hazardous paths (Fig. 8), not to mention the extremely hot weather.

Fortunately we were still entertained by *Attalea,* sighting now *A. maripa* along with *A. moorei*, and unexpectedly, *A. weberbaueri*, all three species very different in habit and readily distinguishable while growing together at about 250 m elevation. This place was also close to a collection point of A. Weberbauer (#6762 in Puerto Mayro) of a palm tentatively assigned to *A. cephalotus* by Glassman (1999). However, it is extremely unlikely that there is still another *Attalea* species beside the three we were looking at in that place, letting *A. cephalotus* as a name of doubtful application, until maybe the staminate flowers of the isotypes can be identified. *Attalea maripa* is tall-trunked and has very long-petiolate leaves arranged in five ranks, while the two other species are relatively short-trunked with sessile and spirally arranged leaves. *Attalea moorei* is further distinguished by the regularly arranged leaflets spreading in one plane while *A. weberbaueri* has clustered leaflets giving the crown a plumose aspect (see key to species). In addition, we found hybrids between *A. moorei* and *A. weberbaueri*, with intermediate and somewhat unstable morphologies.

Soon after along the 5N road, all the *Attaleas* suddenly disappeared without any obvious reason, in the middle of a vast and seemingly homogeneous plain. However, this sudden change coincided also with the replacement of *Astrocaryum faranae* by *A. perangustatum*, so that there looks to exist a biogeographic pattern yet to be unraveled in this place. Higher up on the way we could contemplate the magnificent and untouched montane forests of the protected Cadena de los Cerros de la Sal and record an unusual diversity of palms from the Iriarteeae tribe, including *Socratea salazarii*, *S. exorrhiza*, *Iriartella stenocarpa*, *Iriartea deltoidea*, *Wettinia maynensis* and *Dictyocaryum lamarckianum*. Immediately after crossing this mountain range, we entered a vast valley dominated by *Attalea weberbaueri*, very visible as standing individuals left in deforested areas converted into pastures (Fig. 9), and shortly after we reached the capital of coffee in Peru, Villa Rica. After a night and some coffee in Villa Rica, we ended our *Attalea* trip on the 8th day as initially planned, with a visit to the type locality of *Attalea weberbaueri*, just outside the city of La Merced, in the Chanchamayo valley. In that place, we recorded its occurrence up to 1422 m elevation, which is the second highest record for the genus, after *A. amygdalina* that reaches 1600 m elevation in Colombia (Galeano & Bernal 2010). Interestingly, we found that *A. weberbaueri*, which was described as acaulescent (Glassman 1999), does flower and set fruit at the acaulescent stage but continues its growth and eventually develops an aerial trunk that can exceed 10 m tall.

This last day was the longest of the trip, and we did not know when leaving *Attalea weberbaueri* behind us early in the morning, that we still had 18 hours of exhausting driving ahead through rivers in flood, a snow storm at the Ticlio pass (4818 m elevation) and a trailer traffic jam below, eventually to reach Lima

Table 1. Distinguishing characters among allied species of the *Attalea phalerata* complex with diagnostic features in bold.

	A. phalerata	*A. princeps*	*A. weberbaueri*	*A. moorei*	*A. anisitsiana*	*A.* sp. "Acre"	*A. huebneri*
Trunk maximum height	10 m	15 m	12 m	15 m	**4 m**	12 m	**30 m**
Upper leaf rachis orientation	Twisted	Twisted	Twisted	Twisted	Twisted	**Straight**	Twisted
Basal series of pinnae orientation	3 or 4 planes	3 or 4 planes	3 or 4 planes	**1 plane**	3 or 4 planes	3 or 4 planes	**2 planes**
Median series of pinnae arrangement	Clustered	Clustered	Clustered	Regularly spaced	Clustered	Clustered	Regularly spaced
Median pinnae length	80–90 cm	ca. 100 cm	110–120 cm	70–150 cm	50–60 cm	80–100 cm	100–120 cm
Median pinnae width	2.5–3.0 cm	3.0–4.0 cm	5.0–5.7 cm	4.0–7.5 cm	2.8–3.0 cm	2.5–3.0 cm	3.5–5.0 cm
Pinnae transverse veinlets (fresh state)	?	?	Prominent	Prominent	?	Obscure	?
Peduncular bract	Thick	Thick	Thick	Thick	**Thin**	Thick	Thick
Staminate flowers insertion on rachillae	Unilateral	**spiral throughout**	Unilateral	Unilateral	Unilateral	Unilateral	Unilateral
No. of pistillate flowers on middle rachillae	2–7	2–5	2–5	1 or 2	2–4	?	1–5
Fruit length	5.0–6.5 cm	6.0–8.0 cm	6.0–8.0 cm	7.5–10.0 cm	4.0–6.0 cm	6.0–7.0 cm	**10.5–12.0 cm**
Mesocarp texture and color on mature fruits	Orange, fleshy	Orange, fleshy	?	**White, dry**	Yellow, fleshy	**Cream, ± fleshy**	Orange very fleshy
Fiber cluster pattern in endocarp	Loosely clustered	Strongly clustered	Loosely clustered	Strongly clustered	?	?	Loosely clustered
Fiber cluster adnation in endocarp	Adnate	Free	Adnate	Free	?	?	?
Seeds per fruit	2–4	2–5	1–3	1–5	2–4	2 or 3	4–6

after having completed exactly 3500 km in 15 days, without any alteration from the initial plans.

An encounter in the triple boundary of Peru, Bolivia and Brazil

Following this fruitful fieldwork in Peru, we thought it necessary to share and exchange knowledge with the neighboring countries in order to understand better the challenges of the genus *Attalea* in the western Amazon. With this objective in mind, we decided to meet for a field workshop at Iñapari and Assis Brasil, on the triple boundary between Peru, Brazil and Bolivia in August 2014. We all arrived there, in this small and remote place, from our respective countries, under the hardly bearable heat of the dry season in the southwestern Amazon edges. Although we met almost at sunset, we could not wait to look at *Attalea* and share our experiences about them, so that we immediately headed to a backyard near our hotel where we had sighted an *Attalea*. With the experience gained in Peru, it could immediately be identified as *A. moorei*, but also appeared to exist in Acre, Brazil, where it had not been recorded, and in Bolivia where it had been known as *A. butyracea* (Moraes 2004) or recently as *A. phalerata* var. *concinna*, showing the need to coordinate information among countries. The following day, we explored the seasonally dry, semi-deciduous forest of this Amazon edge, recording *Attalea moorei*, *Astrocaryum ulei*, *Aiphanes horrida* and *Phytelephas macrocarpa*, an association of palm species very similar to that previously seen in the semi-deciduous forest of the central Huallaga valley. Following the road to Puerto Maldonado, the regional capital of Madre de Dios, Peru, we crossed an abrupt climatic change from the hot and dry weather we had experienced in Iñapari, with temperatures close to 40°C, to cool, windy and rainy weather farther in the west. This sudden change was not just a circumstantial climatic condition but coincided with the replacement of the seasonally dry forest by rain forest, with a totally different palm assemblage including *Oenocarpus bataua*, *Iriartea deltoidea*, *Geonoma deversa*, *G. occidentalis* and *Bactris hirta*, among other species, under the shade of gigantic Brazil nut trees. Farther away along the road, we could see large stands of *Attalea moorei* in pastures, with the same invading behavior as noted in the lower Mayo valley.

On the third day, we were invited by the NGO Inkaterra to visit two of their lodges on the Madre de Dios river, close to Puerto Maldonado. There we found an interesting situation of sympatry of two palms of the *Attalea phalerata* complex on the alluvial terraces, namely *Attalea moorei,* and another species that had been well known in Acre as *A. phalerata*, but which now appears to be a distinct, as yet unidentified species.

Attalea phalerata, as circumscribed by Glassman (1999), is a species of the western-central *cerrados* of Brazil, absent from western Amazonia. The name *A. phalerata* has been extensively used in a wider sense, including the western Amazonian populations, since Henderson (1995). This *Attalea phalerata* complex (Pintaud, 2008), which is resolved as a well supported clade in existing phylogenies (Rodriguez et al. in press) is primarily distinguished by the presence of large fibrous clusters in the endocarp. In western Amazonia, this complex includes five taxa, and outside the area, this complex also includes several species, such as *A. anisitsiana* (almost endemic from Paraguay) and *A. phalerata sensu stricto* from the cerrados, possibly *Scheelea corumbaensis* from the Pantanal and *A. excelsa* from the north-eastern Amazonian periphery. Table 1 gives the most evident distinguishing characters among sufficiently known species of the *Attalea phalerata* complex.

In our context of sympatry in Madre de Dios, *Attalea moorei* could be recognized by the twisted leaf rachis with regularly arranged pinnae held vertically, while *Attalea* sp. "Acre" had a straight rachis with clustered pinnae (Fig. 10). *Attalea moorei* could also be distinguished vegetatively by the prominent transverse veinlets of the pinnae, which were obscure in *A.* sp. "Acre." This last species had also a very distinctive mesocarp in mature fruits, creamy-yellow, semi-fleshy and with unusual amber-like inclusions (Fig. 11), different from both *A. moorei* with fruits having a white, dry mesocarp and true *Attalea phalerata* and also *A. huebneri*, both with fruits having a fleshy orange mesocarp.

While leaving the alluvial terraces of the banks of Rio Madre de Dios to enter the hilly *terra firme* forest inland, we found two more familiar *Attalea* species, *A. maripa* and *A. bassleriana*. The latter, a virtually unknown species a few years ago, appears to have a vast distribution in Western Amazonia. In Madre de Dios, it is also known under the common local name *shebón* (Paniagua et al. 2012, as *A. butyracea*). This species also occurs in most of the

13. JCP holding pistillate and staminate inflorescences of *Attalea blepharopus*, next to the road from Chapare to Isinota.

Ecuadorean Amazon, where it has been misidentified as *A. butyracea* (*Bergman 60481, 62131*, QCA, AAU) or *A. phalerata* (*Camara-Leret 1816*, QCA, AAU), in the Colombian Amazon (*Bernal 1404* COL) and most probably in western Brazil and northern Bolivia.

On the fourth and last day of our trip we visited localities further west, in the Andean foothills and located yet another species of the *A. phalerata* complex, namely *Attalea princeps* (Fig. 12), near the village of Mazuco. This species was long known from Bolivia (where it is commonly named *motacu*), more recently found in western Brazil, and now new to Peru. This species is readily distinguished by its petiolate leaves with prominently clustered pinnae inserted on a twisted rachis, and spreading in many different planes.

Having documented these species of western Amazonia, we remained to confirm another *Attalea* species of Bolivia, *A. blepharopus*. Therefore, we organized a field trip to the Chapare region, in central Bolivia, to find the town cited by Alcides d'Orbigny in the territory of the village Yuracaré and regionally corresponding to the Chapare river basin. The closest town to Villa Tunari in the Chapare region population is Isinota. While traveling by car, we looked on both sides of the road at the appearance of the palm known locally as *palla* (Fig. 13, *Moraes R. & Pintaud 2518*). This species is common in the forest and is occasionally accompanied by other palms, such as *Astrocaryum gratum* (dominant), *Attalea princeps, Oenocarpus bataua, Iriartea deltoidea, Socratea exorrhiza*, as well as with other species of *Inga, Triplaris, Virola* and *Theobroma*. We recorded the characteristics of *A. blepharopus* that we consider definitely as a species distinct from the others but very close to *A. bassleriana* by virtue of its sessile leaves. Therefore, Moraes and Pintaud submitted a manuscript for the neotypification of the species. After this journey, we reviewed several *Attalea* herbarium material in Cochabamba, Santa Cruz and La Paz. Records of this species were collected both in Cochabamba and La Paz departments, although with very little material has been collected.

Now we can consider that the western Amazon *Attalea* species are reasonably delimited. Meanwhile, the full description of species is in progress and will appear in a later monograph. Below we present a preliminary dichotomous key of *Attalea*, based on our findings made in this region:

Key to the species of *Attalea* in the western Amazon

1a. Habit acaulescent or subacaulescent (inflorescences born below to slightly above ground) 2

1b. Habit arborescent 5

2a. Middle series of pinnae clustered . . . . . *A. insignis*

2b. Middle series of pinnae regularly arranged 3

3a. Staminate rachillae and staminate flowers unilaterally arranged . . . . . *A. racemosa*

3b. Staminate rachillae and staminate flowers spirally arranged 4

4a. Flowers densely packed and anthers coiled and enrolled . . . . . *A. polysticha*

4b. Flowers loosely arranged and anthers straight . . . . . *A. plowmanii*

5a. Leaves distinctly arranged in 5 vertical ranks . . . . . *A. maripa*

5b. Leaves spirally arranged (in fact obscurely arranged in 8 oblique ranks) 6

6a. Petiole densely woolly-floccose and bright reddish ferruginous . . . . . *A. septuagenata*

6b. Petiole with an appressed, minutely scally, gray-brown or reddish-brown indument . . . 7

7a. Pinnae covered with an appressed gray scally indument abaxially . . . . . *A. tessmannii*

7b. Pinnae without scales outside midrib abaxially 8

8a. Staminate flowers unilaterally arranged at least on proximal part of staminate rachillae 9

8b. Staminate flowers spirally arranged throughout the staminate rachillae, these covered with minute, silvery-white stellate scales (*A. butyracea* complex) 14

9a. Staminate rachillae thick, recurved, flower pit sunken . . . . . *A. speciosa*

9b. Staminate rachillae slender, straight, flower pit superficial (*A. phalerata* complex) 10

10a. Pinnae regularly arranged all along the rachis, mesocarp white, dry . . . . . *A. moorei*

10b. Pinnae clustered at least basally, mesocarp cream to orange, ± fleshy 11

11a. Leaf rachis ascending, straight throughout . . . . . A. sp. "Acre"

11b. Leaf rachis twisted laterally, upper (distal) portion of the leaf held vertically 12

12a. Pinnae from middle series not clustered, in one plane . . . . . *A. huebneri*

12b. Pinnae from middle series clustered, in several planes 13

13a. Middle series of pinnae <5 cm wide . . . . . *A. princeps*

13b. Middle series of pinnae >5 cm wide . . . . . *A. weberbaueri*

14a. Pistillate flowers 1–6 per rachillae, fruits >8 cm long . . . . . *A. bassleriana*

14b. Pistillate flowers 8–16 per rachillae, fruits <8 cm long 15

15a. Staminate rachillae slender, old staminate inflorescence broom like, peduncular bracts narrow, nearly flat . . . . . *A. peruviana*

15b. Staminate rachillae robust, old inflorescence not broom-like, peduncular bracts markedly widened, boat-shaped . . . . . *A. blepharopus*

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Literature Cited

Burret, M. 1929. Die Palmengattungen *Orbignya, Attalea, Scheelea* and *Maximiliana*. Notizbl. Bot. Gart. Berlin-Dahlem 10: 651–701.

Dahlgren, B.E. 1959. Index of American palms. Plates. Field Mus. Nat. Hist. Bot. 14: pls 1–412.

Dransfield, J., N. Uhl, C. Assmusen-Lange, W. Baker, M. Harley and C. Lewis. 2008. Genera Palmarum: the Evolution and Classification of Palms. Royal Botanical Gardens Kew, International Palm Society and the L.H. Bailey Hortorium, Cornell University, Kew.

Galeano, G. and R. Bernal. 2002. New species and new records of Colombian palms. Caldasia 24: 277–292.

Galeano, G. and R. Bernal. 2010. Palmas de Colombia. Guía de Campo. Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá. 688 p.

Glassman, S.F. 1999. A taxonomic treatment of the palm subtribe Attaleinae (Tribe Cocoeae). Illinois Biol. Monogr. 59: 1–414.

Henderson, A. 1995. The Palms of the Amazon. Oxford University Press, Nueva York.

Henderson, A., G. Galeano and R. Bernal. 1995. Field Guide to the Palms of the Americas. Princeton University Press, New Jersey.

IIAP (Instituto de Investigaciones de la Amazonía Peruana). 2014. Informe de Inventario Biológico de la Propuesta ACR Bosques de Shunté y Mishollo, Tocache, San Martín.

Kahn F. and K. Mejía. 1991. The palm communities of two terra firme forests in Peruvian Amazonia. Principes 35: 22–26.

León, B. 2002. Significance of August Weberbauer's plant collecting for today's Río Abiseo National Park, northern Peru. Taxon 51: 167–170.

Lorenzi, H., L.R. Noblick, F. Kahn and E. Ferreira. 2010. Brazilian Flora Lorenzi: Arecaceae (Palms). Instituto Plantarum, Nova Odessa.

Martius C.F.P. von, 1844. Palmetum Orbignianum in A.D. d'Orbigny, Voyage dans l'Amérique méridionale 7 (3): 1–140.

Montúfar R. and J.-C. Pintaud. 2006. Variation in species composition, abundance and microhabitat preferences among Western Amazonian terra firme palm communities. Botanical Journal of the Linnean Society, 151: 127–140.

Moore, H.E., Jr. 1972. *Chelyocarpus* and its allies *Cryosophila* and *Itaya* (Palmae). Principes 16: 67–88.

Moraes R., M. 2004. Flora de Palmeras de Bolivia. Herbario Nacional de Bolivia, Instituto de Ecología, Carrera de Biología, Universidad Mayor de San Andrés, Plural editores, La Paz. 262 p.

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.

Paniagua, N., R.W. Bussmann and M.J. Macía. 2012. El Conocimiento de Nuestros Ancestros – Los Ese Eja y su Uso de las Palmeras, Madre de Dios, Peru. Graficart, Trujillo.

Pintaud, J.-C. 2008. An overview of the taxonomy of *Attalea* (Arecaceae). Revista Peruana de Biología 15, supl. 1: 55–63.

Rodríguez del Castillo, A.M., C. García-Davila, K. Mejía and J.-C. Pintaud. in press. *Attalea*: insights into the diversity & phylogeny of an intriguing genus. Palms

Stauffer, F.W. and J.G. Fariñas. 2006. The identity of *Attalea macrolepis* (Burret) Wess. Boer (Arecaceae). Candollea 61: 83–88.

Tomlinson, P.B. 1990. The Structural Biology of Palms. Clarendon Press, Oxford.

Vargas, V., J.-C. Pintaud and F.W. Stauffer. 2012. Diversidad, usos y conservación de las palmas (Arecaceae) de la Reserva Natural Allpahuayo-Mishana (Peru). Acta Bot. Venez. 3: 53–70.

Zona, S. 2002. Name changes in *Attalea*. Palms 46: 132–133.