Novitates Gabonenses 90: Palisota (Commelinaceae) revisited: description of eight new species from Central Africa and notes on the identity of P. satabiei and P. bogneri

Ehoarn Bidault & Willem Joost van der Burg

Abstract

BIDAULT, E. & W.J. VAN DER BURG (2019). Novitates Gabonenses 90: Palisota (Commelinaceae) revisited: description of eight new species from Central Africa and notes on the identity of P. satabiei and P. bogneri. In English, English and French abstracts. *Candollea* 74: 169–202. DOI: http://dx.doi.org/10.15553/c2019v742a7

A review of the taxonomy of *Palisota* Rchb. ex Endl. *(Commelinaceae)* in Atlantic Central Africa, as a precursor to preparing a treatment of *Commelinaceae* for the *Flore du Gabon*, results in the description of eight new species: *Palisota akouangoui* E. Bidault & Burg, *Palisota alboanthera* Burg & E. Bidault, *Palisota cristalensis* E. Bidault & Burg, *Palisota fadenii* Burg & E. Bidault, *Palisota leewhitei* Burg, O. Lachenaud & E. Bidault, *Palisota plicata* E. Bidault & Burg, *Palisota repens* E.Bidault & Burg, and *Palisota stevartii* Burg & E. Bidault. A discussion is provided on the relevance of several morphological characters and on the taxonomy and delimitation of two poorly known species, *Palisota bogneri* Brenan and *Palisota satabiei* Brenan. The new species are described and illustrated with line drawings and field photographs, accompanied by a distribution map. A key to the *Palisota* species in Atlantic Central Africa is provided. Preliminary risk of extinction assessments indicate that three of them are "Endangered", three are "Vulnerable", one is "Near Threatened", and one species is "Least Concern". Thirty-two species are currently recognized in *Palisota*, nineteen of which occur in Gabon.

Addresses of the authors:

EB: Missouri Botanical Garden, 4344 Shaw Blvd., St. Louis, Missouri 63110, USA and Muséum national d'Histoire naturelle, UMR 7205 CNRS-MNHN-UPMC-EPHE "Institut de Systématique, Evolution, Biodiversité - ISYEB", Herbier National, 16 rue Buffon CP 39, 75005 Paris, France. E-mail: **ehoarn.bidault@mobot.org**

WJvdB: Naturalis Biodiversity Center, P.O. Box 9517, 2300 RA Leiden, the Netherlands.

Submitted on December 4, 2018. Accepted on August 18, 2019. First published online on October 7, 2019.

ISSN: 0373-2967 – Online ISSN: 2235-3658 – *Candollea* 74(2): 169–202 (2019) © CONSERVATOIRE ET JARDIN BOTANIQUES DE GENÈVE 2019

Résumé

BIDAULT, E. & W.J. VAN DER BURG (2019). Novitates Gabonenses 90: Palisota (Commelinaceae) revisité: description de 8 nouvelles espèces d'Afrique centrale et notes sur l'identité de P. satabiei et P. bogneri. En anglais, résumés anglais et français. *Candollea* 74: 169–202. DOI: http://dx.doi.org/10.15553/c2019v742a7

Une révision de la taxonomie du genre *Palisota* Rchb. ex Endl. *(Commelinaceae)* en Afrique centrale atlantique, dans le cadre de la préparation du traitement des *Commelinaceae* pour la Flore du Gabon, permet la description de huit nouvelles espèces: *Palisota akouangoui* E. Bidault & Burg, *Palisota alboanthera* Burg & E. Bidault, *Palisota cristalensis* E. Bidault & Burg, *Palisota fadenii* Burg & E. Bidault, *Palisota leewhitei* Burg, O. Lachenaud & E. Bidault, *Palisota plicata* E.Bidault & Burg, *Palisota repens* E. Bidault & Burg, et *Palisota stevartii* Burg & E. Bidault. Une discussion sur la pertinence des caractères morphologiques et sur la taxonomie de deux espèces mal connues, *Palisota bogneri* Brenan et *Palisota satabiei* Brenan, est proposée. Les espèces sont décrites et illustrées par des dessins au trait et des photographies prises sur le terrain, et accompagnées d'une carte de distribution. Une clé des espèces de *Palisota* en Afrique centrale atlantique est fournie. Une évaluation du risque d'extinction indique que trois espèces sont «En danger», trois autres sont «Vulnérable», une est «Quasi-menacée» et une est «Préoccupation mineure». Trente-deux espèces sont désormais connues pour le genre *Palisota*, dont dix-neuf existent au Gabon.

Keywords

COMMELINACEAE – *Palisotinae* –*Palisota* – Gabon – New species

Introduction

Palisota Rchb. ex Endl. is a genus of *Commelinaceae* limited to Tropical Africa. It is the only member of subtribe *Palisotinae* Faden & D.R. Hunt, which belongs to tribe *Tradescantieae* Meisner, subfamily *Commelinoideae* G. Brückner (Faden & Hunt, 1991). Its center of diversity is located in Central Africa (Faden, 2007) and its range extends to West Africa and eastern Uganda and Tanzania. Species also occur on islands of the Gulf of Guinea but have not been recorded from the Indian Ocean islands, including Madagascar. *Palisota* are terrestrial herbaceous plants, ranging from small rosettes to robust shrub-like herbs up to 3 meters tall. Only one species is known to be a climber, *P. thollonii* Hua. The total number of species has been the subject of extensive discussion. While Faden & Hunt (1991) and Faden (1995) mentioned 18 species, the total has recently been reevaluated upward to 20 species (Faden, 2007). As part of a review of the genus recently conducted by the authors, we currently recognize 24 species and one subspecies. We have also noted 20 additional validly published names and 3 *nomina nuda*, all of which are now considered as synonyms. This situation suggests the complex taxonomic history of *Palisota* and the overall difficulty botanists have had to identify informative morphological characters for discriminating species and genera in *Commelinaceae.*

The first *Palisota* to be published was initially described in the genus *Commelina* as *C. ambigua* P. Beauv. (Palisot-Beauvois, 1804) before being transferred some years later to *Aneilema* as *A. ambiguum* (P. Beauv.) Loudon (Loudon, 1830) and then to *Palisota* by Clarke (1881), following Endlicher's (1836) description of the genus. Similarly, Thunberg (1808) described *Dracaena hirsuta* Thunb. before Kosteletzky (1831) transferred it to his newly described genus *Duchekia* Kostel., recognizing it as a member of *Smilacaceae*, followed by its transfer to *Palisota* by Schumann (1897). During the XIXth century and at the beginning of the XXth century, species of *Palisota* were considered to have great horticultural potential, leading to the description of new species based on poor material, including living plants lacking flowers and fruits, often with no type specimen designated. Examples include *P. albertii* L. Gentil, *P. elizabethae* L. Gentil, and *P. bicolor* Mast. (Gentil, 1910; Masters, 1878), which were described based on perceived differences with the only rosette species known at the time, *P. barteri* Hook.f., based on vegetative characters such as leaf size and the color pattern of the lamina. Hua (1894), Clarke (1881, 1901), Wildeman (1903), and Schumann (1897, 1905) were among the most prolific authors in publishing new species of *Palisota*, sometimes based on small variations in features such as leaf or inflorescence size or pubescence, often observed on a very limited number of collections. Later studies and field observations led to an increase in available specimens, resulting in the placement of some of these early names into synonymy based on the presence of significant variability in some taxa such as *P. ambigua* (P. Beauv.) C.B. Clarke and the realization that some characters are not useful for discriminating among species, such as leaf size or color pattern (Faden, 2007; Hutchinson & Dalziel, 1936). This situation led to the placement of some of the names published by Hua, Clarke and Wildeman in synonymy, but not all. In particular, while several entities are suspected of being conspecific with *P. mannii* C.B. Clarke or *P. barteri*, such as *P. albertii*, *P. bicolor*, and *P. elizabethae*, they remain accepted for the time being because no reference material has yet been found. Moreover, *P. laurentii* De Wild. and *P. pynaertii* De Wild., both from the Democratic Republic of Congo, *P. gracilior* Mildbr. from Cameroon, and *P. myriantha* K. Schum. from Angola, are only known from their types, which we have not been able to locate. Some of them were presumably destroyed at B, but others that should be at BR have not been found.

Brenan (1984), Faden (1995), and Cheek et al. (2018) were the most recent authors to publish new species in *Palisota*, describing *P. bogneri* Brenan, *P. satabiei* Brenan, *P. flagelliflora* Faden, and *P. ebo* Cheek, respectively. Each of the first three of these species, described from Gabon and Cameroon, exhibits a unique habit in the genus. Indeed, *P. bogneri* was the only known rosette species bearing axillary inflorescences below the leaves and *P. satabiei* was the only shortly creeping species with axillary inflorescences. Similarly, *P. flagelliflora* was the only species with conspicuous flagelliform inflorescences. The recently described *P. ebo* closely resembles *P. flagelliflora* by its rosette stature and the bearded filaments of its lower anther.

Nearly 100 collections of *Palisota* have been made in Gabon since 2012, when the authors first became interested in the genus and began preparing a treatment of *Commelinaceae* for the *Flore du Gabon*. During the process of identifying this material at the herbarium in Paris (P), several possible taxonomic novelties were found, which was corroborated by examining specimens at other key institutions with holdings from Central Africa. This revealed that all of the novelties discovered since 2012 were in fact represented by older collections. Hence, the purpose of this paper is to describe eight of these novelties, each of which is associated with field photos and material preserved in ethanol, allowing us to identify morphological patterns that are sufficiently informative to group specimens into coherent, well-circumscribed taxonomic entities. Many specimens representing novelties initially remained unidentified due to the lack of floristic and taxonomic treatments from Central Africa, or they were misidentified as other species, especially *P. bogneri* and *P. satabiei*. As a consequence, a detailed analysis is proposed on the identity and delimitation of both of these species with regard to the taxonomic novelties described here, and a note on the members of the genus that exhibit a decumbent habit is also provided. An identification key to all species known to occur in Atlantic Central Africa (Gabon,

Equatorial Guinea, Cameroon, Republic of Congo) is provided, followed by descriptions of the eight newly recognized species from Gabon.

Notes on the identity of Palisota satabiei

During our review of material from Gabon previously identified as *P. satabiei*, we realized that while all of the collections shared two features (a partly or fully creeping habitus and axillary, relatively short inflorescences), significant variation was expressed in the length of the creeping portion of the stem, the pseudopetiole, the internode, and the inflorescence, as well as in the overall pubescence of all parts and the structure of the inflorescence. We observed short-trailing plants entirely covered by rusty, erect trichomes and bearing short, axillary inflorescences that barely protrude, but we also found long-trailing plants with leaves regularly inserted on the stem, covered by a woolly whitish to ochre pubescence. We suspected that such striking variability was beyond the natural range of variation for *P. satabiei*. Brenan (1984: 832) mentioned that: "The indumentum of *P. satabiei* appears to be rather variable: *Letouzey 8977* has long patent rusty trichomes very sparse or almost absent on the petiole, and the marginal trichomes of the leaf-lamina more or less appressed. *Hallé & Villiers 5310* represents another extreme, with profuse long patent rusty trichomes on the petiole, leaf-margins and upper surface of lamina. *Aké Assi 16101*, unfortunately neither in flower nor fruit but apparently conspecific, occupies an intermediate position, with long rusty trichomes on the petiole, but the lamina indumentum similar to that of *Letouzey 8977*. These differences seem for the present best considered as just part of the range of variation within the species".

Brenan used a cautious approach consistent with the small number of collections available to him in order to avoid describing additional poorly known species based on minor variation in characters that, at the time, were already thought to be of questionable relevance. Recent collections from Gabon have, however, enable us to detect a coherent and distinctive morphological pattern among plants from the Monts de Cristal, where *Hallé & Villiers 5310* was collected. Many of these recent gatherings have what Brenan described as profuse long patent rusty trichomes on all parts. Moreover, they have very short, barely protruding inflorescences that are erect and never branched, unlike what was described for *P. satabiei*. We believe that these differences, which are consistent among the material now available and form a morphologically coherent entity, are sufficient to warrant the description of *P. cristalensis* E. Bidault & Burg as a new species. Examination of material from Equatorial Guinea also revealed collections referable to *P. cristalensis* that had been mis-identified as *P. satabiei*. Unfortunately, we have not been able to find *Hallé & Villiers 5310* at P, so we could not verify its identity, but based on the description Brenan provided, we believe it could also represent *P. cristalensis*.

Brenan (1984) also mentioned that the sterile collection from Forêt classée de la Mondah near Libreville *(Aké Assi 16101)* had long rusty trichomes on the petiole, but that the indumentum of its lamina was similar to that of *Letouzey 8977*, i.e. bearing marginal, short, appressed trichomes. Recent fertile collections made in the same area comprise a distinct morphological entity apparently restricted to the Mondah forest, and which differs from *P. satabiei*, as described by Brenan, by its long, ginger-colored or rusty trichomes along the margins of the pseudopetiole, and the short, unbranched inflorescences barely emerging from the leaf litter, hidden under the leaves and among the roots, and never exceeding 5 cm in length. This entity, already identified as a novelty several years ago by the late C. Wilks and confirmed as such by R. Faden, was never described, despite having been collected multiple times in the Mondah forest. It is described below as *P. leewhitei* Burg, O. Lachenaud & E. Bidault.

Many other specimens collected in Gabon were initially identified as *P. satabiei* but appear to differ from the type *(Letouzey & Satabie 8977)* by their long, creeping habit (up to 2 meters), with the leaves regularly distributed along the creeping portion of the stem, and by their axillary short inflorescences (usually not exceeding 6 cm in length, occasionally up to 8 cm) that are never branched, even in fruit. Examination of collections from the Republic of Congo and Equatorial Guinea revealed additional specimens exhibiting these morphological features. Brenan (1984) mentioned that, in *P. satabiei*, the inflorescence is compact in bud but then becomes lax and branched, with each branch comprising a single cincinnus, as confirmed by Faden (1995). By contrast, the inflorescences of the specimens mentioned above are never branched (even in fruit) and are composed by multiple, separate, short cincinni. Faden (1995) highlighted the importance of the structural shape of the inflorescence in *Palisota*, which leads us to believe that branching and the number of cincinni are species-specific structural characters that are not part of the infraspecific morphological variation occurring within members of the genus. In light of these differences, it would appear best to adopt a narrower concept of Brenan's *P. satabiei* to comprise only material that has strictly branched inflorescences, as mentioned in the protologue and depicted by its type specimen. As a consequence, the material bearing unbranched inflorescences and exhibiting long, creeping stems with regularly distributed leaves along it, which comprises collections that were not available when Brenan described *P. satabiei*, would be best recognized as a distinct species, which is described below as *P. repens* E. Bidault & Burg.

Based on inflorescence structure, we have also identified another entity collected in Gabon that is characterized by the same habit as what is described by Brenan for *P. satabiei*,

but differs in having inflorescences that are never branched, forming a thyrse composed of multiple cincinni bearing flowers with unequal stamens, the lower one being larger, longer, and becoming green after dehiscence of the anthers. Given this difference in the inflorescence structure, and the fact that, according to Brenan (1984), *P. satabiei* has three equal stamens, we have concluded that this entity should also be recognized as being distinct and is therefore described below as *P. akouangoui* E. Bidault & Burg.

A fifth morphological entity that closely resembles *P. satabiei* was collected in the Cristal Mountains in Gabon in 2017. It had previously been known from six collections, *Wieringa et al. 3112[B]* from Ngounié province in Gabon, *Senterre & Ngomo 896, 3457, 3575* & *3576*, and *Senterre et al. 2807,* all from *Parque Nacional de Monte Alén* in Equatorial Guinea. This entity, which differs from *P. satabiei* by its large, plicate leaves with the lamina long- decurrent on the pseudopetiole, and its mostly erect, axillary, unbranched, subglobose and glabrous inflorescences, is described below as *P. plicata* E. Bidault & Burg.

The adoption of a narrower taxonomic concept of *P. satabiei* that more strictly aligns with Brenan's description and the re-assignment of most of the material previously placed in this taxon to five newly described species, leads to *P. satabiei* now being known from a very limited number of specimens, all with branched inflorescences. Most are from southwest Cameroon (*Tchouto et al. 3026, Tchouto et al. BIFAX 92, Tchouto & Elad MMX 200, Tchouto & Elad ONOX 173, Satabie 459,* and *Letouzey 8977*) and one is from Equatorial Guinea (Rio Muni, *Parque Nacional de Monte Alén*, *Senterre et al. 1779*). While *Satabie 459* has a peculiar permanence of its sepals and has fruits with dense indument, it is best placed, at least provisionally, in *P. satabiei*, which is thus currently unknown from Gabon or the Republic of Congo.

Notes on the identity of Palisota bogneri

Brenan (1984) also described *P. bogneri*, which differs from *P. satabiei* by its rosette habit, rendering it nearly stemless, and by bearing axillary, decumbent, unbranched inflorescences inserted at the base of the plant. These strong differences prompted Brenan to describe *P. bogneri*, despite having very little available material: only a single living plant collected in Gabon at an uncertain locality ("Ikoy Bandja"), cultivated in the Botanischer Garten München, from which an herbarium specimen of material in flower was prepared by Bogner in 1977. Recent collections made in Gabon since the 1980s have confirmed that the presence of axillary decumbent inflorescences is constant among a growing number of available specimens, and that there is a clear difference between *P. bogneri* and other rosette-forming species such as *P. barteri*. Nevertheless, some recent collections from Gabon have shown variation in leaf shape, size and indumentum, as well as structural differences compared to the type specimen of *P. bogneri* and the details provided in Brenan's protologue. Some specimens exhibit a more robust habit (leaves up to 50 cm long, with a pseudopetiole to 30 cm long in *Bidault et al. 3807*) along with pale purple to violet flowers bearing unequal stamens, the lower one being more robust and pale yellow to white (e.g., *Bidault et al. 1869, 3807, De Wilde et al. 11549, De Wilde & De Wilde-Bakhuizen 11713*, *Sosef et al. 654, Stévart et al. 4780*, and *Wieringa et al. 3163*, all from Gabon). We observed that these characters are consistant and that there is no material exhibiting intermediate character states compared to collections that are strictly white-flowered with yellow, subequal stamens. Material now assigned to *P. bogneri* was mentioned in previous studies as representing an undescribed species (Vande Weghe et al., 2016; Bidault et al., 2017) but was never published. It is described below as *P. alboanthera* Burg & E. Bidault. This new species, which closely resembles *P. bogneri*, has not yet been collected with certainty in fruit. Previous collections of robust plants with fruits identified as *P. bogneri* could actually represent *P. alboanthera*, since distinguishing between these two species remains difficult without flowers. We therefore propose to continue associating these fruiting specimens with *P. bogneri* until fruiting material clearly belonging to *P. alboanthera* becomes available.

Variation in leaf shape and size as well as in inflorescence length can be observed on material collected after Brenan described *P. bogneri*. Several collections show distinctly narrowly oblong leaves up to 25 × 6 cm (*Le Testu 1388*, *Louis 1451*, and *Wieringa et al. 7374*), which slightly exceeds the range in length (15–20 cm) described by Brenan (1984). Two other collections (*Breteler et al. 8117* and *Breteler et al. 12812*) represent another extreme, with largely oblong leaves measuring up to 30 × 9 cm. However, these collections correspond to *P. bogneri*, as delimted by Brenan, in all other features, such as inflorescence shape, leaf indumentum, and flower color. Moreover, leaf size and shape show a great range of variation among the 12 currently known collections of *P. bogneri* (Fig. 9). We regard these differences in leaf shape and size as part of the natural morphological variation within this species, as observed in many other members of the genus. Among the 12 collections, two have indumentum on the adaxial leaf surface comprising stiff trichomes, such as *Bidault et al. 3110* (with fruits) from the Kouilou region of the Republic of Congo, and *Le Testu 7520* (bearing flowers) from the Lastoursville region in Gabon. The first of these was available when Brenan described *P. bogneri*, but he apparently did not examine it as it was not cited in his study. Both collections show the same features and are most probably conspecific. No intermediates in pubescence have been observed between them and the 10 collections considered to represent typical *P. bogneri*, all of which have glabrous lamina, except for the

dense, short, appressed pubescence at the margins. Nevertheless, all other features of *Bidault et al. 3110* and *Le Testu 7520* correspond to Brenan's description of *P. bogneri*, and we are therefore reluctant to describe them as a new taxon at either the specific or infraspecific level solely based on differences in leaf indument, at least not until additional collections are available that confirm a clear gap indicating the presence of two distinct entities.

Palisota bogneri remains a rare, poorly known species, documented mainly from Gabon, with two collections from the Republic of Congo (*Bidault et al. 3110* and *Lejoly 96/1008*). A collection from Equatorial Guinea *(Senterre & Ngomo 896)* previously misidentified as *P. bogneri* actually belongs to another new species described below, *P. plicata*, so no material of *P. bogneri* is known from this country, although its presence there is plausible. The accumulation of new material since Brenan's work more than three decades ago has now led to the recognition of one morphologically similar and presumably related new species, and we suspect that more novelties resembling *P. bogneri* are yet to be found. Dried material of the four species that form rosette plants and have axillary inflorescences (*P. alboanthera*, *P. bogneri*, *P. ebo*, and *P. flagelliflora*) can be difficult to distinguish from collections of species characterized by a shortly creeping habit and axillary inflorescences. *Palisota flagelliflora* is easily recognizable when fertile by its long, flagelliform inflorescences, and *P. cristalensis*, *P. leewhitei* and *P. plicata* are recognizable by the distinctive pubescence or their short, erect axillary inflorescences. *Palisota ebo* can be distinguished by its long petioles and inflorescences with a single cincinnus.

The distinction between *P. akouangoui* and *P. bogneri* is much more problematic, as these two species have nearly identical inflorescences and can easily be confused based on their leaves. They, along with *P. repens*, occur in the same types of habitat and are often found growing together in Gabon. This can result in material of the two species being included under the same collection number, such as *Bidault et al. 1969* and *Schoenmaker 277*. The main difference between these two species involves their habit, *P. akouangoui* being a shortly creeping herb to 40 cm long, whereas *P. bogneri* is strictly a rosette when young, although older plants may have a rather robust stem to 10 cm covered with old leaf sheaths and the remains of roots, as seen in *de Wilde et al. 9835*. Among the specimens observed, we noted a relatively large proportion lacking the base of the plant, with no information on habit provided it in the label data. This is problematic because, as stated by Faden (1995) and confirmed by our observations, habit is a reliable and informative character for distinguishing groups of species. In the absence of information on habit, *P. akouangoui* and *P. bogneri* can be distinguished from one another by the following features: the presence (in *P. akouangoui*) vs. absence (in *P. bogneri*) of an erect portion of the stem; the inflorescence inserted on the erect portion of the stem above the litter (*P. akouangoui*) vs. at the base of the plant, i.e., at the ground level *(P. bogneri);* and the three yellow subequal stamens *(P. bogneri)* vs. unequal stamens, the lower one being more robust and apparently becoming green after dehiscence of the pollen sacs *(P. akouangoui)*. To facilitate identification of specimens, we recommend that plants systematically be collected with their base and that detailed information be provided on habit.

Notes on the decumbent species of Palisota

During the preparation of the treatment of *Commelinaceae* for the *Flore du Gabon*, two collections (*Sita 535* from Gabon and *Sita 3711* from the Republic of Congo) were found at P, where they had been identified in 2011 as "*Palisota* sp. nov.?" by Faden. Another specimen, *Ikabanga 173*, collected in 2013, proved to be of the same entity. These plants have a decumbent habit, long, developed stems with from 2 to 5 or 6 leaves borne in pseudowhorls at the nodes, densely covered with long, patent, rusty trichomes on the stems and sheaths, and bearing pubescent, terminal inflorescences comprising a subglobose thyrse on a short peduncle. This combination of features appears to be unique within the genus, and we therefore described this new entity below as *P. fadenii* Burg & E. Bidault.

Several recent collections from Gabon exhibit the same decumbent habit as *P. fadenii* but show striking differences in the indumentum of the stems and sheaths, as well as the length and type of pubescence of the inflorescence. In particular, *Ikabanga et al. 347*, *Stévart et al. 4842*, and *Texier et al. 282, 324, 1433* & *1648* all have a decumbent habit, with well-developed stems, leaves borne alternately on the stem and in pseudowhorls at the apex, as well as terminal, spiciform inflorescences entirely covered by a white, woolly pubescence. Two other colletions at WAG (*Breteler & Breteler 12192* and *van der Maesen 5833*) proved to belong to this same entity, which is described below as *P. stevartii* Burg & E. Bidault. The decumbent habit shared by these two new species, along with a third newly collected entity in Gabon that will be described soon (Faden, pers. comm.), is unique within *Palisota*. This feature was previously only known in *P. preussiana* K. Schum. ex C.B. Clarke, restricted to Mount Cameroon and Bioko, from which *P. stevartii* differs by its more slender, spiciform thyrse with protruding white bracts, and from which *P. fadenii* differs by its subglobose inflorescence and dense rusty pubescence on the stems and sheaths.

In this study, a total of 8 new species of *Palisota* are described, bringing the total to 32 currently recognized species, 19 of which have been recorded in Gabon. Nevertheless, we believe more discoveries remain to be made: many mysteries are yet to be solved, in particular involving herbarium specimens we could not link to any of the currently recognized species but are

not sufficient to describe additional species. Several mysterious taxa are also mentioned by authors such as Raponda-Walker & Sillans (1961), who succinctly describe an undetermined *Palisota* that doesn't seem to correspond to any described species but is not linked to any voucher specimen. A comprehensive revision of *Palisota* remains necessary. The present study represents a first step towards a taxonomic treatment of the genus and sets the stage for its inclusion in the *Flore du Gabon*.

Material and methods

During the preparation of the treatment of *Commelinaceae* for the *Flore du Gabon*, the first author collected numerous specimens of *Palisota* while conducting fieldwork in the country. Herbarium collections were made with as many duplicates as possible, and plant parts such as inflorescences bearing flowers at anthesis or fruits were preserved, when available, in 50 % ethanol for observation. Silica gel-preserved material was also collected and photos were taken of living plants in the field.

Herbarium material was examined at BR, BRLU, LBV, MA, MO, P and WAG, as well as images of types deposited at other institutions available through the JSTOR Global Plants website [http://plants.jstor.org]. Most recent collections from Gabon, Equatorial Guinea and São Tomé e Príncipe have duplicates at LBV, BATA and STPH, respectively, including all those resulting from work conducted by the Missouri Botanical Garden's West and Central Africa program. Only specimens seen by the authors are listed among material examined, but all known duplicates have been recorded in Tropicos (2019) and are also available at the *Flora de Guinea Ecuatorial* website [http://www.floradeguinea.com] for collections from that country.

Information on the distribution and habitat of each species is provided based on specimen label data and field observations made by the first author. Maps based on georeferenced specimen data were generated using the ArcGis software.

A preliminary assessment of conservation status using the IUCN categories and criteria (IUCN, 2012, 2017) is provided for each species. The geographical parameters of Area of Occupancy [AOO] and Extent of Occurrence [EOO], estimated using a 2 × 2 km grid, were calculated using the R package ConR (Dauby et al., 2017).

Key to the species of Palisota in Atlantic Central Africa

1. Plants creeping, decumbent, or forming a rosette 2
1a. Plants with an erect stem at least 50 cm tall 3

2. Plants generally rosettes (solitary or multiple aggregated), occasionnally with a stem up to 10(−30) cm long, sometimes horizontal on older individuals 9
2a. Plants strictly creeping or decumbent 16

Species erect, stem at least 50 cm high

3. Climbing herb up to 15 m, branched; sheaths generally with stiff, rusty trichomes; inflorescences lax, up to 30 cm long; flowers white or pale violet; fruits at first white, then waxy, blue, violet to black when ripe ..... ***P. thollonii***
3a. Herbs not climbing, in general not taller than 4 m 4

4. Inflorescences lax 5
4a. Inflorescences subglobose to spadiciform 7

5. Inflorescences comprising swollen cincinni, generally erect when fruiting; fruits white with apical purple stripes, turning completely dark purple at maturity, waxy, narrowly obovoid ..... ***P. ambigua***
5a. Inflorescences with spreading and unswollen cincinni; fruits spherical, not purple at maturity 6

6. Inflorescences more than 1 per terminal verticil, cylindrical, elongated, up to (12–)20–40 cm long, comprising 50–100 cincinni; sepals white, petals white with pink to purple spots; fruits purple tinted with red, turning dark blue to black at maturity, waxy (Guineo-Congolian) ..... ***P. hirsuta***
6a. Inflorescence solitary at the terminal verticil, spiciform, conical, up to 18(−25) cm long, comprising 20–30 cincinni; sepals and petals white to pale violet, flowers all erect on pedicels 1(−2) cm long, each cincinnus forming a unilateral raceme; fruits white turning orange to red at maturity (São Tomé, Annobón) ..... ***P. pedicellata***

7. Inflorescence more or less subglobose to slightly longer then wide, up to 3.5 cm long, generally 1 per verticil; cincinni erect and swollen; fruits bright red when mature ... ***P. brachythyrsa***
7a. Inflorescence spadiciform 8

8. Inflorescence 20–30 × 3–4(−5.5) cm ... ***P. schweinfurthii***
8a. Inflorescences generally smaller, 10–20 × 2–4 cm ..... ***P. alopecurus***

Species in rosette or basal composed rosettes

9. Inflorescences flagelliform, occasionally stoloniferous, up to 2 m long, comprising one to several erect thyrsi, each with one opposed bract and a single sessile cincinnus (Cameroon) ..... ***P. flagelliflora***
9a. Inflorescences not flagelliform, comprising a single thyrse bearing multiple cincinni 10

10. Inflorescences covered by abundant white grayish woolly pubescence; fruits carmine red, densely rusty to brown pubescent ..... ***P. lagopus***
10a. Inflorescences lacking white grayish woolly pubescence; fruits glabrous or with a few sparse trichomes 11

11. Inflorescences spadiciform ..... ***P. mannii***
11a. Inflorescences subglobose to oblong 12

12. Inflorescences with a persistent oval, leafy bract 5–15 mm wide, at least as long as the flowers, subtending each cincinnus, evident, enclosing the inflorescence ..... ***P. bracteosa***

12a. Bracts less than 4 mm wide, shorter than the flowers, barely visible at anthesis, not enclosing the inflorescence 13

13. Inflorescences terminal (located centrally in the rosette), erect ..... ***P. barteri***

13a. Inflorescences axillary, decumbent 14

14. Leaves to 12–15 cm long, with patent-pilose indument on the upper surface of the blade; inflorescences 1.5–7 cm long, lower stamen bearded; fruits dull yellow-brown, hidden below the leaf litter ..... ***P. ebo***

14a. Leaves 15–40 cm long, glabrous on the upper surface of the blade; inflorescences 4–14 cm long, lower stamen unbearded; fruits red, borne above the leaf litter 15

15. Flowers white, with 3 subequal, yellow stamens; leaves to ± 20 cm long ..... ***P. bogneri***

15a. Flowers pink to purple or violet, with 3 unequal stamens, the upper 2 yellow, the lower one white, more robust; leaves to 40 cm long ..... 2. ***P. alboanthera***

Species strictly creeping or decumbent

16. Inflorescences terminal 17

16a. Inflorescences axillary 20

17. Inflorescences subglobose, cincinni erect in fruit .... 4. ***P. fadenii***

17a. Inflorescences spadiciform, cincinni not erect in fruit 18

18. Inflorescences forming a lax elongated thyrse, white woolly pubescent throughout, bracts white, longer than the flowers ..... 8. ***P. stevartii***

18a. Inflorescences robust, lacking white woolly pubescence, bracts shorter than the flowers 19

19. Nodes covered by grayish pubescence, leaves glabrous except along the midrib; inflorescences with non-glandular trichomes, flowers mostly white (Cameroon, Bioko) ..... ***P. preussiana***

19a. Nodes covered with rusty pubescence, leaves with erect pubescence; inflorescences covered by short glandular trichomes; flowers purple (Gabon) .... **[sp. nov. Faden]** (cf. p. 200)

20. Inflorescences mostly erect, rarely pendulous, even in fruit 21

20a. Inflorescences decumbent, never erect 23

21. Plant covered on most parts with rusty to ginger-color, simple, erect trichomes ..... 3. ***P. cristalensis***

21a. Plant not covered by rusty to ginger-color, simple, erect trichomes 22

22. Leaves plicate, obovate to spathulate, 16–31 × (3.5–)5.5–10 cm, the base long-decurrent .... 6. ***P. plicata***

22a. Leaves not plicate, narrowly obovate to obovate-elliptic, 7–13 × 3.5–4.5 cm, the base cuneate ..... 5. ***P. leewhitei***

23. Creeping herbs to 2 m long; leaves regularly inserted all along the creeping, sometimes branched stem .... 7. ***P. repens***

23a. Creeping herb never exceeding 40 cm long, apical portion of stems erect; leaves borne in pseudowhorls on the aerial portion of the stem 24

24. Inflorescences branched, decumbent, with 1 cincinnus per branch (Cameroon) ..... ***P. satabiei***

24a. Inflorescences decumbent, never branched, forming a thyrse with multiple cincinni 25

25. Creeping herb never exceeding 40 cm long, apical portion of stems erect, to 20 cm tall; inflorescences inserted on the aerial portion of the stem, flowers with 3 unequal stamens, the lower one more robust, becoming green after dehiscence of the pollen sacs ..... 1. ***P. akouangoui***

25a. Plant generally forming a rosette, without an erect stem, or stem occasionally elongated and horizontal on the older plants; inflorescences inserted at ground level, flowers with 3 subequal, yellow stamens ..... ***P. bogneri***

Taxonomy

1. ***Palisota akouangoui*** E. Bidault & Burg, **spec. nova** (Fig. 1, 2A–C).

Holotypus: Gabon. Prov. Ngounié: Site Ramsar de Birougou, au N de Malinga, autour du village Moukembi, 02°02'36"S 12°10'01"E, 729 m, 25.III.2018, fr., *Bidault et al. 4100* (MO [MO-3047498]!; iso-: BR!, BRLU!, G [G00341282]!, K!, LBV!, LISC!, MA!, NY!, P!, US!, WAG!).

Palisota akouangoui E. Bidault & Burg most closely resembles P. satabiei Brenan but differs by its strictly unbranched, long-peduncled inflorescence comprising a thyrse composed of multiple cincinni bearing flowers with unequal stamens, the lower of which is larger.

Creeping and decumbent herb to 20–40 cm long (rarely longer), with erect stems 5–12 cm tall, in small gregarious subpopulations forming patches of individuals of various sizes. *Stems* white woolly pubescent at the apex, glabrescent, internodes to 2 cm long, 6–10 mm in diam. *in sicco*, brown to mauve *in vivo*, brownish *in sicco*, bearing profuse axillary roots, a few with abundant yellow root hairs, occasionally forming a cuff surrounding the sheath and stem. *Leaves* alternate, spirally arranged along the aerial part of the stem to pseudowhorled at the apex, absent or rarely present on the creeping

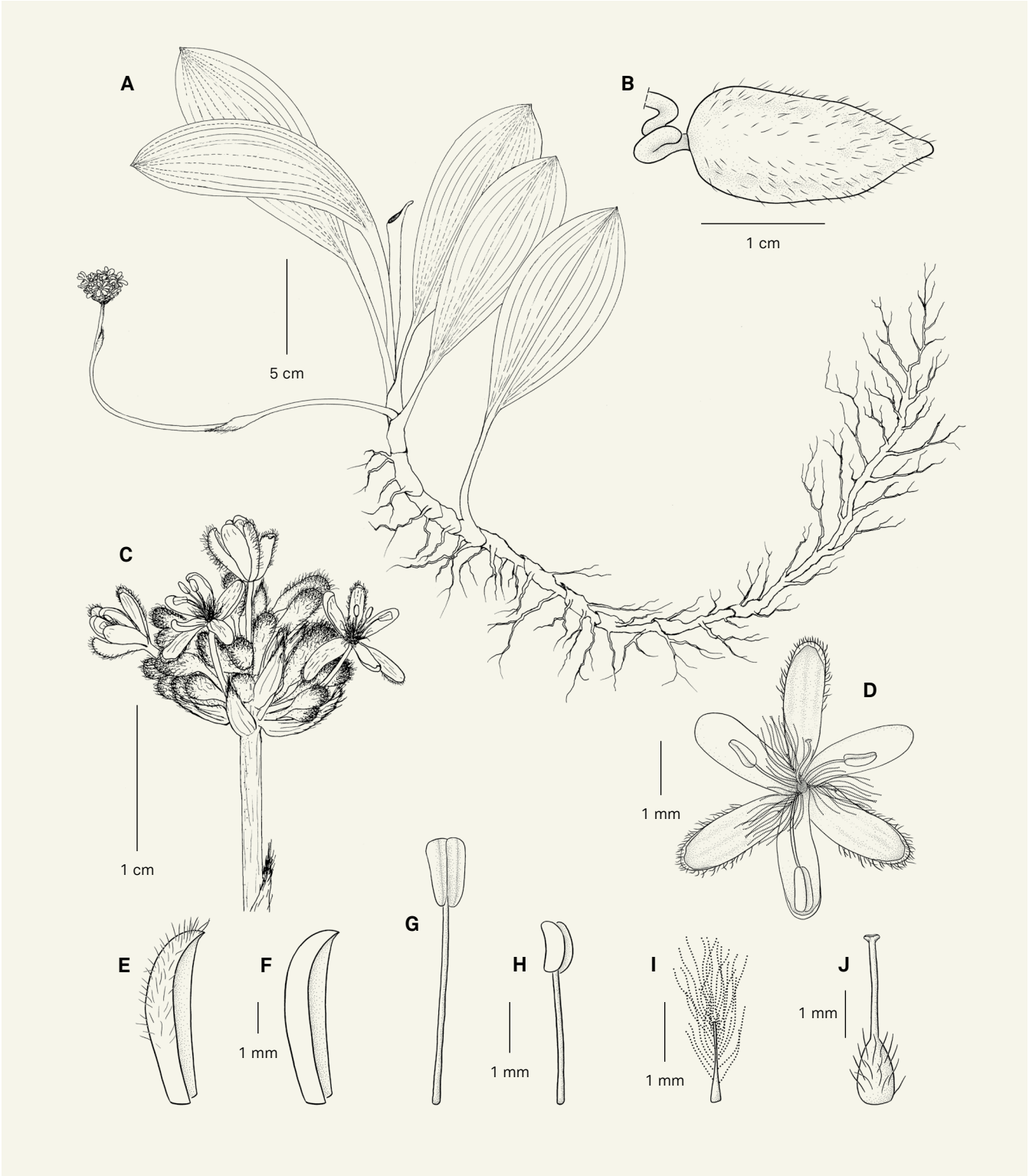


Fig. 1. – *Palisota akouangoui* E. Bidault & Burg. **A.** Habit; **B.** Mature fruit; **C.** Inflorescence; **D.** Bisexual flower; **E.** Sepal; **F.** Petal; **G.** Lower stamen; **H.** One upper stamen; **I.** Staminode; **J.** Ovary and pistil.
[**A:** *Bidault et al. 3687*; **B:** *Bidault et al. 4100*; **C-J:** *Bidault et al. 3785*] [Drawings: D. Geffard-Kuriyama & L. Longou]

part of the stem; sheath up to 3 cm long, long-attenuate on the pseudopetiole, open for a quarter to a third of its length, not swollen at the base; pseudopetiole 3–9 cm long, appressed white woolly pubescent, glabrescent, green to purple; lamina obovate-elliptic to spathulate, 11–25 × 4–9 cm, base narrowly cuneate, margins entire, with small appressed ginger-colored trichomes, apex rounded to obtuse-apiculate, white woolly pubescent on both surfaces when young, glabrescent, adaxial surface green to dark green, abaxial surface slightly lighter green, with prominent, green to purple primary venation. *Inflorescences* strictly axillary, borne on the aerial part of the stem, decumbent, 4–23 cm long, never branched, even in fruit, elongating as they mature; peduncle 3–20 cm long, woolly pubescent, glabrescent, pale green at anthesis, turning dark purple to black, with (2–)3 persistent bracts, 1.3–2 cm long, sheathing, acuminate, densely covered by rusty trichomes, glabrescent; the flowering portion of the inflorescence in a compact thyrse at anthesis, elongating as it matures, occasionally with a cuff of short roots with abundant white to yellow root hairs at the fruiting stage; thyrse ± 1.5 cm long at anthesis, to ± 3 cm long in fruit, with 4–5 bracts initially forming a pseudo-whorl at the base, later each subtending a cincinnus, caducous, narrowly triangular, 8–11 × 1.5–2 mm, with erect, rusty trichomes, more dense at the apex; cincinni 3–5, 1–3 mm long, with 3(–4) flowers, anthesis sequential, several cincinni often bearing an open flower at the same time. *Flowers* male and bisexual on the same inflorescence, buds pale pink at base, white elsewhere except the pale green apex, flowers 4–5 mm in diam., pedicel 1 cm long at anthesis, erect, becoming spirally contorted after flowering, perianth spread to reflexed at anthesis, then closing again. *Sepals* equal, oblong, apically concave, 5 × 2 mm, petaloid, transparent white with a greenish spot at the apex, with short, erect, white to brown trichomes on the abaxial surface, more dense at the apex. *Petals* similar to sepals, white, glabrous. *Staminodes* 3, filaments with long, white, spreading, moniliform trichomes, antherodes lacking. *Stamens* 3, unequal, erect, the two upper ones with a white filament 2–2.5 mm long, glabrous, anthers oblong, rounded, not curved, 0.8 × 0.5 mm, basifixed, yellow; the lower stamen more robust, filament white, 2.5–3 mm long, glabrous, anthers 1.2 × 0.6 mm, larger at the apex, sub-basifixed, pollen sacs slightly curved, pale yellow, becoming green after dehiscence. *Ovary* bottle-shaped to ellipsoid, 1.5 × 0.8 mm, with a few stiff trichomes, style 2.2 mm long, glabrous, white, curved at the apex, stigma truncate. *Fruits* usually borne above the litter, occasionally below, ovoid to ovoid-oblong berries, apex acute to clearly acuminate, 12–17 × 4–10 mm *in sicco*, beige-pink to brown-green when young, becoming bright red, with sparse, long, appressed pubescence, pedicel spirally contorted, becoming dark purple. *Seeds* depressed globose, with rounded and slightly flattened sides, ± 3.5 mm in diam., black *in vivo*, brownish grey *in sicco* due to the thin, pale brown, transparent arilloid that forms a skin, testa beneath smooth, with 20–30 very faint, flattened ribs surrounding the seed, shiny black, embryotega depressed, dark gray, hilum wart-like.

Etymology. – The species epithet honors Eric Akouangou, technician and field botanist at the *Herbier National du Gabon* [LBV], part of the *Institut de Pharmacopée et de Médecine Traditionnelle* [IPHAMETRA] of the *Centre National de la Recherche Scientifique et Technologique* [CENAREST]. In addition to co-managing a large collection of living orchids maintained in Libreville, he has been a co-collector of herbarium material comprising more than 7,500 numbers made in Gabon (7.5% of all collections from the country), including the type of this species. His jovial character, dedication to fieldwork and professionalism make him an important and efficient collaborator. Eric is thus acknowledged for his remarkable contribution to the knowledge of the Gabonese flora.

Distribution and ecology. – *Palisota akouangoui* is known from Cameroon (South province), Equatorial Guinea (Centro Sur), Gabon (7 provinces), and the Republic of Congo (Kouilou province) (Fig. 3). It grows in the understory of mature to secondary forests on *terra firme*, on slopes, ridges or near rivulets where the vegetation is not inundated. It is known from 10 to 850 m elevation.

Conservation status. – The EOO is 192,081 km^2, exceeding the threshold for "Vulnerable" under Criterion B1, and the AOO is estimated at 72 km^2, which is below the threshold for "Endangered" status under Criterion B2. *Palisota akouangoui* is known from 21 collections that represent 16 sub-populations, 3 of which are situated in protected areas, viz. *Parc National des Monts de Cristal* in Gabon, and *Parque Nacional de Monte Alén* in Equatorial Guinea. The main threat to this species are flooding associated with hydroelectric projets proposed on the Louétsi river in Ngounié province, oil exploitation in Rabi (Ogooué-Maritime), and forestry (Ogooué-Lolo, Woleu-Ntem, Estuaire and Nyanga provinces in Gabon, and Kouilou region in Congo). These sub-populations represent a total of 14 locations with respect to the most important threat (hydroelectric projects), which exceeds the upper limit for Vulnerable status. *Palisota akouangoui* therefore qualifies as "Least Concern" [LC] according to the IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. – The character of the lower anther becoming green after dehiscence of the pollen sacs has been observed in a single recent collection of *P. akouangoui (Bidault et al. 3785),* which was collected and photographed at the required developmental stage. We cannot, however, confirm whether this character is constant within the species, but material has been collected at this stage of the anther development from two



Fig. 2. – *Palisota akouangoui* E. Bidault & Burg (**A–C**) and *P. alboanthera* Burg & E. Bidault (**D–G**). **A.** Entire plants showing infrutescences; **B.** Mature fruits, entire and opened, showing seeds; **C.** Inflorescence showing open flowers, with green lower stamen; **D.** Living plant with inflorescence; **E.** Young inflorescence with male flowers, showing erect, pale yellow lower stamen; **F.** Bisexual flower with reflexed, white lower stamen; **G.** Detail of swollen roots. [**A–B:** *Bidault et al. 4100*; **C:** *Bidault et al. 3785*; **D–F:** *Bidault et al. 3807*; **G:** *Stévart et al. 4780*] [Photos: E. Bidault]

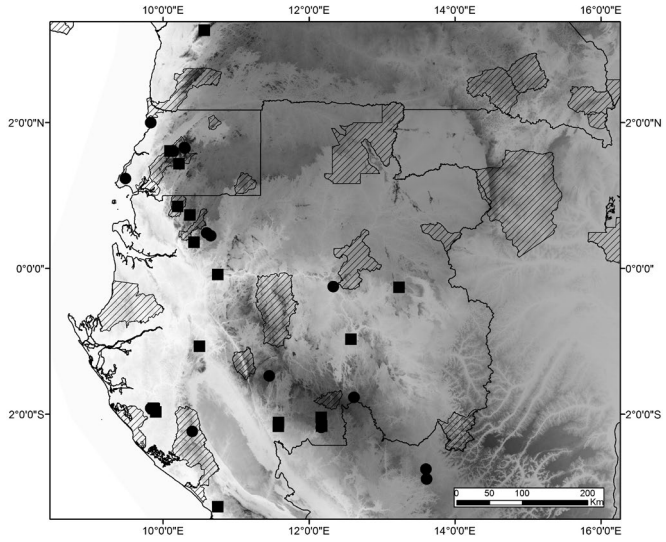


Fig. 3. – Distribution of *Palisota akouangoui* E. Bidault & Burg (squares) and *P. repens* E. Bidault & Burg (circles). Elevation is represented in levels of grey, and protected areas as shaded.

other species (*Bidault et al. 3717* for *P. bogneri*, *Texier et al. 1437* for *P. repens*), none of which shows as green coloration of the anther, which instead remains yellow. The occasional presence of a radicant cuff surrounding the infrutescence, which has sometimes been found under the leaf litter suggests possible vivipary and stoloniferous behavior. While vivipary has not yet been directly observed in *P. akouangoui*, it has been observed in *P. flagelliflora* (Faden, 1995). *Palisota akouangoui* resembles *P. bogneri, P. flagelliflora*, *P. repens* and *P. satabiei*, but can be distinguished from them by the combination of a shortly creeping habit, an unbranched, decumbent inflorescence, and unequal stamens, the lower one being more robust and becoming green after dehiscence of the pollen sacs. In addition to being a strictly rosette species, *P. flagelliflora* is characterized by long, creeping, flagelliform inflorescences bearing solitary cincinni; *P. bogneri* differs in having subequal, consistently yellow stamens. By its shortly creeping habit, *P. akouangoui* can be easily distinguished from *P. repens*, which is a long-creeping species, up to 2 m long, with leaves evenly distributed along the stem. *Palisota akouangoui* most closely resembles *P. satabiei*, with which it has historically been confused, but the latter has branched inflorescences, which is a robust structural character that is never found in *P. akouangoui*, which bears compact, (sub-)globose inflorescences on a rather stout peduncle. Two collections cited as paratypes in the protologue of *P. satabiei* (viz. *Satabie & Letouzey 384* and *407*) in fact represent material of *P. akouangoui*, as indicated by the presence of multiple cincinni on the unbranched inflorescence, whereas *P. satabiei* has solitary cincinni on each ramification of its inflorescence. In the field, *P. akouangoui* and *P. bogneri* often grow together and have occasionally been gathered under the same collection number. For example, *Schoenmaker 277* comprises two sheets deposited at WAG [WAG.1488450, WAG.1952609] that represent *P. bogneri*, whereas the specimen deposited at LBV [LBV0035326] clearly represents *P. akouangoui*, as indicated by the presence of an evident stem. Similarly, most material of *Bidault 1969* represents *P. bogneri*, but the sheet at BRLU is of *P. akouangoui*. A few collections examined could not be assigned with certainty to either one of these species. For instance, *Nguema 2879* could represent *P. bogneri* as it is apparently almost stemless, while it might instead belong to *P. akouangoui* due to its slightly elongated thyrse, but because the base of the plant is missing on every sheet, we were unable to provide a definitive identification.

Paratypi. – **Cameroon. Reg. South:** Massif de Ngovayang, 18 km W de Lolodorf, 03°16'00"N 10°34'00"E, 850 m, 3.II.1979, fl., *Satabié & Letouzey 384* (P); *ibid. loco*, 3.II.1979, fl., *Satabié & Letouzey 407* (P). **Equatorial Guinea. Prov. Centro Sur:** SE du Parc National de Monte Alén, au N du Rio Laña, près de la Cabaña Ecofac de Misergue, 01°26'11"N 10°13'09"E, 530 m, 29.I.2002, fl., *Senterre et al. 2102* (BRLU); SW du PN de Monte Alén, 2 km au NE du site de traversée du Rio Uolo pour aller au cataractas, 01°36'36"N 10°05'47"E, 800 m, 27.VI.2002, fr., *Senterre & Nguema 3091* (BRLU). **Gabon. Prov. Estuaire:** Monts de Cristal, concession SEEF, en bordure de la Foumana et de la Petite Tsibilé, 00°21'36"N 10°25'35"E, 132 m, 5.XI.2017, y. fr., *Bidault et al. 3563* (BR, BRLU, G, LBV, MO, P, WAG); Song, 29525 m on Transect F, 00°51'00"N 10°12'00"E, 335 m, 23.II.2001, fr., *Mayombo-Nzengue 436* (LBV, WAG). **Prov. Moyen-Ogooué:** 5–30 km NNW of Ndjolé, 00°05'00"S 10°45'00"E, 240 m, 23.IV.1992, fr., *Breteler et al. 11054* (WAG). **Prov. Ngounié:** Dibwangui, bords de la Louétsi, 02°06'45"S 11°35'07"E, 391 m, 13.XI.2017, fl., *Bidault et al. 3687* (BR, BRLU, LBV, MO, P); rte entre Dibwangui et Lebamba, 02°10'00"S 11°34'53"E, 360 m, 16.XI.2017, fl., *Bidault et al. 3785* (BR, BRLU, G, LBV, MO, P, WAG); Site Ramsar de Birougou, au N de Malinga, autour du village Mbengamamba, 02°09'48"S 12°10'25"E, 719 m, 23.III.2018, y. fr., *Bidault et al. 4065* (LBV, MO, P); 50 km SE of Lambaréné, 01°04'00"S 10°30'00"E, 155 m, 30.IX.1968, fl., *Breteler 5751* (WAG). **Prov. Nyanga:** 22 km along the road from Mayumba to Tchibanga, and then about 10 km along a forest exploitation track in an E direction, near the Doussa river, 03°16'00"S 10°45'00"E, 10 m, 7.XII.1986, fl., *de Wilde et al. 9205B* (MO, WAG). **Prov. Ogooué-Lolo:** Concession forestière SEEF, au SE du PN de l'Ivindo, à 80 km au NE de Lastoursville, 00°15'32"S 13°14'04"E, 527 m, 17.X.2015, fl., *Bidault et al. 1969B* (BRLU); c. 25 km on the road Lastoursville – Koulamoutou, 00°58'18"S 12°34'36"E, 250 m, 25.X.2005, fl., *Sosef et al. 2082* (LBV). **Prov. Ogooué-Maritime:** Rabi Kunga, 01°55'00"S 09°52'00"E, 50 m, 11.III.2002, fr., *Bourobou et al. 570* (LBV, WAG); *ibid. loco*, 01°58'00"S 09°54'00"E, 65 m, 5.XII.1991, fl., *Schoenmaker 277B* (LBV). **Prov. Woleu-Ntem:** Chantier Rougier Océan, Oveng, c. 25 km SW of Mintsic, 00°44'00"N 11°22'00"E, 590 m, 20.IX.1985, fl., *Reitsma & Reitsma 1495* (LBV); *ibid. loco*, 6.XI.1986, fl., *Reitsma et al. 2516* (LBV). **Republic of Congo. Prov. Kouilou:** Les Saras, piste Cofibois de Condé, 04°24'00"S 12°21'00"E, 200 m, 9.II.1988, fr., *de Foresta 1563* (P).

2. ***Palisota alboanthera*** Burg & E. Bidault, **spec. nova** (Fig. 2D–G, 4).

Holotypus: Gabon. Prov. Ngounié: Mabounié, Transect TS13, 00°46'39"S 10°33'57"E, 89 m, 13.XI.2013, fl., *Stévart et al. 4780* (BRLU!; iso-: BR!, LBV!, MO!, P!, WAG!).

Palisota alboanthera Burg & E. Bidault most closely resembles P. bogneri Brenan but differs by its overall more robust habit,



Fig. 4. – *Palisota alboanthera* Burg & E. Bidault. **A.** Habit; **B.** Inflorescence; **C.** Bisexual flower with reflexed, mature lower stamen; **D.** Male flower with reduced ovary; **E.** Sepal; **F.** Petal; **G.** Lower stamen; **H.** One upper stamen; **I.** Upper staminode; **J.** One lower staminode; **K.** Ovary and pistil; **L.** Staminodial hair; **M.** Ovary hair.
[**A:** *de Wilde & de Wilde-Bakhuizen 11713*; **B-M:** *Bidault et al. 1352*] [Drawings: H. de Vries]

purple to violet flowers, and unequal anthers, the upper two yellow, the lower one white or pale yellow.

Stemless rosette herb to 20–50 cm tall, with ± 10 leaves, in small gregarious subpopulations forming patches of individuals of various sizes; fibrous roots partially swollen at the apex, otherwise narrowly fusiform. *Leaves* in a pseudo-whorl; sheath ± 2–5 cm long, forming an acute angle with the pseudopetiole; pseudopetiole variable in length, up to 28 cm, canaliculate; lamina narrowly obovate, 14–27(–45) × 3–10(–15) cm, base long-decurrent to cuneate, margins entire, apex acuminate, glabrous on both surfaces except for small appressed ginger-colored trichomes on the margins, upper surface green to shiny dark green, lower surface with whitish primary venation. *Inflorescences* axillary, borne at the base of the plant, decumbent and erect at the apex, up to ± 10 cm, 8.5–24 cm long, unbranched; peduncle 7–14 cm long, 4–5 mm in diam., glabrous, pink to violet, with 3(–4) persistent leafy ovate acute bracts of the same color, 1–3 × 0.5–2 cm; thyrse dense, globose, 1.5–2.5 cm in diam., to oblong, 4–10 × 1.5–2.5 cm; cincinni 3–5 mm long, elongating to ± 1.5 cm at maturity, erect, each bearing ± 6 flowers. *Flowers* either all male, functionally male, or functionally female on the same inflorescence, bud pale pink to dark purple, flower 5–7 mm in diam., pedicel 6–9 mm long, erect at anthesis, becoming spirally contorted after flowering, perianth reflexed after anthesis, then closing again. *Sepals* equal, oblong, slightly concave, 3–4 × 1 mm, petaloid, pale pink to violet, glabrous or with a few purple to violet trichomes at the apex on the abaxial surface. *Petals* similar to sepals, slightly more translucid, glabrous. *Staminodes* 3, filaments with long, white, apparently beaded, spreading trichomes, antherodes lacking. *Stamens* 3, unequal, erect, filaments white, the two upper ones with a glabrous filament 2–3 mm long, anthers oblong, slightly curved, 1.5 × 0.8 mm, basifixed, yellow; the lower stamen more robust, filament 3–3.5 mm long, glabrous, anther 1.5 × 1.2 mm, dorsifixed, white, occasionally pale yellow, pollen sacs curved, reniform, pollen same color as the anther, anther indehiscent on functionally female flowers. *Ovary* ovoid, 1.5 × 0.8 mm, glabrous, white to dark violet, style 3 mm long on the female flower, stylode truncated on the male flower, glabrous, pale pink to violet on the basal two third of its length, pale pink toward the apex, stigma truncate. *Fruits* not seen.

Etymology. – The species epithet refers to the white anther of the lower stamen in the flowers of this taxon. While white anthers are not uncommon in *Palisota*, this species is the only one we are aware of that has two yellow anthers and a single white one.

Distribution and ecology. – *Palisota alboanthera* appears to be endemic to Gabon, where it is known from Moyen-Ogooué, Ngounié, Ogooué-Ivindo and Ogooué-Lolo provinces (Fig. 5). It grows in the understory of mature to secondary forests on *terra firme*, occasionally on rocky slopes, more often in low areas and close to rivers, but not on inundated ground. It is known from 27 to 840 m elevation.

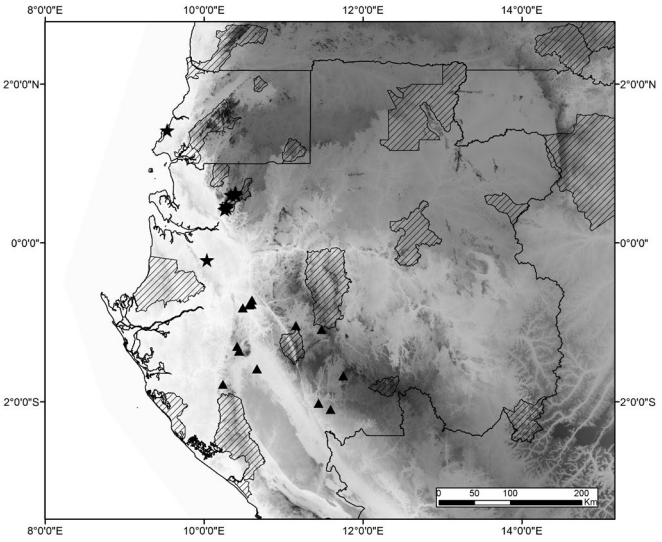


Fig. 5. – Distribution of *Palisota cristalensis* E. Bidault & Burg (stars) and *P. alboanthera* Burg & E. Bidault (triangles). Elevation is represented in levels of grey, and protected areas as shaded.

Conservation status. – The EOO is 16,574 km^2, below the threshold for "Vulnerable" status under Criterion B1, and the AOO is estimated at 52 km^2, which is below the threshold for "Endangered" status under Criterion B2. *Palisota alboanthera* is known from 13 collections, all made in the south-central part of Gabon between 1924 and 2017. While the oldest of these, *Le Testu 5106*, was collected nearly a century ago, we consider that the sub-population it represents is likely to persist today as the area still shows significant forest cover. These 13 collections represent 9 sub-populations. One of these, located at Mabounié, 45 km SE of Lambaréné, is in a mining concession, where exploitation has been planned but is not currently being developed. Two additional collections, representing one sub-population, were made in the Koumounabouali range near Fougamou, where selective logging has been practiced in the past and is still occurring today. Another collection, representing one sub-population, comes from a forestry concession (held by CBG – *Compagnie des Bois du Gabon*) located 25 km W of Mandji, and we documented yet another sub-population in 2017 in the vicinity of the Louétsi river in Nougnié province, on the site of a planned hydroelectric project, which is expected to lead to its extirpation. The 9 sub-populations represent 9 locations with respect to the most important threat (hydroelectric projects), none of which are located in protected areas. *Palisota alboanthera* is thus threatened by forestry, mining, and the development of a hydroelectric project,

leading to projected decline of its EOO, AOO, the quality of its habitat, number of locations and number of mature individuals. *Palisota alboanthera* therefore qualifies as "Vulnerable" [VU B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)] according to the IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. – *Palisota alboanthera* closely resembles *P. bogneri* by its rosette habit and axillary decumbent inflorescence, but can be distinguished by its more robust habit and pink to purple (vs. white) flowers with three unequal stamen, the lower one becoming white (vs. all stamens yellow). No collections of *P. alboanthera* have been observed that contain both fruits and flowers, and without floral characters, it can be difficult to distinguish this species from *P. bogneri*. We believe that *Dauby et al. 1688* represents a fruiting collection of *P. alboanthera*, due to its large size compared to typical *P. bogneri*, as well as its axillary inflorescence, differentiating it from *P. barteri*, whose inflorescences are erect and terminal. However, other smaller-sized plants have been collected that we could not assign with confidence to either *P. alboanthera* or *P. bogneri*, such as *Wieringa et al. 7374*. In the absence of information on the base of the plant, *P. alboanthera* can be confused with *P. akouangoui*. *Leal et al. 1863*, for instance, probably represents *P. alboanthera*, but is not cited below as a paratype because the absence of the base of the plant precludes identifying it with certainty. Variation in the color of the flowers and the anther of the lower stamen was observed on a recent collection *(Bidault et al. 3807),* and two individuals from this subpopulation with young and old inflorescences, respectively, were photographed and collected. The young inflorescence bore pink flowers with erect stamens, the lower one being larger and pale yellow, an inflorescence of intermediate age exhibited dark pink (or pale purple) flowers with erect anthers, the lower one being clearly white, whereas the oldest inflorescence had dark purple flowers with reflexed anthers, the lower one being white. This variation could be correlated with floral function: the young inflorescence had functionally male flowers (dehiscence of the lower anther was observed) with a truncated stylode the intermediate-aged inflorescence had functionally male flowers without a style or ovary (although dehiscence of the lower anther was not observed), and the oldest inflorescence comprised functionally female flowers with a fully developed style and deposited pollen, and the dehiscence of the lower anther was not observed. These observations were, however, made at a single time and may not be fully representative of flowering within this species (no living plants have been cultivated). More detailed field observations could reveal functionally bisexual flowers, shown either by maturation of the female features of younger flowers or dehiscence of the anther in the lower stamen of older flowers.

Paratypi. – Gabon. **Prov. Moyen-Ogooué:** Mabounié, à 45 km au SE de Lambaréné, rives de la Ngounié, 00°49'05"S 10°29'12"E, 27 m, 14.X.2012, fl., *Bidault et al. 815* (LBV, MO); *ibid. loco*, 00°43'04"S 10°36'09"E, 123 m, 17.XI.2013, fl., *Bidault et al. 1352* (BR, BRLU, LBV, MO). **Prov. Ngounié:** Mabounié, à 45 km au SE de Lambaréné, rte menant au NE de la concession, 00°46'10"S 10°35'50"E, 84 m, 30.X.2014, fl., *Bidault et al. 1869* (BR, BRLU, LBV, MO); Dibwangui, bords de la Louétsi, en remontant vers les rapides, 02°05'49"S 10°35'34"E, 406 m, 17.XI.2017, fl., *Bidault et al. 3807* (BR, BRLU, LBV, MO, P); road from Mandji into CBG concession, 20–25 km W of Mandji, sentier botanique, 01°46'48"S 10°14'12"E, 97 m, 12.XI.2011, fl., *Maas et al. 10262* (WAG); forêt des Echiras, entre Pagha et Luoutèti, 26.XI.1924, fl., *Le Testu 5106* (P); Divinde, 01°02'22"S 11°09'21"E, 419 m, 16.X.2012, fl., *Towns & Ongoda 1329* (WAG); 26.8 km on road Lébamba to Yeno, 02°01'12"S 11°26'30"E, 230 m, 12.XI.1994, fl., *Wieringa et al. 3163* (WAG); 13.5 km on the road Moukabou to Mbigou, 01°40'22"S 11°45'11"E, 840 m, 13.III.2013, y. fr., *Wieringa 7397* (WAG); SW of Fougamou, Koumounabwali massive, 01°18'00"S 10°25'00"E, 250 m, 11.XII.1995, fl., *de Wilde et al. 11549* (LBV, MO, WAG); massif de Koumounabouali, 01°21'42"S 10°26'30"E, 420 m, 9.XII.1996, fl., *de Wilde & de Wilde-Bakhuizen 11713* (LBV, WAG). **Prov. Ogooué-Lolo:** Mont Iboundji, 01°05'24"S 11°28'48"E, 600 m, 8.II.2000, fl., *Sosef et al. 654* (LBV, WAG).

3. ***Palisota cristalensis*** E. Bidault & Burg, **spec. nova** (Fig. 6, 7A–D).

   Holotypus: Gabon. **Prov. Estuaire:** Monts de Cristal, basse-vallée de la Mbé, rive Est, 00°26'18"N 10°17'11"E, 203 m, 28.X.2017, fl., *Bidault et al. 3379* (MO [MO-3047497]!; iso-: BR!, BRLU!, G [G00341283]!, LBV!, P!, WAG!).

   Palisota cristalensis E. Bidault & Burg most closely resembles P. leewhitei Burg, O. Lachenaud & E. Bidault but differs by the combination of a more robust habit, its straight, erect rusty pubescence on the stems, inflorescences, petioles, upper surface of the lamina and primary venation on the lower surface of the lamina, and its erect inflorescence oriented parallel to the petiole.

   Creeping and decumbent herb, with erect stems ± 10–20 cm tall, in small gregarious subpopulations forming patches of up to ten individuals of various sizes, covered on all its parts by erect, stiff, rusty to ginger-colored, 3–9 mm long trichomes, except for the glabrous abaxial surface of the lamina. *Stems* fleshy, internodes 0.5–5 cm long, 5 mm in diam. *in sicco*, light green *in vivo*, brownish *in sicco*, bearing axillary roots growing through the sheath base, one of them elongated, glabrous, 1.5 mm in diam., the others short, covered with abundant yellow root hairs, forming a cuff surrounding the sheath and stem. *Leaves* alternate, spirally arranged along the aerial part of the stem; sheath 7–15 mm long, open for half to four fifths of its length, with brown margins, swollen at the base, forming a whitish-green bulge; pseudopetiole 2.5–5 cm long, bright green; lamina obovate-elliptic to narrowly elliptic, 11–25 × 3–7.5 cm, base acute to cuneate, margins entire, glabrous, adaxial surface green to dark green, abaxial surface lighter green, glabrous except for the primary venation with the same stiff, rusty to ginger-colored trichomes observed on other parts. *Inflorescences* strictly axillary, borne on the aerial

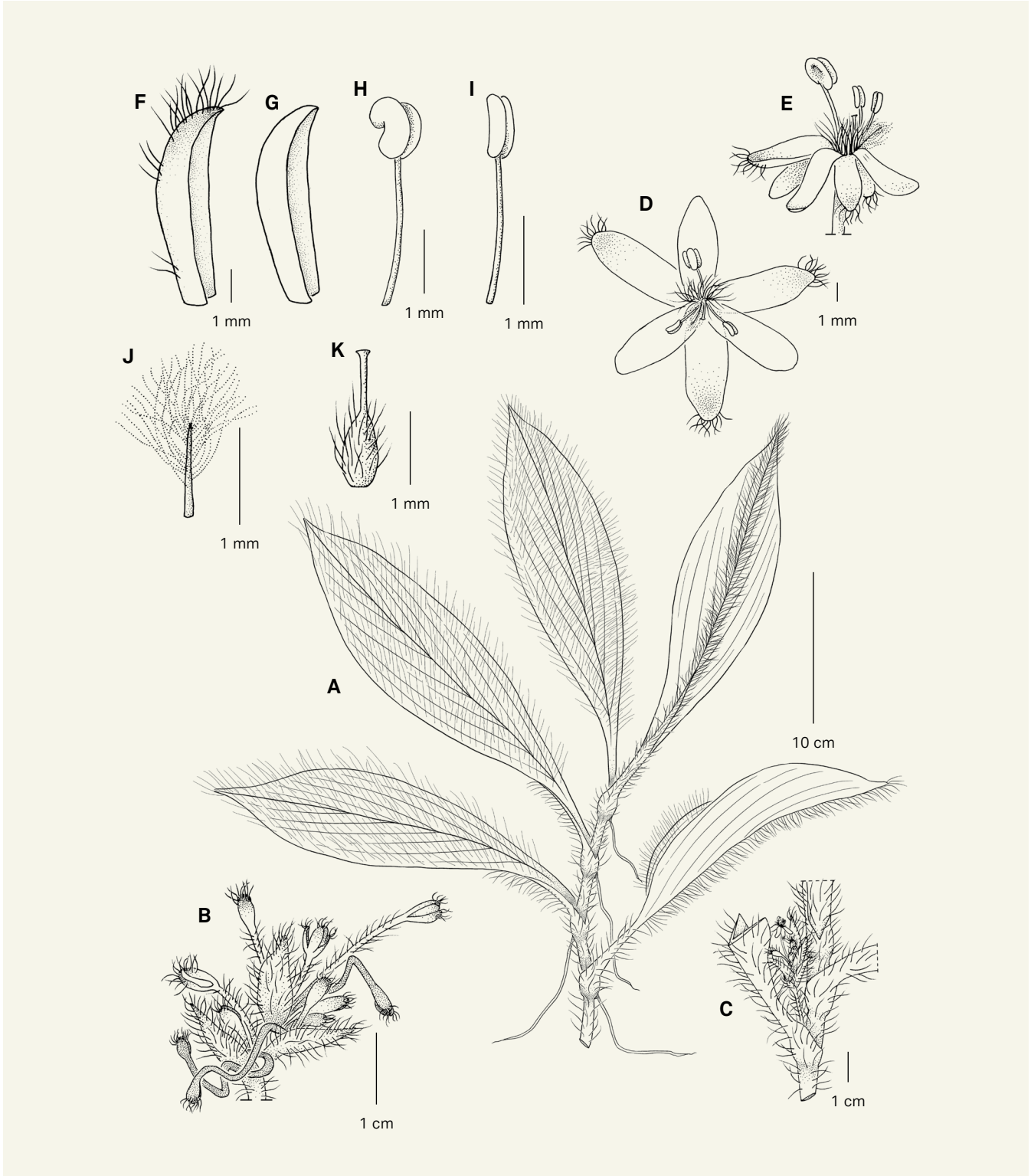


Fig. 6. – *Palisota cristalensis* E. Bidault & Burg. **A.** Habit; **B.** Inflorescence; **C.** Portion of stem with inflorescence; **D.** Bisexual flower from above; **E.** Bisexual flower, side view; **F.** Sepal; **G.** Petal; **H.** Lower stamen; **I.** One upper stamen; **J.** Staminode; **K.** Ovary and pistil. [**A, D-K:** *Bidault et al. 3379*; **B-C:** *Bidault et al. 3309*] [Drawings: L. Longou]



Fig. 7. – *Palisota cristalensis* E. Bidault & Burg (**A–D**) and *P. fadenii* Burg & E. Bidault (**E–F**). **A.** Living plant in habitat; **B.** Inflorescence showing closed flowers; **C.** Detail of an open flower; **D.** Detail of pubescence on the upper side of the lamina; **E.** Detail of an open bisexual flower showing the reflexed lower stamen still in place, and the two upper stamens removed; **F.** Detail of an open bisexual flower from the outside, showing the reflexed lower stamen still in place, one of the upper stamens, and the calyx with one larger sepal.
[**A, C:** *Bidault et al. 3379*; **B, D:** *Bidault et al. 3309*; **E–F:** *Sita 535*] [Photos: **A–E:** E. Bidault; **F:** W.J. van der Burg]

part of the stem, erect, covered by the sheath for about 1.5 cm, then following the axis of the pseudopetiole, occasionally up to the base of the lamina, 4.5–5 cm long at anthesis, never branched; peduncle 1–4 cm long, with 2 persistent bracts, sheathing, acuminate, 1 cm long; the flowering portion with 3–6 additional bracts, each subtending a cincinnus, broadly to narrowly ovate, acuminate, 7–15 × 2–6 mm; cincinni sessile, with ± 4 flowers, anthesis sequential, only one flower open at a time per inflorescence. *Flowers* male and bisexual, 8–8.5 mm in diam., pedicel 12–16 mm long at anthesis, shorter in bud, erect at anthesis, becoming spirally contorted after flowering, perianth spread to sub-reflexed at anthesis, then closing again. *Sepals* equal, oblong, 6 × 2 mm, petaloid, white with a pale green spot and brown-ochre to purple trichomes at the apex of the abaxial surface. *Petals* similar to sepals, 6 × 2–2.5 mm, glabrous, white. *Staminodes* 3, filaments with long white to pale yellow spreading trichomes, antherodes lacking. *Stamens* 3, unequal, erect, filaments white, the two upper ones with a filament 1.6–1.8 mm long, glabrous, anthers oblong, curved, 1.5 × 0.6–0.7 mm, sub-basifixed, yellow; the lower stamen more robust, filament 2.5 mm long, glabrous, anthers 2 × 2 mm, pollen sacs curved, reniform, dorsifixed. *Ovary* bottle-shaped to ellipsoid, 1 × 0.5 mm, obscurely pubescent, style 1.7 mm long, glabrous, white at base, brown-ochre at the apex, stigma truncate. *Fruits* irregularly ovoid, slightly oblique berries, weakly triangular in transverse section, green becoming bright red, 15–19 × 9–12 mm *in sicco*, with sparse, thin, erect rusty trichomes, apex more or less acuminate, pedicel spirally contorted, becoming dark purple. *Seeds* triangular-ovoid, 3.5 × 3 × 3 mm, shallowly and finely puckered and with numerous (up to ± 40) faint, irregular ribs; operculum/embryotega small, slightly raised, round, hilum minute, in plane with the dark grayish brown testa.

Etymology. – The species epithet refers to the Cristal Mountains in Gabon, where most specimens of this species have been collected.

Distribution and ecology. – *Palisota cristalensis* is known from Gabon (Estuaire and Woleu-Ntem provinces) and Equatorial Guinea (Rio Muni). Most specimens (8) have been collected in the Cristal Mountains in Gabon, one came from the Ndote Reserve in Equatorial Guinea, and one is known from south of the Komo river, near the Remboué river (Fig. 5). It grows in the understory of mature to secondary forests on *terra firme*, on slopes and nearby rivers, but not on inundated ground. It is known from 40 to 555 m elevation.

Conservation status. – The EOO is 6,320 km², above the upper threshold for "Endangered" status under Criterion B1, and the AOO is estimated at 32 km², at lower end of the range for "Endangered" status under Criterion B2. *Palisota cristalensis* is known from 10 collections, 8 of which were made in the Cristal Mountains, both inside and outside the National Park (Mbé sector), near the Kinguélé and Tchimbélé hydroelectric dams on the Mbé river, all after the completion of dam construction. One collection was gathered at an oil exploitation concession in 1991 near the Remboué river, south of the Komo river, in Estuaire province, and another one was made in the Ndote Reserve in Equatorial Guinea in 1998. These 11 collections represent 4 sub-populations. The sub-population located at the Remboué drilling site is threatened by oil exploitation, and that located near Kinguélé in the Mbé valley in Cristal Mountains, though situated in the National Park, is threatened by the planned development of a hydroelectric dam on the Mbé river, which is expected to lead to its extirpation. Despite being located outside the National Park, there is no evidence of an existing threat to the sub-population located near Tchimbélé in the Cristal Mountains. The 4 sub-populations represent 4 locations with respect to the most important threat (hydroelectric projects). This species is threatened by oil exploitation and the development of a hydroelectric project, leading to projected decline of its EOO, AOO, quality of its habitat, number of locations and number of mature individuals. *Palisota cristalensis* therefore qualifies as "Endangered" [EN B2ab(i,ii,iii,iv,v)] according to the IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. – Despite its abundance in the Cristal Mountains, where 8 specimens were collected starting thirty years ago, *P. cristalensis* has never been recognized as separate from *P. satabiei*. This is probably due to the morphologically broad description of *P. satabiei* provided by Brenan (1984) and to his inclusion of *Hallé & Villiers 5310* from the Cristal Mountains, described as having profuse long, patent rusty trichomes on the petiole, leaf margins and upper side of the lamina, a collection that we have not located at P, but which we suspect could be of *P. cristalensis*. Nevertheless, *P. cristalensis* differs from *P. satabiei* by its short, erect inflorescence, and its peculiar pubescence, which we now know does not fall within the range of variation of *P. satabiei*. *Palisota cristalensis* more closely resembles *P. leewhitei* by its habit and short, erect inflorescence bearing sessile cincinni, but can be easily distinguished from it by its pubescence and an overall more robust habit.

Paratypi – **Equatorial Guinea. Prov. Litoral:** Ndote AP, rte forestière Engong - [?], 01°25'00"N 09°32'00"E, 40 m, 37.VII.1998, st., *Lejoly & van Asbroek 32* (BRLU). **Gabon. Prov. Estuaire:** Monts de Cristal, Kinguélé, basse-vallée de la Mbé, 00°25'13"N 10°15'26"E, 96 m, 26.X.2017, fl., *Bidault et al. 3309* (BR, BRLU, LBV, MO, P, WAG); Parc des Monts de Cristal, vers le pont de Kinguélé, 00°28'07"N 10°16'36"E, 120 m, 5.XI.2015, fl., *Boupoya & Issembé 1159* (LBV, MO); Plateforme de forage Remboué 1, 00°13'00"S 10°02'00"E, 40 m, 21.I.1991, fl., *Louis & Moungazi 3288* (LBV, MO); side road at km 46 of road from Kougouleu to Méla, just within PN Monts de Cristal, 00°36'18"N 10°20'12"E, 104 m, 21.XI.2011, fl., *Maas et al. 10428* (WAG); Cristal Mountains, 1 km W of Tchimbélé, 00°37'00"N 10°24'00"E, 450 m,

16.XII.1989, fl., *Wieringa 234* (LBV, MO, WAG); 1 km WNW of Tchimbélé, on the bank of Bingiligwen river, 00°37'00"N 10°23'00"E, 460 m, 12.V.1990, fr., *Wieringa 904* (LBV, WAG). **Prov. Woleu-Ntem:** Cristal Mountain, 00°36'00"N 10°24'00"E, 500 m, 15.XI.2000, y. fr., *Nguema Miyono 1335* (LBV, MO, WAG); 3 km from hydroelectric compound at Tchimbélé, 00°37'54"N 10°23'25"E, 555 m, 14.XI.2002, fl., *Strijk 346* (LBV, MO, WAG).

4. ***Palisota fadenii*** Burg & E. Bidault, **spec. nova** (Fig. 7E–F, 8).

Holotypus: Gabon. Prov. Haut-Ogooué: région de Moanda, forêts et galerie aux env. de Mounana, [01°25'S 13°13'E], c. 400 m, 3.I.1962, fl. & y. fr., *Sita 535* (P [P06836329]!; iso-: BRLU!, G [G00341284]!, MO [MO-3029909]!, P [P06836328, P06836338]!, WAG!).

Palisota fadenii Burg & E. Bidault most closely resembles P. brachythyrsa Mildbr., P. thollonii Hua and P. preussiana K. Schum. ex C.B. Clarke, but differs from them by its smaller stature, densely hairy inflorescences forming a globose, compact thyrse, and by the long, stiff, ginger-colored trichomes on its leaf sheaths and stems.

Erect or decumbent herb to 30–50 cm tall, not rooting at nodes, rarely branched. *Stems* with erect, rusty to ginger-colored trichomes ± 1–2 cm long, more dense on the nodes and sheaths, internodes (8–)10–20 cm long, 2–4 mm in diam., brownish *in sicco*. *Leaves* 1–2 on nodes, reduced, and (2–)3–4(–6) in a terminal pseudowhorl, larger; sheath 8–18 mm long, generally open to the swollen base; pseudopetiole 2–5 cm long; sheaths and pseudopetiole densely covered by erect, rusty to ginger-colored trichomes 1.5–3 cm long; lamina largely elliptic, 10–13.5 × 4–6.5 cm, base cuneate, margins entire with small appressed ginger-colored trichomes, apex acuminate, adaxial surface white puberulous to pubescent with erect, brown, stiff trichomes, abaxial surface densely brownish pubescent, especially on the primary venation. *Inflorescences* strictly terminal, 1 per apical verticil, erect, 4–8 cm long, simple; peduncle 1.5–3(4.5) cm long, with 1 persistent peduncular bract, sheathing, acuminate, densely covered by rusty to ginger-colored trichomes; the flowering portion in a subglobose thyrse 3–4.5(–6) cm in diam., with a few more bracts, each subtending a cincinnus, persistent, narrowly triangular, 6–10 mm long; cincinni spreading at anthesis then erect in fruit, with dense, fuzzy, rusty to brown pubescence, with ± 6 flowers, anthesis sequential, several cincinni often bearing an open flower at the same time. *Flowers* male and bisexual, pinkish when in bud, brownish at anthesis, 5–7 mm in diam., pedicel 2–5 mm long, erect at anthesis, densely pubescent. *Sepals* subequal, the 2 lower ones oblong-elliptic, 2 × 0.75 mm, the upper one ovate, 2 × 2 mm, with brown-ochre trichomes covering the abaxial surface. *Petals* equal, elliptic, rounded at the apex, 2 × 1 mm, glabrous. *Staminodes* 3, 1 mm long, filaments with long, yellow, spreading trichomes, antherodes lacking. *Stamens* 3, unequal, erect, the two upper ones with a filament 1.5 mm long, glabrous, anthers flattened, ellipsoid, slightly curved, 0.9 × 0.5 mm, ± 0.1 mm thick, basifixed, yellow; the lower stamen with a filament 1 mm long, glabrous, anther obovate-oblong, 0.9–1 × 0.7–1 mm, ± 0.3 mm thick, curved at the apex. *Ovary* obovoid, 0.5–0.75 mm long, densely pubescent, the trichomes 1 mm long, style 2.5–3 mm long, glabrous, pale lilac, stigma clavate. *Fruits* ovoid berries, apex acuminate, ± 5 mm in diam. *in sicco*, densely pubescent, red when mature, bearing ± 4 seeds. Mature seeds not seen.

Etymology. – This species is named in honor of Dr. Robert B. Faden of the Smithsonian Institution (US), who in 2011 identified the two collections known at the time as belonging to an undescribed taxon, and in recognition of the immense contribution he has made to our knowledge of *Commelinaceae* around the world.

Distribution and ecology. – *Palisota fadenii* is known from Gabon (Haut-Ogooué and Estuaire provinces) and Republic of Congo (Kouilou province) (Fig. 9). Only three collections have been made over a 50 year period, and this species thus appears to be rare. It grows in the understory of secondary *terra firme* forest (*Ikabanga et al. 173*) or gallery forest (*Sita 535*). It is known from 50 to 400 m elevation.

Conservation status. – The EOO is 82,827 km², greatly exceeding the threshold for "Vulnerable" status under Criterion B1, and the AOO is estimated at 12 km², at the lower end of the range for "Endangered" status under Criterion B2. *Palisota fadenii* is known from 3 collections representing 3 sub-populations: one from Kouilou province in Republic of Congo in 1974 *(Sita 3711);* one from the Moanda region in Haut-Ogooué province, collected in 1962 *(Sita 535)*; and one from near Libreville collected in 2011 *(Ikabanga et al. 173)*. We consider that the sub-population represented by *Sita 3711* has not been extirpated because the area is still largely forested and is now included within a National Park (Conkouati-Douli NP). The sub-population in the Moanda region is located near a mine site, but not within the footprint of the current mining operations. Nevertheless, it is in the direct vicinity (200 meters) of a plateau that will be subjected to mining in the near future. As a consequence, this sub-population is believed not to have been extirpated as yet, but it is threatened by the future development of the mine. The sub-population located near Libreville (Malibé 2) is situated outside the boundaries of the Mondah Forest Reserve and hence is not protected from threats associated with urbanization that has drastically increased over the last few decades in the area and is still increasing today. The persistence of this subpopulation is doubtfull and it could be regarded as extirpated. Each of the 3 sub-populations is represented by a single collection, and together they represent 2 or 3 locations with respect to



Fig. 8. – *Palisota fadenii* Burg & E. Bidault. **A.** Habit; **B.** Inflorescence; **C.** Bisexual flower; **D.** Upper sepal; **E.** One lower sepal; **F.** Petal; **G.** One upper stamen; **H.** Lower stamen; **I.** Staminode; **J.** Ovary and pistil.
[*Sita 535*] [Drawings: D. Geffard-Kuriyama & L. Longou]

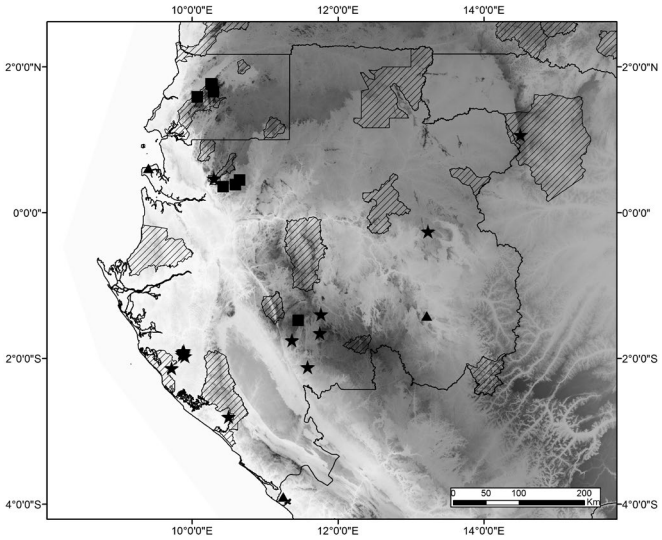


Fig. 9. – Distribution of *Palisota bogneri* Brenan (stars), *P. plicata* E. Bidault & Burg (squares), and *P. fadenii* Burg & E. Bidault (triangles). Elevation is represented in levels of grey, and protected areas as shaded.

the most important threat (urbanization). *Palisota fadenii* is highly threatened by urbanization and mining activities, which have led to or will likely lead to the extirpation of two sub-populations, and thus an inferred and projected decline in its EOO, AOO, quality of its habitat, number of locations, and number of mature individuals. *Palisota fadenii* therefore qualifies as "Endangered" [EN B2ab(i,ii,iii,iv,v)] according to the IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. – *Palisota fadenii* is the rarest species treated in this study and has never been photographed in the field. The description of the color of the flower is based on the notes accompanying *Sita 3711*, and only few open flowers were present on the herbarium specimens observed. The disjunction in the distribution of this species (350 and 500 km separate the known subpopulations) and the fact that it has been found in coastal as well as continental areas is striking, especially since many *Palisota* collections have been made in Gabon during the last few decades. In addition to its overall rareness, the paucity of collections of this species could also be explained by its unusual phenology, with flowering taking place in January and fruiting in March and April. *Palisota fadenii* is easily recognizable among the decumbent species by its subglobose thyrse bearing red fruits. Nevertheless, it resembles *P. brachythyrsa* in sharing these features, although the latter species belongs to the group of free-standing *Palisota* with a robust stem. *Palisota fadenii* can also be distinguished from *P. brachythyrsa* by its thyrse being at least as wide as long and bearing multiple elongated cincinni giving it a clearly subglobose shape, whereas *P. brachythyrsa* has a shortly elongated thyrse with only a few cincinni that remain short, even in late fruiting stages, giving it an irregular shape.

Paratypus. – **Gabon. Prov. Estuaire:** Libreville, Canton Tsini-Otandé, villages Malibé 2, 00°36'30"N 09°24'08"E, 50 m, 17.III.2011, fr., *Ikabanga et al. 173* (LBV, MO). **Republic of Congo. Prov. Kouilou:** P.C.A. de N'Zambi, rte N'Gongo, à 5 km de N'Tiétié, [03°54'S 11°15'E], c. 50 m, 30.IV.1974, fr., *Sita 3711* (P).

5. ***Palisota leewhitei*** Burg, O. Lachenaud & E. Bidault, **spec. nova** (Fig. 10, 11A–C).

Holotypus: Gabon. Prov. Estuaire: Forêt Classée de la Mondah, 00°34'27"N 09°20'02"E, 20 m, 3.III.2011, fr., *Lachenaud et al. 1165* (BR!; iso-: LBV!, MO!).

Palisota leewhitei Burg, O. Lachenaud & E. Bidault differs from all other Palisota species by the combination of a creeping habit, long, ginger-colored trichomes on the margins of the canaliculate pseudopetiole, and the short inflorescences barely emerging from the leaf litter, hidden under the leaves and among the roots.

Creeping and decumbent herb, stems on or partially hidden in the litter, erect portion ± 10–15 cm tall, subpopulations forming patches completely covering the ground; stems 5 mm in diam., purple, bearing abundant roots growing through the sheath base, covered with yellow root hairs and forming a cuff surrounding the stem. *Leaves* alternate, spirally arranged along the shoot, a few aggregated at the apex; sheath ± 12 mm long, open for half its length, purple, barely or not swollen at base; pseudopetiole short, 1–2 cm, canaliculate, green or brown to purple, bearing long ginger-colored trichomes at the margins; lamina narrowly obovate to obovate-elliptic, 7–13 × 3.5–4.5 cm, margins entire with small appressed ginger-colored trichomes, these becoming longer and stiff towards lamina base; upper surface bright green, shiny, lower surface lighter green, dull. *Inflorescences* strictly axillary, hidden under the stems and leaves or in the litter among the roots, or barely emerging, ± 5 cm long, simple, peduncle short, with 1 basal bract, widely ovate, with long indument at the apex, the peduncle bearing ± 3 similar pseudowhorled bracts along with several more linear bracts, indument of equal density, with ± 5 terminal flowers borne in 1 or 2 cincinni. *Flowers* male and bisexual, ± 10 mm in diam., white in bud and at anthesis, pedicel 15–20 mm long, becoming spirally contorted after flowering and turning purplish, woolly pubescent and also with a few stiff trichomes, perianth reflexed after anthesis, then closing again. *Sepals* sub-equal, oblong, 6 × 2 mm, petaloid, the upper one slightly shorter and more robust, white to greenish white, pinkish at the apex of the abaxial surface, with a few wrinkled trichomes. *Petals* similar to sepals, 6 × 2(–2.5) mm, but glabrous and totally white. *Staminodes* 3, filaments with long, white, spreading trichomes, antherodes lacking. *Stamens* 3, unequal, clearly erect, filaments white, the two upper ones with a filament 1.6–1.8 mm long, glabrous, anthers oblong, curved, 1.5 × 0.6–0.7 mm, sub-basifixed, yellow; the lower

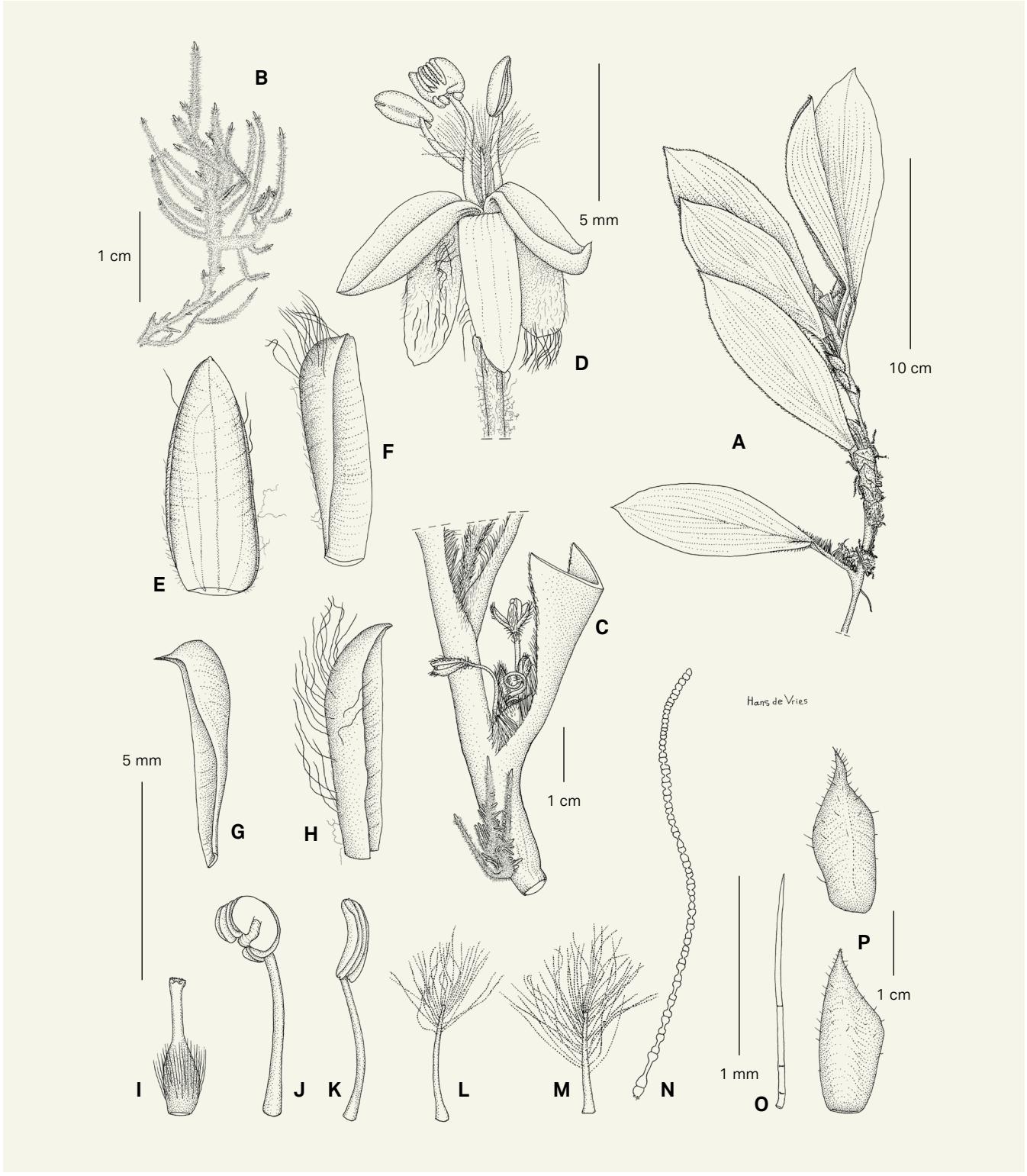


Fig. 10. – *Palisota leewhitei* Burg, O. Lachenaud & E. Bidault. **A.** Habit; **B.** Axillary root; **C.** Portion of stem with inflorescence, axillary roots, pseudopetiole; **D.** Male flower; **E.** Sepal, interior view; **F.** Upper sepal, side view; **G.** Petal, side view; **H.** Lower sepal, side view; **I.** Ovary and pistil; **J.** Lower stamen; **K.** One upper stamen; **L.** Upper staminode; **M.** One lower staminode; **N.** Staminodial hair; **O.** Ovary hair; **P.** Fruit, side and dorsal views.
[**A–O:** *Maas et al. 10079*; **P:** *Lachenaud et al. 1165*] [Drawings: H. de Vries]



Fig. 11. – *Palisota leewhitei* Burg, O. Lachenaud & E. Bidault (**A–C**) and *P. plicata* E. Bidault & Burg (**D–G**). **A.** Living plants in habitat; **B.** Inflorescence showing capillary roots, open and closed flowers; **C.** Mature fruit; **D.** Living plants in habitat; **E.** Inflorescence with open flowers; **F.** Detail of an open flower; **G.** Mature fruit. [**A, C:** *Lachenaud et al. 1165*; **D–E:** *Bidault et al. 3561*; **F–G:** *Bidault et al. 3576*] [Photos: **A, C:** O. Lachenaud; **B:** J.-P. Vande Weghe; **D–G:** E. Bidault]

stamen more robust, filament 2.5 mm long, glabrous, anthers 2 × 2 mm, pollen sacs curved, yellow, reniform, dorsifixed. *Ovary* bottle-shaped to ellipsoid, 1.5 × 0.8 mm, with a few stiff trichomes, style 1.5 × 0.3 mm, glabrous, white, stigma truncate. *Fruits* ovoid, slightly oblique berries, red, weakly triangular in cross section, 2–2.5(–2.7) × 1 cm, with a few stiff apical trichomes, pedicel spiraled. *Seeds* ellipsoid, 4 × 3 mm, covered by a thin, pale brown, transparent arilloid skin, testa beneath smooth with 20–30 very faint grooves, embryotega depressed, round, light gray, hilum wart-like, situated in a depression.

Etymology. – This species is named after Prof. Lee White, former Executive Secretary of the *Agence Nationale des Parcs Nationaux* (ANPN), the Gabonese National Parks Agency, and now Minister of Forest, Sea, and the Environment, in recognition of his work towards the protection of biodiversity in the Mondah forest and in Gabon in general. Prof. White was also one of the first person to collect material of *Palisota leewhitei*.

Distribution and ecology. – *Palisota leewhitei* is endemic to Gabon and is known only from the Mondah forest, a protected area a few kilometers northwest of Libreville, where it is locally abundant (Fig. 12). This species has been recorded in low elevation (2 to 20 m) *terra firme* hyper-humid forest, where it forms dense, ground-covering patches.

Conservation status. – The EOO cannot be calculated since this species is known from a single sub-population, and the AOO is estimated at 8 km^2, below the threshold for "Critically Endangered" status under Criterion B2. *Palisota leewhitei* is known from 6 collections, all made between 1992 and 2018 in the Mondah Forest Reserve, which represent a single sub-population. The most recent collection dates from 2018, confirming that the sub-population has not been extirpated. Although it is located within a protected area, with on-site documentation to inform the public of its narrow-endemic status, *P. leewhitei* is subjected to the effects of human activities and may be impacted by stochastic events within a very short time period, such as illegal land clearing or logging in the Mondah forest, that could rapidly result in a change of status to Critically Endangered or could even render it Extinct. *Palisota leewhitei* therefore qualifies as "Vulnerable" [VU D2] according to the IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. – *Palisota leewhitei* resembles other member of the genus bearing short, erect inflorescences and exhibiting the same habit, such as *P. cristalensis* and *P. plicata*. It can, however, be distinguished from this latter by its smaller, not plicate leaves, its purple petiole with erect stiff trichomes, and its shorter inflorescences. Though we have not been able to examine the sterile collection *Aké Assi 16101* cited by Brenan (1984) as belonging to *P. satabiei*, we suspect it could represent *P. leewhitei* based on the description of the pubescence provided by Brenan (long rusty trichomes on the petiole, lamina glabrous except for an appressed pubescence on the margins) and the fact that it was collected in the Mondah forest, in which case it would be the first collection of this species. *Palisota leewhitei* was recognized to be a new species by the late C. Wilks, who pointed it out to Prof. White, long before we began studying *Palisota*. M.E. Leal, who previously worked for the Missouri Botanical Garden in Gabon, collected material of *P. leewhitei*, duplicates of which were sent to the Smithsonian Institution, where R. Faden confirmed that it was a taxonomic novelty, although he never formally published it. The species was subsequently collected and photographed multiple times by several botanists and naturalists who visited the Mondah forest, including by Prof. White, who encouraged several researchers working in Gabon at the time (including M. Leal, G. McPherson, T. Stévart and G. Walters) to describe it. Finally, O. Lachenaud collected material in 2011 that has been designated as the type, and drew to the attention of the authors the fact that it was a taxonomic novelty. The Mondah *Palisota* has been depicted in several books (Vande Weghe, 2005; Vande Weghe et al., 2016) as an example of the many narrowly endemic species restricted to the Libreville peninsula (Walters et al., 2016).

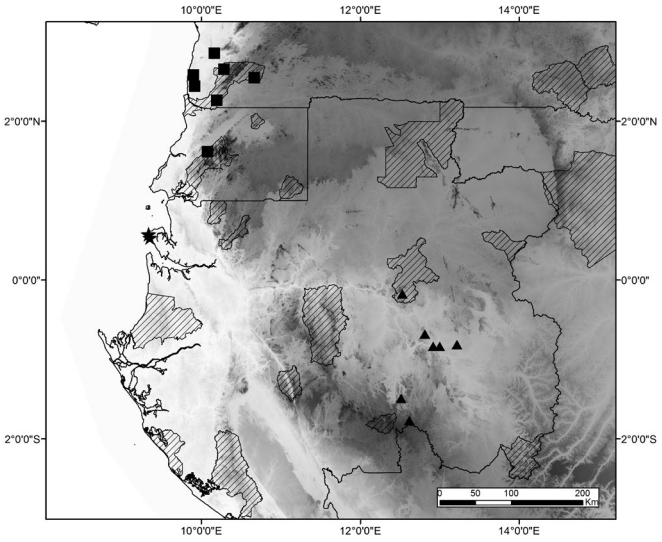


Fig. 12. – Distribution of *Palisota satabiei* Brenan (squares), *P. leewhitei* Burg, O. Lachenaud & Bidault (stars), and *P. stevartii* Burg & E. Bidault (triangles). Elevation is represented in levels of grey, and protected areas as shaded.

Paratypi. – **Gabon. Prov. Estuaire:** Forêt de la Mondah, NNW of Libreville, 00°31'59"N 09°20'59"E, 20 m, 29.II.1992, fr., *Breteler 10867* (WAG); *ibid. loco*, 11.IV.2006, fr., *Leal et al. 1032* (MO); *ibid. loco*, 3.XI.2011, fl., *Maas et al. 10079* (WAG); *ibid. loco*, 2.XI.2014, fl., *White s.n.* (BRLU); *ibid. loco*, 20.X.2018, fl., *White s.n.* (BRLU, LBV, MO).

6. ***Palisota plicata*** E. Bidault & Burg, **spec. nova** (Fig. 11D–G, 13).

Holotypus: Gabon. Prov. Estuaire: Monts de Cristal, Concession SEEF, rive E du Komo, 00°23'13"N 10°35'37"E, 548 m, 6.XI.2017, fl. & fr., *Bidault et al. 3576* (MO [MO-3047496]!; iso-: BR!, BRLU!, G [G00341285]!, LBV!, P!, WAG!).

Palisota plicata E. Bidault & Burg most closely resembles P. leewhitei Burg, O. Lachenaud & E. Bidault but differs by the combination of its plicate, obovate leaves, longer inflorescences bearing flowers above the litter, swollen stems at the insertion of the sheath, and an overall more robust habit.

Creeping and decumbent herb, rhizome-like rooting stem to 30 cm long, occasionally dichotomous, with an erect apical portion ± 10–15 cm tall, in small gregarious subpopulations forming patches of individuals of various sizes. *Stems* fleshy, shortly brown woolly pubescent, glabrescent, internodes 0.5–3.5 cm long, 5–7 mm in diam. *in sicco*, light green or dark mauve *in vivo*, brownish *in sicco*, bearing axillary roots not growing through the sheath base, covered with abundant yellow root hairs, occasionally forming a cuff surrounding the sheath and stem. *Leaves* alternate, spirally arranged along the aerial part of the stem, in an apical pseudoverticil; sheath 7–15 mm long, open for a quarter to a third of its length, occasionally to its swollen base that forms a whitish-green or dark mauve bulge, sometimes longitudinally striped; pseudopetiole absent or to 5 cm long, if present bearing long, ginger-colored trichomes on the margins; lamina obovate to obovate-elliptic, 16–31 × (3.5–)5.5–10 cm, base long-decurrent, plicate, margins entire, with small, appressed, ginger-colored trichomes, secondary venation prominent on both surfaces, upper surface green to dark green, whitish woolly sericeous when young, glabrescent, lower surface glaucous green to glaucous silver, persistent whitish woolly sericeous. *Inflorescences* strictly axillary, always borne on the aerial part of the stem, erect to rarely pendulous, 3–5 cm long, simple; peduncle 1–1.3 cm long, with (2–)3 persistent peduncular bracts, sheathing, acuminate, margins densely covered by ginger-colored trichomes; the flowering portion with a few more bracts, each subtending a cincinnus, caducous, narrowly triangular, up to 1 cm long; cincinni with ± 6 flowers, anthesis sequential, several cincinni often bearing an open flower at the same time. *Flowers* bisexual, 9–10 mm in diam., pedicel 12–15 mm long, erect at anthesis, becoming spirally contorted after flowering, perianth sharply reflexed at anthesis, then closing again. *Sepals* equal, oblong, 5–6 × 1.5–2 mm, petaloid, white with brown-ochre trichomes at apex on the abaxial surface. *Petals* similar to sepals, 4.5 × 1.5–2 mm, glabrous. *Staminodes* 3, filaments with long, white, spreading trichomes, antherodes lacking. *Stamens* 3, unequal, erect, filaments white, the two upper ones with a filament 2.8–3 mm long, glabrous, anthers oblong, curved, 1.5 × 0.8 mm, sub-basifixed, yellow; the lower stamen more robust, filament 3–3.2 mm long, glabrous, anthers 1.5 × 1.2 mm, pollen sacs curved, reniform, sub-basifixed. *Ovary* bottle-shaped to ellipsoid, 1.5 × 0.8 mm, with a few stiff trichomes, style 2.5 mm long, glabrous, yellowish white, stigma truncate, white. *Fruits* irregularly ovoid, slightly oblique berries, weakly triangular in transverse section, green becoming bright red, 11–15 × 6–7 mm *in sicco*, with sparse, thin, erect pubescence, apex more or less acuminate, pedicel spirally contorted, becoming dark purple. *Seeds* globose or polygonal with rounded and flat sides, ± 4 mm in diam., black *in vivo*, brown *in sicco* due to the thin, pale brown, transparent arilloid skin, testa beneath smooth, with 20–30 clearly marked, rounded, shallow ribs surrounding the seed, light gray, embryotega markedly depressed, whitish, hilum wart-like, situated in an evident depression.

Etymology. – The epithet of this species refers to the plicate character of the leaves.

Distribution and ecology. – *Palisota plicata* is known from five collections made in *Parque Nacional de Monte Alén* in Equatorial Guinea, three collections from in the Cristal Mountains in Estuaire province, Gabon, and one from Ngounié province in Gabon (Fig. 9). It grows in the understory of mature to secondary hyper-humid forests on *terra firme*, on slopes, ridges or nearby rivers, but not in inundated areas. It is known from 132 to 1,200 m elevation.

Conservation status. – The EOO is 9,106 km², within the range for "Vulnerable" status under Criterion B1, and the AOO is estimated at 28 km², which is within the range for "Endangered" status under Criterion B2. *Palisota plicata* is known from 9 collections, representing 6 sub-populations, 3 of which are located in the *Parque Nacional de Monte Alén*. Two sub-populations were collected in the *Société Equatoriale d'Exploitation Forestière* (SEEF) logging concession in the Cristal Mountains, both of which are threatened by logging activities, and one is also by flooding associated with a planned hydroelectric dam on the Komo river, which is expected to lead to its extirpation. These 6 sub-populations represent 4 locations with respect to the most important threat (a hydroelectric project). *Palisota plicata* is threatened by forestry in Ngounié province and the Cristal Mountains, and flooding associated with the development of a hydroelectric project, also in the Cristal mountains, which are projected to lead in the future to the decline of its EOO, AOO, quality of habitat, number of locations, and number of mature individuals. *Palisota plicata* therefore qualifies as "Endangered" [EN B2ab(i,ii,iii,iv,v)] according to the IUCN Red List Categories and Criteria (IUCN, 2012).



Fig. 13. – *Palisota plicata* E.Bidault & Burg. **A.** Habit; **B.** Inflorescence; **C.** Bisexual flower, side view; **D.** Sepal; **E.** Petal; **F.** Lower stamen; **G.** One upper stamen; **H.** Ovary and pistil; **I.** Staminode; **J.** Mature fruit; **K.** Immature fruit with exocarp removed, showing immature seeds; **L.** Sketches of leaf base variation.
[**A, D-J, L (right):** *Bidault et al. 3576*; **B-C, L (left):** *Bidault et al. 3561*; **K:** *Bidault et al. 3514*] [Drawings: L. Longou]

Notes. – *Palisota plicata* resembles other species with short-trailing stems that are erect at the apex and with axillary inflorescences, such as *P. akouangoui*, *P. cristalensis*, *P. leewhitei*, and *P. satabiei*, but the plicate nature of the leaves makes it unique in the genus. In fertile condition, *P. plicata* is also easily distinguished from *P. akouangoui* and *P. satabiei* by its mostly erect (rarely pendulous but never decumbent) and strictly unbranched inflorescences. It differs from *P. cristalensis* by the absence of rusty, erect pubescence on all parts, and from *P. leewhitei* by the combination of plicate, obovate leaves, longer inflorescences, swollen stems at the insertion of the sheath, and an overall more robust habit. A sterile herbarium specimen collected in Cameroon *(Kaji 101)* examined at P could represent this species, but in the absence of flowers and fruits, we are not able to assign it there with confidence. *Palisota plicata* is thus currently unknown from Cameroon, but its presence there would not be surprising.

Paratypi. – **Equatorial Guinea. Prov. Centro Sur:** SO du Parc National de Monte Alén, sur le transect Ecofac de Mosuma à 4300 m du début du layon, au sommet de la dernière colline du transect, 01°35'28"N 10°04'17"E, 750 m, 17.III.2001, st., *Senterre & Ngomo 896* (BRLU, MA); Monte Alén PN, près de la piste longeant par le le transect dit de Monte Alén, 01°39'38"N 10°17'36"E, 1200 m, 12.III.2002, fr., *Senterre et al. 2807* (BRLU); N du PN de Monte Alén, à proximité du transect Ecofac de Monte Chocolate, vers 1500 m de l'origine, 01°45'44"N 10°16'29"E, 750 m, 16.XI.2002, fl., *Senterre & Ngomo 3457* (BRLU); N du Parc National de Monte Alén, 2 km au NW du transect Ecofac de Monte Chocolate, vers 1500 m de l'origine, 01°46'09"N 10°15'37"E, 850 m, 25.XI.2002, fl., *Senterre & Ngomo 3575* (BRLU); *ibid. loco*, 25.XI.2002, fl., *Senterre & Ngomo 3576* (BRLU). **Gabon. Prov. Estuaire:** Monts de Cristal, concession SEEF, en bordure de la Foumana et de la Petite Tsibilé, 00°21'36"N 10°25'35"E, 132 m, 5.XI.2017, fl. & fr., *Bidault et al. 3561* (BR, BRLU, LBV, MO, P); Monts de Cristal, concession SEEF, rive est du Komo, 00°27'00"N 10°39'09"E, 519 m, 3.XI.2017, fr., *Bidault et al. 3514* (BRLU, LBV, MO, P, WAG). **Prov. Ngounié:** Eteke to Ovala, 01°28'30"S 11°27'18"E, 750 m, 8.XI.1994, fl., *Wieringa et al. 3112[B]* (WAG).

7. ***Palisota repens*** E. Bidault & Burg, **spec. nova** (Fig. 14, 15A–D).

Holotypus: Gabon. Prov. Ogooué-Lolo: Monts Birougou, Ramsar area, Maranda I village, 20 km S of Pana, 01°46'05"S 12°36'59"E, 715 m, 5.XII.2017, fl., *Texier et al. 1437* (MO [MO-3047495]!; iso-: BR!, BRLU!, LBV!, P!, WAG!).

Palisota repens E. Bidault & Burg most closely resembles P. akouangoui E.Bidault & Burg and P. satabiei Brenan, but differs by the combination of a creeping stem up to 2 m long bearing regularly distributed leaves, and inflorescences that are shorter (compared to P. akouangoui) and unbranched (unlike in P. satabiei).

Creeping herb to 0.5–2 m long, occasionally branched, with apically erect stems ± 4–5 cm tall, in small gregarious subpopulations forming patches of individuals of various sizes. *Stems* fleshy, wine-red to mauve, woolly white-grayish to rusty pubescent, caducous on the older stems, internodes 2–5(–10) cm long, 2.5–6 mm in diam. *in sicco*, bearing axillary roots growing through the sheath base, covered with abundant yellow root hairs, never forming a cuff surrounding the sheath and stem. *Leaves* alternate, regularly distributed along the creeping stem, rarely if ever in an apical pseudoverticil; sheath 11–20 mm long, bent to a 90° angle such that the pseudopetiole is perpendicular to the stem, open for half of its length, occasionally to the swollen base, forming a bulge; pseudopetiole (2–)4–6 cm long; lamina obovate to obovate-elliptic, (7–)10–18 × 3–6 cm, base long-cuneate, flat to slightly plicate, margins entire, with small, appressed, rusty to ginger-colored trichomes, apex with acumen 5–12 mm long, adaxial surface green to dark green, abaxial surface bright to glaucous green, both surfaces whitish woolly sericeous when young, glabrescent. *Inflorescences* strictly axillary, rarely geotropic when borne on the apical aerial part of the stem, more often plagiotropic and borne on the creeping portion, 2.5–6(–8) cm long, simple; peduncle 1–3 cm long, with 2–4 persistent peduncular bracts, 8–10(–14) × 3–5 mm, always one at the base of the peduncle, sheathing, acuminate, rusty woolly pubescent to glabrous; the flowering portion with a few more bracts, each subtending a cincinnus, caducous, oblong-lanceolate, pubescent, up to 10 × 5 mm; cincinni sessile or subsessile, with 2–3 flowers, anthesis sequential, several cincinni often bearing an open flower at the same time. *Flowers* male and bisexual, 8–10 mm in diam., pedicel 4–5 mm long, erect at anthesis, becoming spirally contorted after flowering, covered with brown-ochre trichomes, perianth spread at anthesis, then closing again. *Sepals* equal, oblong, 6 × 2 mm, petaloid, white with dense brown-ochre trichomes on the abaxial surface. *Petals* similar to sepals, glabrous. *Staminodes* 3, filaments with long, white, spreading trichomes, antherodes lacking. *Stamens* 3, unequal, erect, filaments white, the two upper ones with a filament 2–2.5 mm long, glabrous, anthers cylindrical, with a rounded base and apex, 2 × 0.8 mm, sub-basifixed, yellow; the lower stamen more robust, filament of the same length, glabrous, anthers 2.2 × 1.6 mm, pollen sacs slightly curved. *Ovary* bottle-shaped to ellipsoid, 1 × 0.5 mm, glabrous, style 2.5 mm long, glabrous, white to pale pink, stigma truncate. *Fruits* irregularly ovoid, slightly oblique berries, weakly triangular in transverse section, dark mauve to black, becoming bright red, 1 × 0.6 cm *in sicco*, with sparse, thin, erect pubescence, apex acuminate, pedicel spirally contorted, becoming dark purple. *Seeds* 4, depressed globose, angular, with rounded and slightly flattened sides, ± 2.5 × 3.5 mm, testa smooth, with 20–30 rather faint, flattened ribs, dull dark brown, embryotega round and slightly depressed, the same color as the testa, hilum constricted, wart-like.

Etymology. – The species epithet refers to the distinctive creeping habit of this taxon, which is the only known member



Fig. 14. – *Palisota repens* E. Bidault & Burg. **A.** Habit; **B.** Inflorescence; **C.** Bisexual flower; **D.** Mature fruit; **E.** Immature fruit; **F.** Sepal; **G.** Petal; **H.** Ovary and pistil; **I.** Lower stamen; **J.** One upper stamen; **K.** Staminode.
[**A:** *Bidault et al. 3506*; **B–C, F–K:** *Texier et al. 1437*; **D–E:** *Bidault et al. 4405*] [Drawings: L. Longou]



Fig. 15. – *Palisota repens* E. Bidault & Burg (**A–D**) and *P. stevartii* Burg & E. Bidault (**E–G**).
A. Apical part of creeping stem showing evenly distributed leaves; **B.** Portion of stem showing curved petiole, root borne in opposition, shortly decumbent inflorescence with closed flowers; **C.** Immature fruit; **D.** Inflorescence with two open flowers, the right one being an aberrant 4-stamened flower; **E.** Detail of inflorescence with cincinni and closed flower; **F.** Open flower; **G.** Flowered axis.
[**A, C:** *Bidault et al. 3981*; **B:** *Bidault et al. 3506*; **D:** *N. Texier et al. 1437*; **E:** *Stévart et al. 4842*; **F:** *Texier et al. 1648*; **G:** *Ikabanga et al. 347*]
[Photos: **A–C:** E. Bidault; **D, F:** N. Texier; **E:** T. Stévart; **G:** D. Ikabanga]

of *Palisota* to be strictly creeping over long distances (up to 2 meters), rooting at the nodes, and with leaves regularly inserted along the stem.

Distribution and ecology. – *Palisota repens* is known from Gabon, Equatorial Guinea (Rio Muni) and Republic of Congo (Lékoumou province). In Gabon, it has been collected in Estuaire, Ngounié, Ogooué-Ivindo and Ogooué-Maritime provinces (Fig. 3). It grows in the understory of mature to secondary forests, on slopes, ridges or low areas nearby rivers, but never on inundated ground. It is known from 35 to 1170 m elevation.

Conservation status. – The EOO is 128,388 km², far exceeding the threshold for "Vulnerable" status under Criterion B1, and the AOO is estimated at 60 km², within the range for "Endangered" status under Criterion B2. *Palisota repens* is known from 15 collections, representing 13 sub-populations, 2 of which are situated within the *Parque Nacional de Monte Alén* in Equatorial Guinea, and one within the Moukalaba-Doudou National Park in Gabon, all of which are thought to persist today. The main threats to this species are flooding associated with the construction of hydroelectric projects in the Cristal Mountains, oil exploitation in Rabi (Ogooué-Maritime), and forestry in the Cristal Mountains, as well as in Ogooué-Ivindo, Ogooué-Maritime and Ngounié provinces. These sub-populations represent a total of 12 locations with respect to the most important threat (hydroelectric projects), which just exceeds the upper limit for Vulnerable status. *Palisota repens* therefore qualifies as "Near Threatened" [NT] according to the IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. – *Palisota repens* resembles shortly creeping species such as *P. akouangoui* and *P. satabiei*, but differs in showing long creeping stems up to 2 meters bearing regularly distributed leaves, whereas the latter two taxa have short (up to 40 cm), leafless creeping stem terminating in an erect portion of the axis that bears most of the leaves. *Palisota repens* can be easily confused with *P. akouangoui* in the field because they co-occur and have leaves and inflorescences that are very similar on first inspection. To distinguish these two species, as well as *P. satabiei*, it is necessary to observe and carefully note the habit and phyllotaxy of each plant, and to collect material representing a single habit. *Palisota repens* can sometimes also be confused with *P. plicata*: *Wieringa et al. 3112* comprises a mixture of material of these two species. One sheet *3112[A]* at WAG [WAG.1965281] represents *P. repens*, whereas another *3112[B]* [WAG.1965282] is *P. plicata*. The type collection, *Texier et al. 1437,* includes a single open flower photographed and preserved in alcohol that shows a fourth, apparently under-developed stamen, although several other flowers and floral buds were dissected and consistently bore 3 stamens alternating with 3 feathery staminodes, as described above. Although *P. repens* is known from 15 collections, a very limited number of open flowers are available, as this species has usually been collected with old flowers or fruits. As a consequence, we are not able to determine whether the presence of flowers with 4 (or more) stamens replacing staminodes might represent a second floral type. Until additional material is available and more observations can be made, we have chosen to consider the single observed 4-stamened flower as aberrant.

Paratypi. – **Equatorial Guinea. Prov. Centro Sur:** Monte Alén, transecto Monte Alén, 01°39'N 10°18'E, 1170 m, 23.IV.2001, fl., *Ngomo 948* (BRLU); PN de Monte Alén, entre le transect dit de Monte Alén et la Cabaña Bong, 01°39'30"N 10°17'35"E, 1170 m, 7.III.2002, st., *Senterre & Obiang 2665* (BRLU); Parc National de Monte Alén, 11 km à l'E de la Cabaña de Mosumo, 01°36'25"N 10°08'29"E, 615 m, 12.VII.2003, fr., *Senterre & Obiang 4138* (BRLU). **Prov. Litoral:** Bata, alrededores de Akonikieng, [02°00'N 09°50'E], c. 35 m, 7.II.1992, fl. & fr., *Carvalho 5010* (MA, WAG); Ngoma (10 km SE de Etembue), layon 25, 01°14'N 09°25'E, 42 m, 12.VIII.1998, fl., *Lejoly & Elad 98/134* (BRLU). **Gabon. Prov. Estuaire:** Monts de Cristal, concession SEEF, rive E du Komo, 00°27'00"N 10°39'09"E, 519 m, 3.XI.2017, fl., *Bidault et al. 3506* (LBV, MO); Concession SEEF, rive E du Komo, à 15 km au N du barrage, 00°29'16"N 10°36'00"E, 470 m, 7.XI.2017, y. fr., *Bidault et al. 3616* (BR, BRLU, LBV, MO, P). **Prov. Ngounié:** Site Ramsar de Birougou, au N de Malinga, entre les villages Leyonga et Mbengamamba, 00°10'45"S 12°10'08"E, 697 m, 21.III.2018, y. fr., *Bidault et al. 3981* (BR, BRLU, G, K, LBV, MA, MO, P, US, WAG); 5 km on road Etéké to Ovala, 01°28'30"S 11°27'18"E, 750 m, 8.XI.1994, fl., *Wieringa et al. 3112A* (WAG). **Prov. Ogooué-Ivindo:** Camp éléphant, 00°15'00"S 12°20'00"E, 300 m, 31.III.2004, fr., *Moungazi 1493* (LBV, WAG). **Prov. Ogooué-Maritime:** Rabi-Kunga, 01°55'00"S 09°52'00"E, 50 m, 31.V.2002, fl., *Bourobou et al. 637* (LBV); Rabi, 01°55'00"S 09°50'00"E, 60 m, 25.III.1990, fr., *Breteler et al. 9509* (BR, MO, WAG); c. 40 km au NW de Doussala, autour du campement III, 02°14'00"S 10°24'00"E, 450 m, 12.IV.2000, fr., *Sosef et al. 1258* (LBV, MO, WAG). **République du Congo. Prov. Lékoumou:** Komono, 02°53'16"S 13°36'38"E, 602 m, 1.IV.2009, fr., *Cheek et al. 14831* (P, WAG).

8. ***Palisota stevartii*** Burg & E. Bidault, **spec. nova** (Fig. 15E–G, 16).

Holotypus: Gabon. Prov. Ogooué-Lolo: concession CEB, NO de Bambidie, 00°40'48"S 12°48'51"E, 389 m, 17.XI.2015, fl., *Stévart et al. 4842* (MO [MO-3047494]!; iso-: BRLU!, LBV!).

Palisota stevartii Burg & E. Bidault differs from all other Palisota species by the combination of leaves that are alternate below but form a terminal verticil, an erect, densely white woolly terminal inflorescence, up-curved bracts, and white flowers with indument, borne on very long pedicels extending out of the inflorescence.

Erect or decumbent herb ± 30 cm tall, occasionally to 80 cm, sometimes rooting at nodes, branched, or several stems emerging from the same base; roots fibrous. *Stems* green to reddish *in vivo*, sericeous with white to rusty trichomes ± 1–2 cm long, more densely-velutinous on the nodes and sheaths,

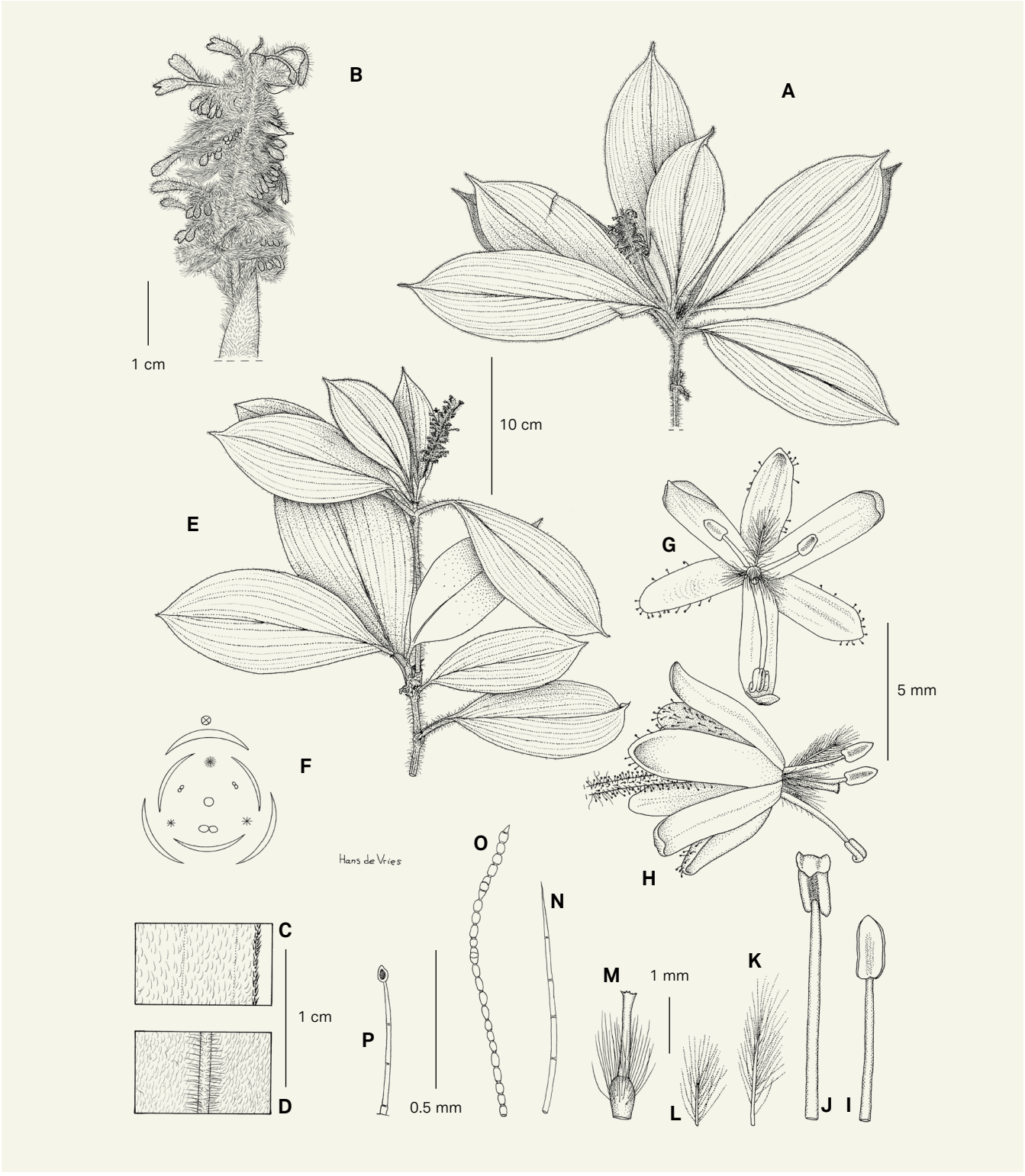


Fig. 16. – *Palisota stevartii* Burg & E. Bidault. **A–B.** Habit; **C.** Detail of pubescence on the upper side of lamina and leaf margin; **D.** Detail of pubescence on the lower side of the lamina and midrib; **E.** Inflorescence; **F.** Floral diagram; **G.** Bisexual flower, front view; **H.** Bisexual flower, side view; **I.** One upper stamen; **J.** Lower stamen; **K.** Upper staminode; **L.** One lower staminode; **M.** Ovary and pistil; **N.** Staminodial hair; **O.** Sepal hair; **P.** Ovary hair.
[**A, G, I–P:** *van der Maesen et al*. 5833; **B–E:** *Stévart et al*. *4844*; **H:** *Texier et al*. *282*] [Drawings: H. de Vries]

often glabrescent, internodes 3–10(–20) cm long, 3–7 mm in diam., brownish *in sicco*. *Leaves* alternate below, (2–)3–5(–6) in a terminal verticil; pseudopetioles hardly sheathing, the obscure sheath open for a quarter to a third of its length, occasionally to its base; pseudopetiole 0–2.5(–3.5) cm long; sheaths and pseudopetiole densely covered by erect, white to rusty trichomes 6 mm long; lamina elliptic to slightly obovate, (9–)15–20(–35) × (3–)5.5–9(–11.5) cm, base acute to obtuse, margins entire, with small, appressed, white or ginger-coloured trichomes, apex abruptly acuminate, adaxial surface glossy, sparsely pubescent with white or rusty, erect trichomes, abaxial surface sparsely brownish pubescent, especially on the primary vein. *Inflorescences* strictly terminal, 1 per apical verticil, erect, spiciform, spiciform thyrse (3–)8–13(–18) × 1.5–2.5(–4) cm, entirely covered by long, woolly, white, glutinous trichomes, including the flowers; peduncle 1–3.5(–12) cm long, very short at first, then expanding fully towards anthesis, all parts white, with 1–2 persistent, peduncular, leaf-like bracts, sheathing, acuminate, green to white, ± 2.5–7(–13) cm long, with whitish or pale green indument; floral bracts lanceolate to linear, 10–12(–18) × 2–3 mm, exceeding the length of buds, each subtending a cincinnus, persistent, white to pale green; cincinni ± 5 mm long, with ± 11–17 flowers, anthesis sequential, most cincinni generally bearing an open flower at the same time, buds oriented downward before anthesis. *Flowers* bisexual, white at anthesis, 8–10 mm in diam., pedicel expanding to 6–10 mm and spread at anthesis, exceeding the bract. *Sepals* equal, oblong-elliptic, 4.5–5 × 0.8–1.2 mm. *Petals* equal, similar to sepals, glabrous. *Staminodes* 3, subequal, filaments with long, yellow, spreading trichomes, the two lower ones 3 mm long, the upper one 4 mm long, antherodes lacking. *Stamens* 3, unequal, erect, the two upper ones with a filament 2.5–3 mm long, glabrous, anthers flattened, ellipsoid, slightly curved, 0.5–0.7 mm long, basifixed, yellow, often with a darker, reddish connective; the lower stamen with a filament 4–4.5 mm long, glabrous, anther thicker than the two upper ones, oblong, ± 0.75 mm long, folded at the apex, dorsifixed, white, with a dark reddish point of attachment to the filament. *Ovary* spherical, ± 1 mm in diam., with stiff trichomes 1.5 mm long, style 1.5–2 mm long, stigma shortly setaceous. *Fruits* not seen.

Etymology. – This species is named in honor of Dr. Tariq Stévart, who collected the type specimen and who has contributed to our knowledge of *Palisota* in Gabon by making numerous collections over the years. Tariq is also acknowledged for his important contribution to the study and conservation of the flora of Tropical Africa, in particular *Orchidaceae*.

Distribution and ecology. – Palisota stevartii appears to be endemic to Gabon, where it is known only from the eastern part of the country in Ogooué-Ivindo and Ogooué-Lolo provinces (Fig. 12). It grows in the understory of mature to secondary *terra firme* forests on slopes or plateaus. It is known from 250 to 705 m elevation.

Conservation status. – The EOO is 7,285 km^2, within the range for "Vulnerable" status under Criterion B1, and the AOO is estimated at 28 km^2, within the range for "Endangered" status under Criterion B2. *Palisota stevartii* is known from 7 collections, representing 6 sub-populations, one of which is situated in the *Parc National d'Ivindo* (Gabon). None of these sub-populations are thought to have been extirpated, given the recent collection dates and the fact that there is still significant forest coverage, including in the area where the oldest collection was made. Three sub-populations occur in logging concessions, including the SIAEFG concession located East of Birougou NP. The 6 sub-populations represent 6 locations with respect to the most important threat (forestry). This species is threatened by forest exploitation, which is projected to lead to future degradation of the quality of its habitat. *Palisota stevartii* therefore qualifies as "Vulnerable" [VU B1ab(iii)+2ab(iii)] according to the IUCN Red List Categories and Criteria (IUCN, 2012).

Notes. – Palisota stevartii resembles the other species with a decumbent habit and terminal inflorescences with numerous flowers forming a thyrse, either elongated or subglobose, such as *P. fadenii*, *P. preussiana*, as well as an undescribed new species being recognized by R.B. Faden that we have included in the key presented in this paper. While all of these species share the characteristics listed above, they show a great deal of variation in inflorescence morphology. *Palisota stevartii* is distinctive in that it has an elongated thyrse completely covered by a white woolly indument, which is unique in the genus. The fruits of two other species belonging to this group are red, almost spherical berries, differing from species in the group with shortly creeping stems as well as some rosette species, which are characterized by elongated and acuminate berries. However, the fruits of both *P. stevartii* and *P. preussiana* are yet to be observed so they may or may not conform to this pattern.

Paratypi. – **Gabon. Prov. Ogooué-Ivindo:** Ivindo NP, Bai de Langoué, 00°10'23"S 12°31'49"E, 581 m, 11.XII.2016, fl., *Texier & Bissiemou 282* (BRLU, LBV, MO, P, WAG). **Prov. Ogooué-Lolo:** c. 30 km E of Lastoursville, 00°50'00"S 13°00'00"E, 300 m, 19.XI.1993, fl., *Breteler & Breteler 12192* (LBV, MO, WAG); Lastourville, Concession Forestière de la Compagnie Equatoriale du Bois, 00°48'46"S 13°13'06"E, 280 m, 3.XII.2012, fl., *Ikabanga & Haurez 347* (BR, BRLU, LBV, MO); chantiers SBL, fin de rte 1, 20 km from Lastoursville Railway Bridge, 00°49'59"S 12°55'00"E, 250 m, 25.XI.1988, fl., *Maesen et al. 5833* (WAG); Monts Birougou, Ramsar area, Maranda I village, 20 km S of Pana, 01°46'02"S 12°37'04"E, 705 m, 5.XII.2017, fl., *Texier et al. 1433* (BR, BRLU, LBV, MO, P, WAG); SIAEFG logging concession, 30 km north of Pana, Monts Birougou, Ramsar area, 01°29'29"S 12°30'48"E, 705 m, 12.XII.2017, fl., *Texier et al. 1648* (LBV, MO).

Acknowledgements

We are grateful to the curators and staff of the herbaria visited (BR, BRLU, LBV, MO, P, and WAG) for their assistance and for the loan of specimens. MNHN (P) gives access to the collections in the framework of the RECOLNAT national Research Infrastructure (ANR-11-INBS-0004). This paper draws on the result of numerous field trips conducted in Gabon by the first author and colleagues, undertaken under the Memorandum of Understanding between the Missouri Botanical Garden [MBG] and the *Centre National de la Recherche Scientifique et Technologique* [CENAREST]. We thank the director of IPHAMETRA *(Institut de Pharmacopée et de Médecine Traditionelle),* Prof. Henri Paul Bourobou Bourobou, and the Curator of the *Herbier National du Gabon*, Nestor Engone Obiang, for supporting our research. Part of our fieldwork was financed and supported technically by WWF-Gabon and by the *Agence Nationale des Parcs Nationaux* [ANPN], and conducted in association with the *Institut de Recherche pour le Développement* [IRD]; persons from these institutions are warmly thanked. CENAREST also provided the necessary research permits for our field work (permit AR0027/18). Some field activities were conducted for Environmental and Social Impact Assessments of the Maboumine (Eramet-Comilog) mining concession and the Kinguélé aval hydroelectric project, and for baseline studies for the Ngoulmendjim and Dibwangui hydroelectric projects. Staff from Maboumine (and especially Pierre van Asbroek), Golder, TEREA, and BIOTOPE are warmly thanked, as well as personnel of Ivindo and Monts de Cristal National Parks, for great moments spent together in the field. Fieldwork was also conducted in logging concessions held by the following companies: *Société Equatoriale d'Exploitation Forestière* [SEEF], *Société d'Inventaire, d'Aménagement et d'Exploitation Forestière du Gabon* [SIAEFG], *Compagnie Equatoriale du Bois* [CEB], and *Rougier Gabon*. Their staff are acknowledged for granting access to these concessions and for providing assistance in the field. We are also grateful to Jean-Philippe Biteau (Jardi-Gab) for cultivating *P. leewhitei*. Laurent Tellier and the staff of Sylvafrica are also thanked for their help. We are grateful to the Wildlife Conservation Society (WCS) Gabon for assistance provided during each of our trips to Gabon. Thanks also to Eric Akouangou, Dimitri Bikissa, Davy Ikabanga, Yves Issembé, Ian Lafferty, Brandet Lissambou, Raoul Niangadouma, Eddy Ngagnia, Diosdado Nguema, Christelle Nyangala, Thomas Nzabi, Jean-Yves Serein and Bonaventure Sonké for their assistance in the field, as well of the inhabitants of the many villages we visited. The following persons kindly provided photos of living material: João Farminhão, Tania d'Haijière and Tariq Stévart *(P. pedicellata),* Nicolas Texier *(P. repens)*, Jean Pierre Vande weghe *(P. leewhitei),* Prof. Lee White (photos and collections of *P. leewhitei*), Davy Ikabanga (*P. stevartii*), and Bruno Senterre *(P. plicata).* Patricia Barberá is acknowledged for providing high-resolution scans of *Palisota* specimens at MA. Many thanks also to Hans de Vries, Ludivine Longou and Didier Geffard-Kuriyama (the two latter from *Muséum National d'Histoire Naturelle – Centre National de la Recherche Scientifique, Unité Mixte de Service 2700 2AD, atelier iconographie scientifique*) for their wonderful line illustrations. We warmly thank Tariq Stévart for improving our risk of extinction assessments and providing general comments on the manuscript, and Martin Callmander, Pete Lowry and Marco O.O. Pellegrini for improving this manuscript. Finally, Gilles Dauby is acknowledged for initially highlighting the complexity of *Palisota* and the need to conduct taxonomic work while he and first author conducted fieldwork together in 2012.

References

Bidault, E., O. Lachenaud & T. Stevart (2017). La flore. *In:* Vande Weghe, J.P. & T. Stevart (ed.), *Le delta de l'Ogooué:* 142–171. Agence Nationale des Parcs Nationaux, Libreville, Gabon.

Brenan, J.P.M. (1984). Two new species of Palisota (Commelinaceae) from West Africa. *Kew Bull.* 39: 829–832.

Cheek, M., G. Prenner, B. Tchiengué & R.B. Faden (2018). Notes on the endemic plant species of the Ebo Forest, Cameroon, and the new, Critically Endangered, Palisota ebo (Commelinaceae). *Pl. Ecol. Evol.* 151: 434–441. DOI: https://doi.org/10.5091/plecevo.2018.1503

Clarke, C.B. (1881). Palisota. *Monogr. Phan.* 3: 131–134.

Clarke, C.B. (1901). Commelinaceae. *In:* Olivier, D. (ed.), *Fl. Trop. Afr.* 8: 25–88. London.

Dauby, G., T. Stévart, V. Droissart, A. Cosiaux, V. Deblauwe, M. Simo-Droissart, M.S.M. Sosef, P.P. Lowry, G.E. Schatz, R.E. Gereau & T.L.P. Couvreur (2017). ConR: An R package to assist large-scale multispecies preliminary conservation assessments using distribution data. *Ecol. Evol.* 7: 11292–11303. DOI: https://doi.org/10.1002/ece3.3704

Endlicher, S. (1836). *Genera plantarum secundum ordines naturales disposita*. Vindobonae.

Faden, R.B. (1995). Palisota flagelliflora (Commelinaceae), a New Species from Cameroon with a unique habit. *Novon* 5: 246–251.

Faden, R.B. (2007). Taxonomic problems in the genus Palisota (Commelinaceae) in Tropical East Africa. *Kew Bull.* 62: 133–138.

Faden, R.B. & D.R. Hunt (1991). The classification of the Commelinaceae. *Taxon* 40: 19–31. DOI: https://doi.org/10.2307/1222918

Gentil, L. (1910). New or noteworthy plants. *Gard. Chron.* 48: 423.

Hua, H. (1894). Observations sur le genre Palisota à propos de trois espèces nouvelles du Congo. *Bull. Soc. Bot. France* 41: L–LV.

Hutchinson, J. & J.M. Dalziel (1936). Commelinaceae. *Fl. W. Trop. Africa* 2(2): 308–320. London.

IUCN (2012). *IUCN Red List Categories and Criteria: Version 3.1.* Ed. 2. IUCN Species Survival Commission, Gland & Cambridge.

IUCN [Standards and Petitions Subcommittee] (2017). *Guidelines for using the IUCN Red List Categories and Criteria. Version 13.* Prepared by the Standards and Petitions Subcommittee.

Kosteletzky, V.F. (1831). Smilacaceae. *Allg. Med.-Pharm. Fl.* 1: 205–228.

Loudon, J.C. (1830). *Loudon's Hortus britannicus : a catalogue of all the plants indigenous, cultivated in, or introduced to Britain. Part I.* Printed for Longman, Rees, Orme, Brown, and Green & Longman, London.

Masters, M.T. (1878). Palisota bicolor. *Gard. Chron.* 9: 527.

Palisot-Beauvois, A.M.F.J. (1804). Commeline. *Fl. Oware* 1: 25–26.

Raponda-Walker, A. & R. Sillans (1961). *Les plantes utiles du Gabon*. Paul Lechevalier, Paris.

Schumann, K. (1897). Commelinaceae africanae. *In:* Engler, A. (ed.), Beiträge zur Flora von Afrika. XIV. *Bot. Jahrb. Syst.* 24: 263–263.

Schumann, K. (1905). Commelinaceae. *In:* Engler, A. (ed.), Beiträge zur Flora von Afrika. XXVII. *Bot. Jahrb. Syst.* 36: 209.

Thunberg, C.P. (1808). *Dissertatio botanica de Dracaena*. Uppsala.

Tropicos (2019). Missouri Botanical Garden, St. Louis [http://www.tropicos.org]

Vande Weghe, J.P. (2005). Les parcs nationaux du Gabon. Akanda et Pongara: plages et mangroves. Wildlife Conservation Society, Libreville, Gabon.

Vande Weghe, J.P., E. Bidault & T. Stevart (2016). *Les plantes à fleurs du Gabon. Une introduction à la flore des angiospermes.* Agence Nationale des Parcs Nationaux, Libreville, Gabon.

Walters, G., E.C. Ngagnia Ndjabounda, D.U. Ikabanga, J.-P. Biteau, O. Hymas, L.J.T. White, A.-M. Ndong Obiang, P. Ndong Ondo, K.J. Jeffery, O. Lachenaud & T. Stévart (2016). Peri-urban conservation in the Mondah forest of Libreville, Gabon: Red List assessments of endemic plant species, and avoiding protected area downsizing. *Oryx* 50: 419–430. DOI: https://doi.org/10.1017/S0030605315000204

Wildeman, E. de (1903). Études de systématique et de géographie botaniques sur la flore du Bas- et du Moyen-Congo. *Ann. Mus. Congo Belge, Bot. sér. 5,* 1.