Ann. Naturhist. Mus. Wien	100 B	683 - 707	Wien, Dezember 1998

A revision of *Perissocarpa* STEYERM. & MAGUIRE (Ochnaceae)

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With contributions by B. Kartusch (wood anatomy) and
H. Halbritter (pollen morphology).

Abstract

The genus *Perissocarpa* (Ochnaceae) is revised. It comprises 3 species: *P. ondox* sp.n. from Peru, *P. steyermarkii* and *P. umbellifera*, both from northern Brazil and Venezuela. New observations concerning floral biology and ecology, fruits and epigeous germination are presented: The petals are found to remain tightly and permanently connate, forming a cap, which protects the poricidal anthers from moisture and is shed as a whole in the course of buzz pollination. Full descriptions, including illustrations of species, a key for identification, a distribution map and a list of exsiccatae are provided. A new key for distinguishing between *Perissocarpa* and *Elvasia* is also presented. Chapters on wood anatomy and pollen morphology are contributed by B. Kartusch and H. Halbritter, respectively.

Key words: Ochnaceae, *Perissocarpa*, *Elvasia*, floral biology and ecology, buzz pollination, South America, Brazil, Peru, Venezuela, wood anatomy, pollen morphology, growth form.

Zusammenfassung

Die Gattung *Perissocarpa* (Ochnaceae) wird einer Revision unterzogen und umfaßt nunmehr 3 Arten (*P. ondox* sp.n. aus Peru, *P. steyermarkii* und *P. umbellifera*, beide aus Nord-Brasilien und Venezuela). Neue Beobachtungen zur Biologie und Ökologie der Blüten, den Früchten und zur epigäischen Keimung werden vorgestellt: Beispielsweise bleiben die Kronblätter andauernd eng verbunden und bilden eine kappen-ähnliche Struktur, die die poriziden Antheren vor Nässe schützt und im Verlaufe der "buzz pollination" als Ganzes abgeworfen wird. Beschreibungen und Abbildungen aller Arten, ein Bestimmungsschlüssel, eine Verbreitungskarte und eine Liste der Exsiccatae werden präsentiert. Ein neuer Bestimmungsschlüssel für die Unterscheidung der Gattungen *Perissocarpa* und *Elvasia* wird ebenso vorgestellt. Kapitel über die Anatomie des Holzes bzw. Morphologie des Pollens werden von B. Kartusch, bzw. von H. Halbritter beigesteuert.

Introduction and historical overview

The genus *Perissocarpa* was erected 14 years ago, although the earliest herbarium collection now assignable to it dates to 1949. This and other more recent collections, however, were found only in fruit. Due to the absence of flowers, these collections could not be assigned to any genus or family (STEYERMARK 1984). The first flowering specimens were collected in 1966 on the Península de Paria in north-eastern Venezuela and were described as *Elvasia steyermarkii* (MAGUIRE 1968). In 1984 STEYERMARK & MAGUIRE (in STEYERMARK 1984) finally erected the genus *Perissocarpa*, transferring *E. steyermarkii* to this new genus, and additionally describing the new taxa *P. umbellifera* and *P.*

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steyermarkii subsp. *tachirensis*, all occurring in Venezuela. Three years later both species were reported also to occur in Serra Aracá in northern Brazil (STEYERMARK 1987; cf. also PRANCE & JOHNSON 1992).

Additional collections from the Peruvian department Huánuco have revealed another new species and provided the impetus for this revision. This also provided an opportunity to offer new information on floral biology and ecology, and to a lesser extent also on seed morphology.

Distinctions between the related genera *Perissocarpa* and *Elvasia*

According to AMARAL (1991), the genera *Elvasia* and *Perissocarpa* (distinguished by separate sepals, yellow petals and 2 - 7 carpels, vs. connate sepals, white petals and 2 carpels, respectively) form a monophyletic group in subfamily Ochnoideae. My own observations suggest, however, that not all these features can be used to distinguish the two genera. For example, in *P. ondox* from Peru, which is here described as new species, the sepals are entirely separate! The colour of the corolla seems usually a constant character, but on two collections of *P. umbellifera* the label-data indicate petals (Maguire et al. 29712), respectively flower buds (Amaral 1561), to be cream-yellow and yellow. Further observations are obviously necessary to confirm these reports.

The most striking difference between the two genera is the biology and structure of the corolla. In *Perissocarpa* the petals are permanently and tightly connate, forming a cap which protects the poricidal anthers from moisture and is shed as a whole in the course of buzz pollination (for details see "Floral biology and ecology", below). In *Elvasia*, on the other hand, the petals are free. Hence, AMARAL's (1991: 169) key is here partially (lead 3) emended as follows:

1 Calyx always divided to the base, shed after anthesis; corolla opening regularly and composed of separate, yellow petals, which are shed long after pollination; carpels 2 - 7 ..... *Elvasia*

1* Calyx of flower buds divided to the base or only in the distal half; sepals, or respective calyx-segments, normally persistent on young fruits and often still visible on older fruits; petals generally white, rarely (?) cream-yellow, permanently and tightly connate, forming a cap (fig. 6: d, j, k), which protects the poricidal anthers from moisture and is shed as a whole in the course of buzz pollination; carpels 2 - 3 ..... *Perissocarpa*

Growth form

To date, it is not yet known to which architectural tree-model (for this topic see HALLÉ et al. 1978) the species of *Perissocarpa* conform. However, the following details concerning the growth of branches have been observed on herbarium specimens: Twigs grow rhythmically (as determined by HALLÉ et al. 1978: 25), regularly developing terminal resting buds covered with several cataphylls (bud-scales). New branches are generated in a sylleptic (= continuous) way (HALLÉ et al. 1978: 42).

Perissocarpa steyermarkii and *P. ondox* normally develop short and long twig (growth) segments. Each segment is distally delimited by a short zone only a few millimeters long with several scars derived from the scales of the former resting bud. Short segments are numerous and normally 1 - 4 (- 10) cm long, with short internodes and fully developed, alternate leaves. Near the distal end of these segments the nodes are even closer and the leaves are, consequently, subopposite or rarely even pseudo-whorled. Short segments contribute exclusively to the elongation of the respective branch.

Horizontal expansion of branches is restricted to long twig segments, which, like inflorescences, are generated in a sylleptic manner in leaf-axils of short segments. These long segments are less numerous, normally 8 - 15 cm long, perpendicularly projecting from the parental axis, and markedly curved-ascending or sometimes straight and inclined-erect. Their distal part is vertically oriented. They resemble fig. 61Ab in HALLÉ et al. (1978). Crowded bud-scale scars at the base are missing. Two to three small, linear scars probably derived from scales, or sometimes from leaves with reduced lamina (normal leaf scars are larger and look different), can normally be observed scattered along the proximal half of the axis. Only 1 - 3 fully developed leaves are arranged close to the distal end (internodes very short), thus appearing subopposite. As these leaves are normally shed during the following growth period, these long segments are characteristically leafless. Like inflorescences, they appear always to be favored in the allocation of resources, as can be seen from their markedly enlarged bases and the noticeably thin distal part of the parent axis. During following growth cycles, new segments elongating the axis begun by a long segment are again exclusively of the short type.

In *P. umbellifera* the growth of twigs is somewhat different and more complex: A distinction between short and long twig segments can often not be made. Some herbarium specimens (e.g. Colonello 738, Amaral 1561) exhibit only long growth segments. In these cases the lateral, markedly curved-ascending, and except for the apex, leafless segments are mostly subopposite and seem to be generated proximally on parent segments. A diminution of growth is not evident on the several cm long parent segments, each sometimes possessing several well spaced, or mostly only 2, subopposite leaves close to the terminal resting bud or near the position of the former bud, which is marked by the small zone of crowded bud-scale scars. Several other specimens differ, however, in having short parent axes or alternate, lateral shoots. In order to better understand the actual modality of growth of branches, a detailed study of living material is indispensable.

The sessile and umbellately branched inflorescences of *P. umbellifera* are always terminal on lateral shoots and are surrounded at their base by few to several crowded, usually smaller, sessile leaves. Judging from what can be determined from herbarium specimens, the following interpretation seems likely: The growth segments following lateral segments seem, when fertile, to be completely transformed into leafless inflorescences, each with an obviously very short main axis and (3 -) 5 - 10, long lateral partial-inflorescences. However, the leaves surrounding the inflorescences at their bases probably belong to the preceding (parent) growth segments. Due to the complicating factors of very short internodes, densely clustered partial-inflorescences and crowded leaves at the base of inflorescences, further studies of alcohol-preserved juvenile inflorescences are necessary for clarification.

Wood anatomy

B. Kartusch*

Method: Samples have been immersed for some weeks in a compound of 96% ethanol + water + glycerine (1 : 1 : 1) to soften the very hard wood for sectioning. Slices around 20 - 30 µm thick have been obtained with a sledge microtome. Safranin and astrablue were used for counterstaining the slices.

Species studied (nomenclature of species pertaining to the other genera according to: BOGGAN et al. 1997):

Elvasia elvasioides (PLANCH.) GILG: van Donselaar 1179 [U + wood sample U10833], from Suriname, Brokopondo District.
Elvasia macrostipularis SASTRE & LESCURE: Granville 6269 [U + wood sample U29920], from French Guiana, Montagne de la Trinité.
Ouratea angulata TIEGH.: Oldenburger et al. 421 [U + wood sample U15314], from Suriname, Sipaliwini Savanna Area.
Ouratea schomburgkii (PLANCH.) ENGL.: Jansen-Jacobs et al. 1402 [U + wood sample Uw33138], from Guyana, Essequibo River.
Perissocarpa steyermarkii: Liesner & González 10249.

Growth rings absent or obscure, due to radially more flattened fibers. Differences in the lumen diameter and fibrewall thickness ratio very faint. Vessels vary little in diameter. Wood diffuse-porous. Vessels solitaire, angular to round in outline; tangential diameter: *P. steyermarkii* 89 - 156 µm, *E. elvasioides* 72 - 151 µm, *E. macrostipularis* 79 - 133 µm; number per mm²: *P. steyermarkii* 19, *E. elvasioides* 39, *E. macrostipularis* 10. Vessel-member length: *P. steyermarkii* 348 - 696 µm, *E. elvasioides* 310 - 738 µm, *E. macrostipularis* 470 - 849 µm. Simple vessel perforation. Intervascular pits alternate to opposite, diameter 4 - 5 µm. Vessel ray pits similar but half bordered. Axial parenchyma abundant, apotracheal, diffuse, in the main uniformly distributed in tangential bands one cell wide, with some clusters composed of 15 - 20 cells and some scanty paratracheal cells. *E. macrostipularis* with only tangential bands up to 8 cells wide, or with clusters of up to 40 cells (mean 20) cells near rays. Rays heterocellular, 1 - 5 seriate; when uniseriate, composed of erect square cells, when 2 - 5 seriate, composed of a central portion of recumbent cells and long marginal extensions of square and erect cells. Ray number per mm: *P. steyermarkii* 12, *E. elvasioides* 11, *E. macrostipularis* 13. Height of uniseriate rays up to 15 cells; height of multiseriate rays up to 70 and more cells. Rhombic crystals observed in ray cells in samples of *E. elvasioides* and *O. angulata*. Fibres non-septate; lumen diameter: *P. steyermarkii* 3.68 - 9.44 µm, *E. elvasioides* 3.68 - 8.48 µm, *E. macrostipularis* 3.36 - 6.56 µm; wall thickness: *P. steyermarkii* 5.12 - 11.52 µm, *E. elvasioides* 6.96 - 12.72 µm, *E. macrostipularis* 7.60 - 12.48 µm; length: *P. steyermarkii* 1372 - 2161 µm, *E. elvasioides* 1812 - 2488 µm, *E. macrostipularis* 1859 - 3051 µm, (compare table 1).

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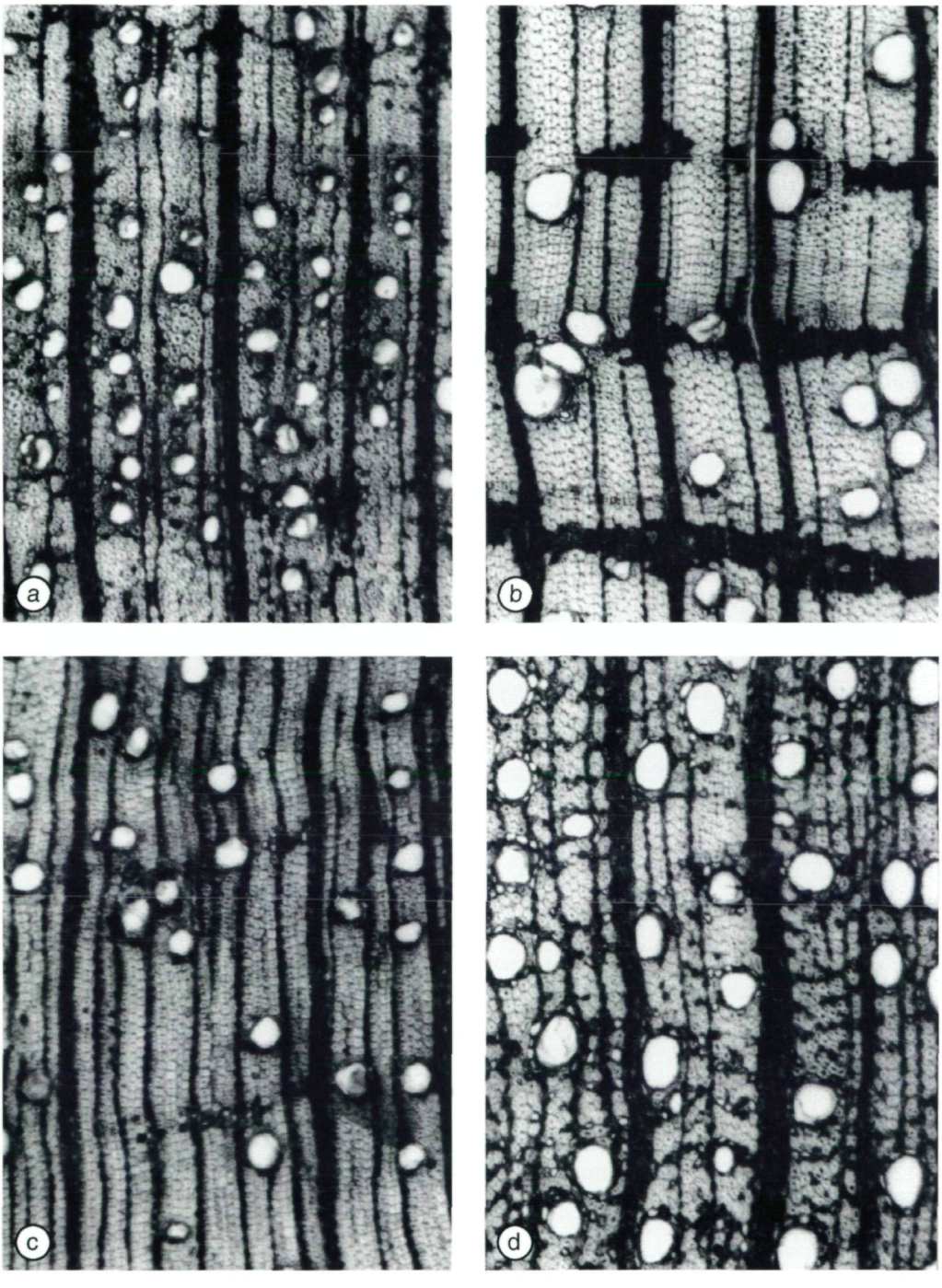

Fig. 1: Wood anatomy: **a**) *Elvasia elvasioides* (van Donselaar 1179); **b**) *Elvasia macrostipularis* (Granville 6269); **c**) *Perissocarpa steyermarkii* (Liesner & González 10249); **d**) *Ouratea schomburgkii* (Jansen-Jacobs et al. 1402); all transversal sections, 50x.

Table 1: Some quantitative characters of wood of *Perissocarpa* compared to that of *Elvasia* and *Ouratea*.

	mean vessel frequency / mm²	mean vessel diameter (µm)	mean vessel member length (µm)	mean libriform fibre length (µm)	mean fibre wall thickness (µm)	mean fibre lumen diameter (µm)	mean rays / mm
Elvasia elvasioides	39	110	491	2179	9.6	6.08	11
Elvasia macrostipularis	10	109	688	2223	10.32	4.64	13
Perissocarpa steyermarkii	19	124	486	1644	8.72	5.76	12
Ouratea angulata	12	89	596	1610	9.04	5.12	12
Ouratea schomburgkii	18	66	837	1896	10.8	7.36	12

Pollen morphology

H. Halbritter*

Method: Mature anthers of *Perissocarpa ondox* were fixed in ethanol, chemically dehydrated with 2,2-dimethoxypropane and critical point dried. The pollen was mounted on a stub with double sided sticky tape, sputter coated with gold and observed in a JEOL T-300 scanning microscope at 10 kV.

Investigated taxa:

Perissocarpa ondox: Morawetz & Wallnöfer 16-2288
P. steyermarkii: Steyermark & Rabe 96342
P. umbellifera: Amaral 1561
Elvasia macrostipularis: Granville 6269 (cf. chapter "Wood anatomy")

The tricolporate pollen of *Perissocarpa ondox* (fig. 2) is very small, about 10 µm in diameter. In the hydrated condition the shape is spheroidal or slightly triangulate (apertures expanded). The pollen surface shows a striate exine pattern, with very narrow striae. The colpus membrane is covered with small roundish exine elements.

The pollen of *Perissocarpa ondox* is very similar to that of *P. umbellifera* and *P. steyermarkii*. In *Elvasia macrostipularis* the striae of the pollen surface are, however, slightly wider than in species of *Perissocarpa*.

Floral biology and ecology

The quite small flowers of *Perissocarpa* are five-merous, subsessile, and densely crowded along the partial-inflorescences (fig. 5, 7). The five erect, subsessile, anthers (fig. 6: e - h) are arranged in one whorl, opening apically by two, slitlike pores. The contorted

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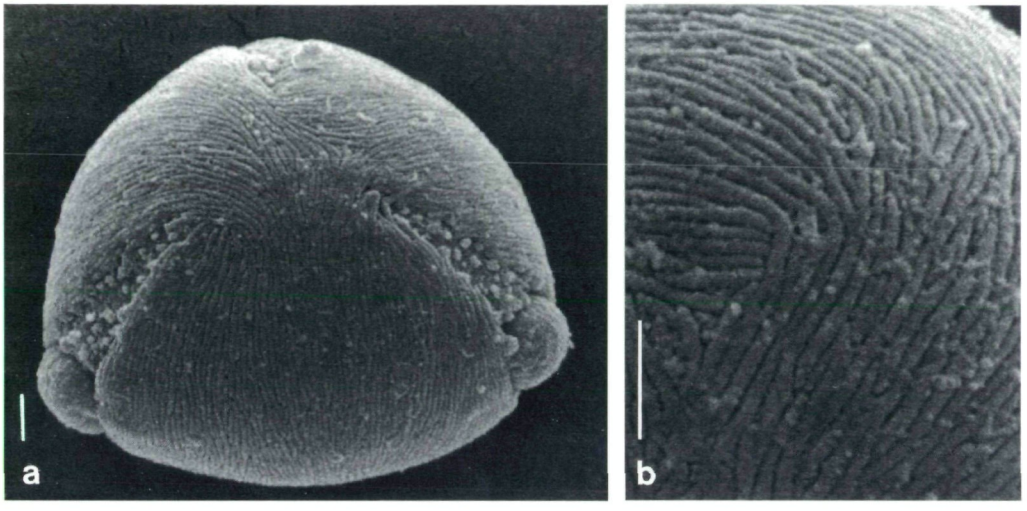

Fig. 2: Pollen of *Perissocarpa ondox*: **a**) grain in polar view; **b**) detail of surface showing striate exine; (from Morawetz & Wallnöfer 16-2288); Bars = 1 µm.

petals (fig. 6: d, i - k) are bilobed and widest apically, gradually tapering and completely free towards their base. The exterior (uncovered) lobes are also free, whereas the inner (covered) ones are inflexed, spirally intercalated and permanently and tightly connate. In this way the corolla, in its interior, forms apically an open, cylindrical-obconical structure, which is composed of the inner lobes of the petals and which encloses the single style (fig. 3, 6k). Around this cylindrical-obconical structure 5 oblong cavities are arranged, each enclosing one anther.

At anthesis the petals are abscised at the base, but remain tightly connate distally. Therefore, the corolla loosely sits on the stamens and the ovary, like a cap. Due to the action of insects scrambling over the densely crowded flowers during buzz pollination (for this topic see BUCHMANN 1983 and ERICKSON & BUCHMANN 1983), the corolla is ultimately thrown over and shed as a whole. All these floral peculiarities are unique among Ochnaceae.

In *P. ondox* the central part of some petals are inflated ± baloon-like (fig. 3). According to my limited experience the number and location of inflated petals seems to be irregular: often only three in one corolla, sometimes more, rarely less. The exterior (uncovered) petal-lobes of inflated petals are, therefore, diverging in mature flowers (fig. 6d). In this way the corolla increases noticeably in size before anthesis, a circumstance which, in view of the relatively narrow cavities enclosing the anthers, seems to facilitate its abscission as a whole (see above). In the case of *P. steyermarkii* these cavities are, however, relatively wide. This seems to explain the absence of inflated petal-lobes in this species. In the case of *P. umbellifera* more adequate flowering material is necessary to verify the occurence of these characters.

This unusual fate of the corolla can easily be explained as an adaptation to environmental conditions. The following observations have been made in 1988 in the Cerro del Sira in Peru. *Perissocarpa ondox* grows in this locality in large stands along exposed

ridges in the cloud forest. Main flowering time is during the rainy season, from December to March, when these sites are almost constantly in clouds, with fog frequently reaching the ground. Especially along the ridges the fog condenses ("Nebel auskämmen") on exposed parts of the trees. Due to persistent moisture and relatively low temperatures during fog-free hours, the crowns and inflorescences barely become dry. At anthesis the cap-like corolla protects, therefore, the anthers from becoming moist (otherwise, water would obstruct the pores, making buzz pollination impossible).

Since *P. steyermarkii* is also known to grow in cloud forests, it is most likely, despite absence of meteorological data for most of the growing sites, that flowering time also generally coincides with the rainy season. The only precipitation data available for any of the sites were this species occurs, is from Estado Táchira in western Venezuela (BONO 1996: 134). This author indicates the rainy season to be in the months between April and November, with a maximum of rain falling in June and July. Indeed, according to the labels, the only two flowering specimens of this species known to me (Steyermark & Manara 125174, and van der Werff & González 5282) were actually collected during these two wettest months, thus confirming my assumption.

In the case of *P. umbellifera* the situation could be somewhat different, but details are lacking. Petals in this species are only slightly lobed distally and seem not to be very tightly connate. The apical pores of the anthers are moreover particularly wide (AMARAL 1991: fig. 7a) compared to those of the other two species. These features could indicate that *P. umbellifera* is adapted not only to a different habitat (see "Distribution and habitat"), but also to different meteorological conditions.

Fruits and germination

STEYERMARK (1984) erroneously described the fruits as 3-seeded. He obviously considered the single, large and thickened cotyledons to be seeds. This misinterpretation has later been corrected by AMARAL (1991), who recognized that the fruits yield only one large seed. She did not, however, provide further details.

The 1-seeded fruits can be described as "indehiscent fruits with delayed dehiscence" (ROTH 1977: 187). The exalbuminose seed (fig. 6: l - m) consists of two large, thickened, green cotyledons, an eccentric small radicula and shoot apex, and is inseparably united with the leathery fruit wall (for more details see the generic description).

In the Sira mountains I was able to observe epigeous germination. After landing between leaf litter in the immediate vicinity of the parent trees, the fruits open quite soon by one distal, longitudinal slit. The green, flat, adaxial surfaces of the cotyledons diverge slightly, whereas the convex, abaxial surfaces remain connate to the leathery fruit wall and the thickened pedicel (fig. 6m). The primordium of the shoot located laterally between the cotyledons (fig. 6: l) soon starts elongating. The young shoot is densely covered with cataphylls. At the base of the fruit, on the side where the radicula is located, several uniform, small roots appear (fig. 6m). Leaves of the juvenile plants are narrower than those of adult trees (as documented by Dudley 13127a and Dudley 13160).

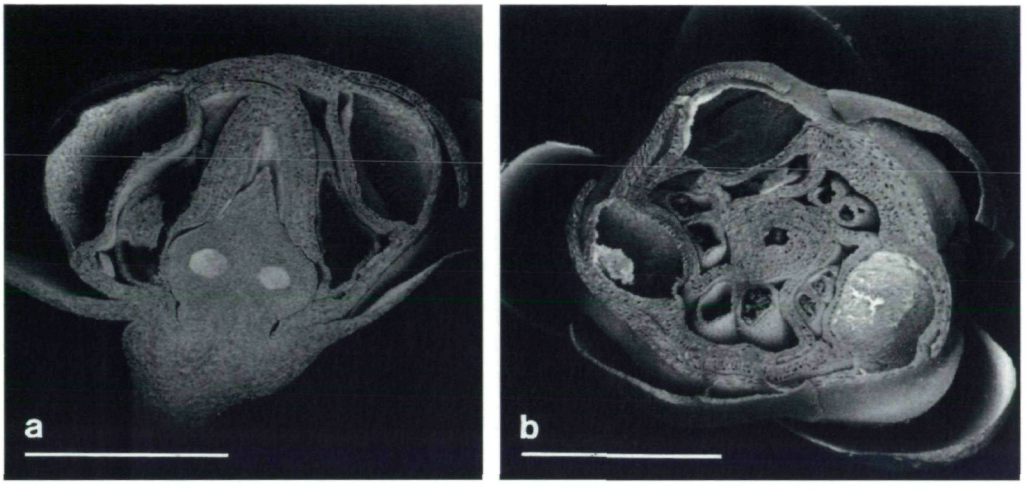

Fig. 3: *Perissocarpa ondox*: **a**) longitudinal section through older flower bud; **b**) cross section through apical part of older flower bud; (from Morawetz & Wallnöfer 16-2288); Bar = 1 mm. (photographs: H. Halbritter).

Distribution and habitat

Perissocarpa is known only (see fig. 4) from Venezuela (STEYERMARK 1984; BERRY et al. 1995: 177), northern Brazil (STEYERMARK 1987; PRANCE & JOHNSON 1992) and Peru (RAINER 1995: 243, who used my floristic data). The genus has only infrequently been collected due to its occurrence in remote or barely accessible sites (tepuis and other isolated mountain ranges). *P. ondox* and *P. steyermarkii* are restricted to cloud forests, whereas *P. umbellifera* occurs in dwarf and scrub forests in rocky, open places. More details are given below under treatments of individual species. It is likely that *Perissocarpa* also occurs in Colombia and Ecuador.

Taxonomy

***Perissocarpa* STEYERM. & MAGUIRE**, Ann. Missouri Bot. Garden 71: 319 (1984)
Type species: *Perissocarpa steyermarkii* (MAGUIRE) STEYERM. & MAGUIRE

Shrubs to medium-sized trees to 15 m high; dbh to 20 cm; exuding only scarcely noticeable quantities of sap when cut; wood (at least that of *P. ondox* and *P. steyermarkii*) heavy and hard; twigs subterete, often differentiated into short or long growth segments (cf. chapter "Growth form"); bark of twigs grey to brown, often slightly striate or papery-scaly; all parts of the plant glabrous; **leaves** alternate, at the distal end of growth segments subopposite; vernation involute; young, already fully expanded leaves showing a pair of faint, longitudinal, curved vernation lines [resembling those of *Erythroxylon coca*, see Fig. 64 in SCHULZ (1931)] running abaxially from base to apex

of lamina, near the primary vein (rarely visible in *P. umbellifera*); stipules soon deciduous or persistent, triangular or oblique-triangular, with hyaline, erose margins; petiole enlarged at base, flat or slightly canaliculate adaxially, finely longitudinal-striate abaxially, distally with lateral wings (derived from decurrent and gradually tapering lamina) which narrow to edges near middle of petiole, where they turn towards its adaxial side; lamina coriaceous, often slightly shiny on both surfaces, broadly lanceolate to elliptic, sometimes slightly obovate, rarely ovate; margins entire, near apex sometimes minutely crenate, slightly revolute abaxially, possessing a thickened marginal vein, and irregularly distributed, small point- or mucro-like dark structures (probably vein endings or remnants of teeth), which are more spaced proximally and closer distally; leaf apices rounded to acute, sometimes acuminate, cuspidate or retuse; leaf bases ± angustate (lamina decurrent on petioles); primary vein impressed, but with a markedly prominent, carinate central part adaxially, prominent and finely longitudinal-striate abaxially; secondary veins flat, numerous, ± straight, closely parallel to each other, rarely visible adaxially, paxillate as defined by MELVILLE (1976: tab 2, 18 [*Calophyllum*]), lirate as defined by KLUCKING (1995: plate 76, fig. 4 [*Blastemanthus*] and 5 [*Elvasia*]); tertiary veins very short and rarely visible abaxially; **inflorescences** and infructescences in *P. steyermarkii* and *P. ondox* solitary or paired, lateral or sometimes pseudo-terminal on short twig segments, pedunculate, alternate-branched and mostly curved-ascending, ("Doppeltraube"); in *P. umbellifera* terminal on lateral branches, sessile and umbellately branched; partial-inflorescences densely subspicate, inclined-erect or ascending; **flowers** nearly sessile or shortly pedicellate, subtended at base by one triangular bract and two smaller, lateral bracteoles, which are normally shed at anthesis; pedicels markedly enlarged distally; calyx 5-merous, on flower buds divided to its base into 5 sepals, or undivided in the lower half, or for most of its length and, shortly before anthesis, splitting from apex to base into (2 -) 3 irregularly wide segments mostly with more than one calyx-lobe at apex; calyx lobes quincuncial, in *P. ondox* large and free to the base of the calyx, small to minute and free only apically on calyx of *P. steyermarkii* and *P. umbellifera*; sepals, respectively calyx-segments patent or reflexed at anthesis and long persistent; petals 5, contorted, narrowed to cuneate and free basally, widest and ± slightly asymmetrically bilobed distally; (central part of some petals inflated, at least in *P. ondox*); exterior (uncovered) petal-lobes free; inner (covered) lobes inflexed, spirally intercalated, and tightly and permanently connate (hardly separable without inflicting damage), forming in the centre of the cap-like corolla an open, cylindrical-obconical structure (fig. 3, 6k) which encloses the single style; around this cylindrical-obconical structure the corolla-cap possesses 5 additional, oblong cavities, each enclosing one anther; corolla-cap never opening, but shed as a whole in the course of buzz pollination (cf. chapter "Floral biology and ecology"); stamens 5, haplostemonous, episepalous, erect, long-persistent (sometimes persistent at the base of fruits); filaments short, filiform; anthers basifixed, bithecate; connectives inconspicuous; thecae latrorse, each opening apically with one wide or slit-like pore; endothecium not retained (KUBITZKI & AMARAL 1991); pollen tricolporate and very small; ovary superior, subglobose, gradually tapering into the single, obconical style, 2 - 3-carpellate, 2 - 3-locular; stigma inconspicuous; ovules one per locule; placentation axial; funicles inconspicuous; **fruits** (cf. chapter "Fruits and germination") indehiscent, slightly opening during germination (fig. 6m), 1-seeded, depressed globose to subglobose or depressed globose-bilobate (with a ± noticeable longitudinal groove

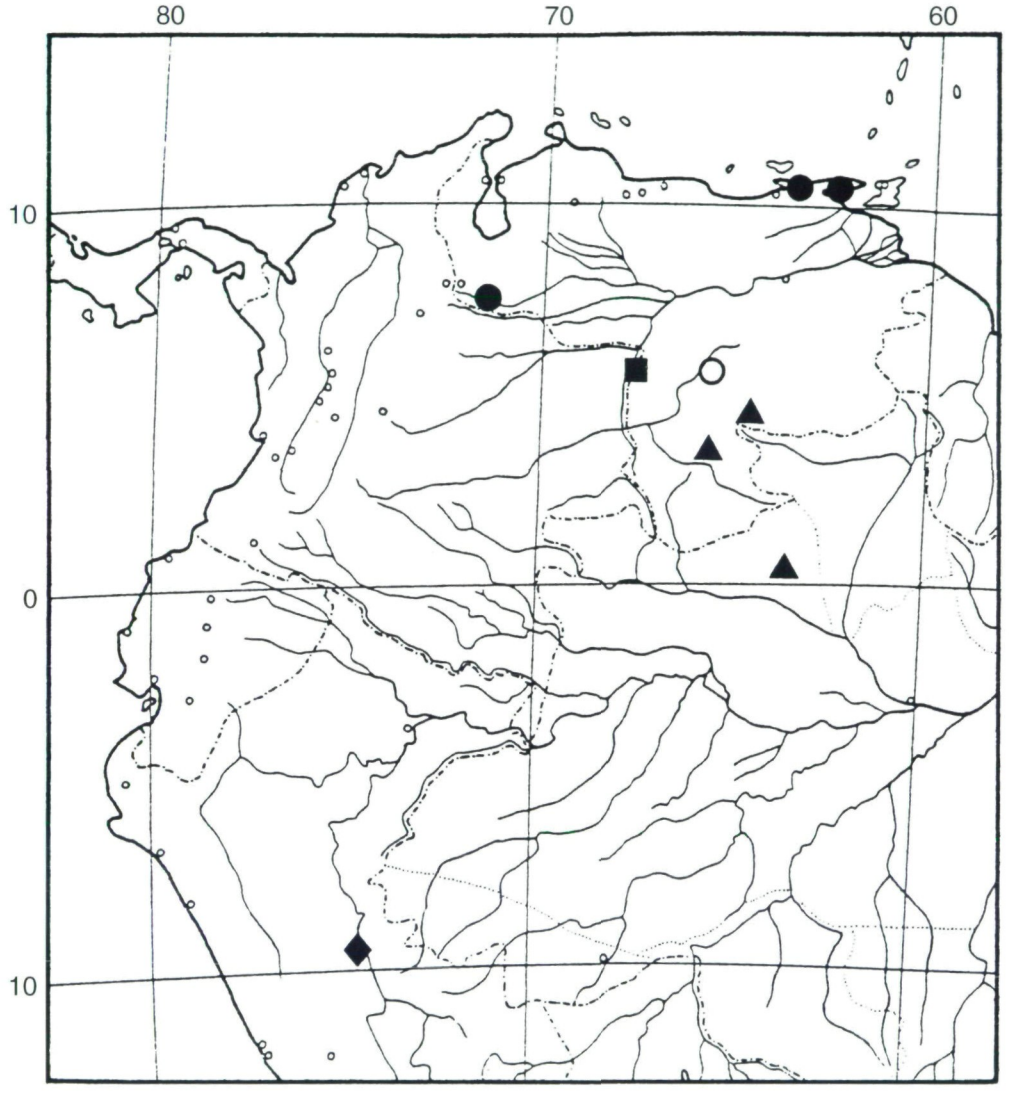

Fig. 4: Distribution of: *Perissocarpa ondox* (◆), *P. steyermarkii* (●; ○ = populations reported by HUBER 1995b: 122 - 123), *P. umbellifera* (■), co-occurrence of both, *P. steyermarkii* and *P. umbellifera* (▲).

surrounding the fruit in the plane between the two large cotyledons), tapering or abruptly constricted into the pedicel, dark brown to ferrugineous, and scaly outside, at the base often carrying the reflexed remnants of the sepals or calyx segments; immature and mature fruits differing only in size; fruit wall leathery and ± inseparably fused with the relatively hard seed; seed exalbuminose, consisting of two large, thickened cotyledons; primordium of the root ("Wurzelscheitel") and shoot apex ("Sproßscheitel") small, located laterally at base between the cotyledons (fig. 6: l).

Key to species

1 Inflorescences sessile, surrounded at their base by few to several crowded, usually smaller, sessile leaves; partial-inflorescences umbellately arranged (no main axis visible) and ascending candelabra-like; calyx of flower buds only divided at the apex; calyx-lobes less than 0.2 mm long and hardly visible (fig. 8: i, o); petioles 0.1 - 0.6 (- 1) cm long; shrubs or small trees 1 - 3 (- 5) m tall, growing in dwarf and scrub forests mostly on rocky, open sites; Guayana Shield ..... *P. umbellifera*

1* Inflorescences pedunculate; partial-inflorescences alternately arranged along the several cm long main axis, inclined-erect to curved-ascending; calyx of flower buds divided down to the base or only in the distal 1/2 - 1/4 of the total length; calyx-lobes more than 0.6 mm long and well visible; petioles mostly more than 1 cm long; medium-sized trees ca. 4 - 15 m tall, occurring in cloud forests 2

2 Calyx of flower buds divided only in the distal 1/2 - 1/4 of the total length (fig. 8: a, b, f), and irregularly splitting from apex to base shortly before anthesis, into (2 -) 3 persisting calyx-segments, which are often visible at the base of younger fruits; larger fruits 1.2 - 1.6 (- 2) cm long (excluding pedicel) and 1.5 - 2 (- 2.5) cm wide, longitudinally surrounded only by a faint groove; leaves (4.7 -) 9 - 16 (- 20) x (2 -) 4 - 7 (- 10) cm; petioles (0.3 -) 1 - 2 (- 2.5) cm long; Guayana Shield, Coastal Cordillera and Andes of Venezuela ..... *P. steyermarkii*

2* Calyx of flower buds always divided down to the base (fig. 6a); the 5 entirely free sepals often persisting at base of younger fruits; larger fruits 0.7 - 1 cm long (excluding pedicel) and 1.2 - 1.6 cm wide, longitudinally surrounded by a conspicuous groove; leaves (3 -) 6 - 11 (- 13) x (1 -) 2.5 - 4.5 (- 5.5) cm; petioles (0.2 -) 1 - 1.5 (- 1.7) cm long; Peruvian Andes ..... *P. ondox*

Perissocarpa ondox B.WALLN. sp.n. (fig. 2 - 3, 5 - 6)

Type: Peru, Dept. Huanuco, Prov. Pachitea, western slope of Cerro del Sira, ca. 24 km SE to ca. 26 km ESE of Puerto Inca, cloud forest along a ridge near "Laguna" (9°26'S, 74°45'W), soils composed of red latosols with a thick humus layer, ca. 1380 m, 2 Feb 1988 (fl, young fr)[1], **Morawetz & Wallnöfer 16-2288** [holotype: W[2] (photo W 2003); isotypes: F, G, K, MO, NY, LZ, USM].

Diagnosis: Differt a *Perissocarpa steyermarkii* foliis minoribus (3 -) 6 - 11 (- 13) cm longis, (1 -) 2.5 - 4.5 (- 5.5) cm latis, laciniis calycis in gemmis usque ad basin liberis.

Trees to 10 m tall; dbh to 20 cm; wood dark red when fresh, very heavy and hard; branches very flexible; **leaves**: petioles (0.2 -) 1 - 1.5 (- 1.7) cm long, 0.1 - 0.15 cm wide; stipules triangular or obliquely triangular, 0.2 - 0.4 x 0.2 cm, early deciduous, rarely persistent; young leaves involute in bud; exterior, exposed part of the exserted, but not yet expanded leaves covered with a thin layer of resin; after expansion abaxial (sometimes also adaxial) side of lamina with a pair of clearly visible vernation lines (near centre of leaf, 0.3 - 0.5 cm distant from primary vein); area in between with scattered remnants of the transparent,

[1] Abbreviations: defl = deflorate; fl = flowering; fr = fruiting.

[2] Acronyms of herbaria according to HOLMGREN et al. (1990).

Fig. 5: *Perissocarpa ondox* B. WALLN., sp.n. (holotype).

or sometimes white, resin-layer; lamina completely flat (except for primary vein), strikingly red when sprouting, glossy and dark green (uniformly brown on both surfaces when dry), broadly lanceolate, (3 -) 6 - 11 (- 13) x (1 -) 2.5 - 4.5 (- 5.5) cm, (lamina of seedlings lanceolate, ca. 9 x 2.3 cm), broadest in the middle, but sometimes slightly above or below it; leaf apices acute (long-acute on seedlings); leaf bases angustate; **inflorescences** and infructescences lateral or sometimes pseudo-terminal (cf. chapter "Growth form"), 7 - 13 cm long, including the 1.5 - 3.5 cm long and 0.2 - 0.3 (- 0.5) cm thick, subterete or slightly angular peduncle; main axis several cm long; partial-inflorescences 10 - 20 in number, 2 - 6 cm long, densely and alternately arranged along the main axis, subspicate, flowerless proximally, after fructification with prominent pedicel-bases and strongly decurrent angles; **flowers** (fig. 6: a - k): bracts triangular, shorter than flower buds, rounded on corners, with slightly hyaline and irregularly erose margins, ca. 1.4 x 1.3 mm; bracteoles similar to bracts, but acute apically and rounded laterally at base, ca. 0.8 x 0.8 mm; pedicel up to 0.5 mm long and wide at apex; calyx green, divided to base; sepals ovate, markedly concave adaxially, ca. 2 mm x 1.5 mm, patent at anthesis and markedly thickened basally, ± reflexed on young fruits; petals greenish-white when young, white at anthesis, 4 x 3 mm, bilobed, mostly dextrorsely (fig. 6d), less frequently sinistrorsely (fig. 6: j - k) contorted; central part of some petals inflated ± balloon-like (fig. 3, 6d; cf. chapter "Floral biology and ecology"); stamens ca. 1.6 mm long; filaments ca. 0.2 - 0.3 mm long; anthers yellow, ca. 1.4 mm long and ca. 0.9 - 1 mm wide; pores relatively small, ca. 1/7 of anther-length; ovary white, ca. 0.8 mm long, ca. 1.1 mm wide, slightly compressed laterally if 2-locular or faintly trigonous if 3-locular; style ca. 0.6 mm long; immature and mature **fruits** (fig. 6: l - m) brown to greenish-brown (brown when dried), depressed globose-bilobate, surrounded by a longitudinal groove, markedly tapering into the 0.2 - 0.3 cm long and 0.3 cm wide, conical pedicel, which abscises with the fruit; larger fruits 0.7 - 1 cm long (excluding pedicel) and 1.2 - 1.6 cm wide.

Epithet: The name is coined arbitrarily (see GREUTER et al. 1994: Art. 23.2).

Distribution (fig. 4), habitat and ecology: *P. ondox* is known only from the central part of the western slopes of the Sira mountains (Cerro del Sira) in Peru. All specimens cited below have been collected in the cloud forest, which abruptly begins near the temporary "campamento Pato Rojo" (9°27'S, 74°46'W) at 1080 m and gradually passes into the elfin forest at ca. 1650 m, above the temporary "campamento Peligroso" (9°25'S, 74°44'W). It mostly grows in large populations in relatively low woods on exposed ridges. The species is absent from the shrubby "colorado" vegetation on exposed hilltops (= exclaves of elfin forest at lower altitudes), and in the taller woods growing on slopes, in valleys and

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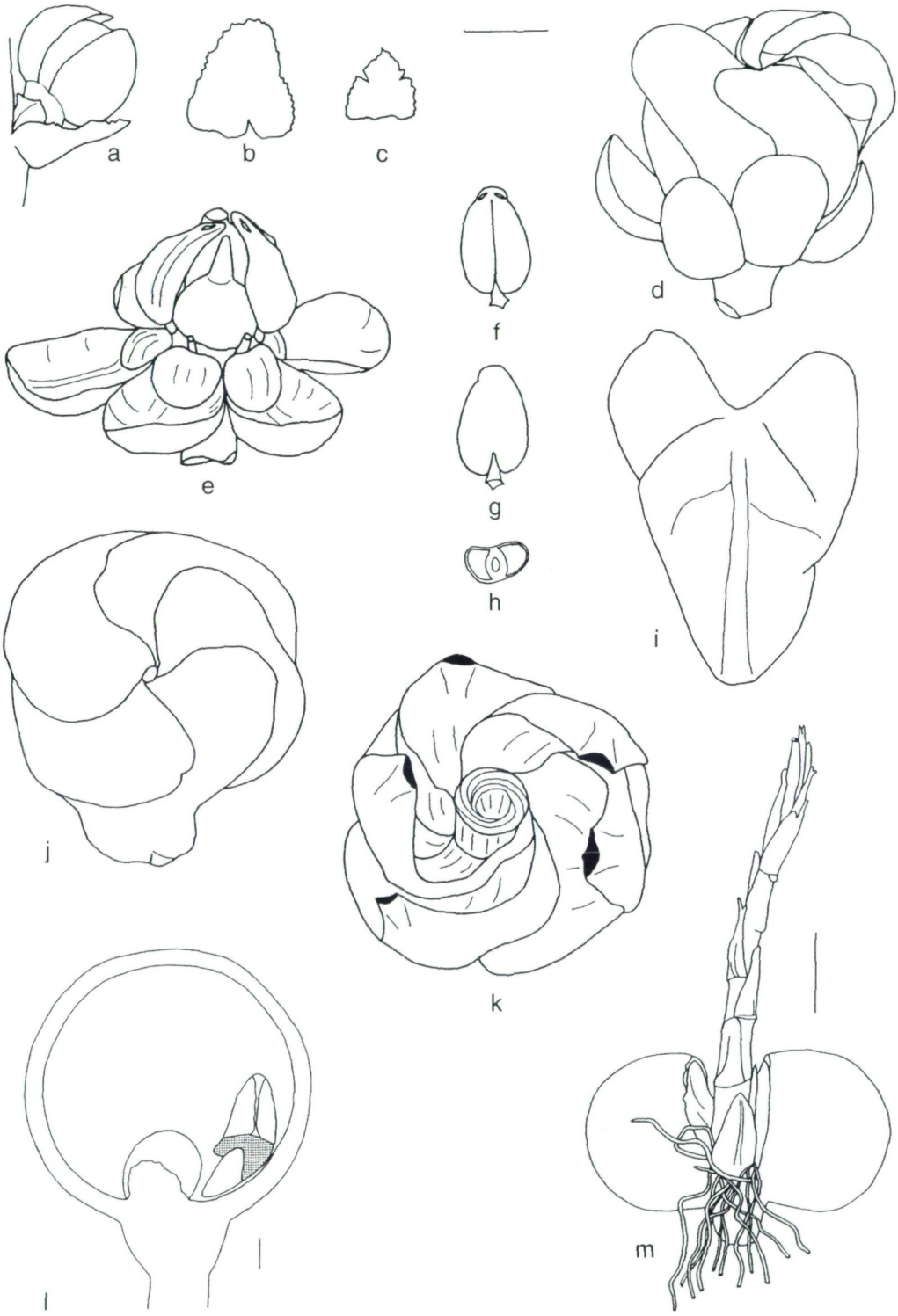
Fig. 6: *Perissocarpa ondox*: **a**) flower bud; **b**) bract; **c**) bracteole; **d**) flower shortly before anthesis; **e**) flower at anthesis (corolla shed; two anthers removed); **f**) stamen seen from abaxial side; **g**) stamen seen from adaxial side; **h**) anther in cross section; **i**) petalum; **j**) apical (exterior) part of the shed corolla; **k**) interior of the shed corolla; **l**) longitudinal section of fruit showing adaxial surface of one cotyledon as well as the radicula and the shoot apex covered with the first two cataphylls (the dotted area indicates the connection to the other cotyledon; the basal, ± circular structure can be observed on many fruits and indicates the presence of a cavity, housing an insect larva of unknown affinity); **m**) fruit shortly after epigeous germination; — (a - k: from alcohol-preserved material of Morawetz & Wallnöfer 16-2288 [Bar = 1 mm]; l [Bar = 1 mm] and m [Bar = 5 mm]: from alcohol-preserved material of Wallnöfer 115-13688).



depressions. The wood is remarkably hard and the branches are very flexible. These characters of *P. ondox* seem to be an adaptation to the strong storms, which affect the habitat from time to time, as can be seen in the enormous wind gaps scattered on the slopes. Leafing occurs in December, when the red, young leaves strikingly influence the appearance of the forest. Flowering time coincides with the rainy season (cf. "Floral biology and ecology").

Paratypes: Peru, Dept. Huanuco, Prov. Pachitea, western slope of Cerro del Sira, ca. 24 km SE to ca. 26 km ESE of Puerto Inca, cloud forest on a small hill ca. 1 - 2 km W-WSW of the "Laguna" (9°26'S, 74°45'W), 1300 m, 13 Jun 1988 (fr), **Wallnöfer 115-13688** [LZ, MO, U, USM, W], "tree 9 m, dbh 13 cm"; – same area, but: cloud forest in the surrounding of the "campamento Pato Rojo", 1100 - 1200 m, 3 Jan 1988 (fl, fr), **Wallnöfer 119-030188** [LZ, USM, W], "shrub"; – same area, but: at top of ridge about half way between Camp 2 (Patricio) and Camp 3 (Laguna), just before a steep descent of limestone [?] substrate into a deep valley before Camp 3, ca. 1000 m [according to own observations actually ca. 1250 - 1320 m], 22 Jul 1969 (st), **Dudley 13127a** [NA, USM n.v.], "dominant seedlings in the very wettest sites ..."; – same area, but: in valleys before steep descent of ridge just before Camp 3, ca. 900 m [according to own observations actually 1200 - 1250 m], 23 Jul 1969 (st), **Dudley 13160** [NA, USM n.v.], "seedling, dominant in dense very wet cloud forest"; – same place and date: (st), **Dudley 13161** [NA, USM n.v.], "dominant tree, multiple-trunked, 10 - 30 ft. tall, dbh 4 - 8", leaves glossy, dark green"; – same area, but: in rain forest at Camp 3 (Laguna), ca. 1290 m [according to own observations actually 1380 m], 13 Jul 1969 (fl buds), **Wolfe 12310** [CONN n.v., F (photo at W), USM n.v.], "ascending tree 30 ft. tall, dbh 8", flowers white"; – same place and date: (fl buds), **Wolfe 12310a** [NA, USM n.v.]; (fl buds), **Wolfe 12310b** [NA, USM n.v.].

Perissocarpa steyermarkii (Maguire) Steyerm. & Maguire,
Ann. Missouri Bot. Garden 71: 319 (1984); (fig. 1c, 7 - 8)

≡ *Elvasia steyermarkii* Maguire, Acta Bot. Venezuelica 3: 297 - 299 (1968)

Type: Venezuela, Estado Sucre, Península de Paria, Cerro de Humo [NNW-N Irapa, according to Steyermark & Agostini (1966: 10)], laderas pendientes de bosque siempre verde que miran al norte, a lo largo de las cabeceras de Río Santa Isabel, acerca de camino de bestias entre "Los Positos" y La Roma, 700 - 800 m, 11 Aug 1966 (fl), **Steyermark & Rabe 96342** [holotype: NY (photo W 2007); isotypes: F (photo at W), US (photo at W), VEN n.v.], "tree 8 m; leaves coriaceous, deep green above, pale green below; rachis olive green; calyx green; stamens buff-yellow, erect; petals 5, white".

= *P. steyermarkii* subsp. *tachirensis* Steyerm. & Maguire, Ann. Missouri Bot. Garden 71: 320 (1984)

Type: Venezuela, Estado Táchira, between dam site and narrow ridge along Río San Buena, wooded sandstone hills, area of Presa Las Cuevas (Desarrollo Doradas Camburito y Complimentario Agua Linda), ca. 10 km E of La Fundación, 7°47'48"N, 71°46'47"W, 550 - 600 m, 21 Jun 1981 (fl buds + defl; 1 specimen at MO with fr), **Steyermark & Manara 125174** [holotype: VEN n.v. (photo at W); isotypes: F (photo at W), MO 5x (photocopies and photo at W), NY 2x (photo at W), US (photo at W)], "common tree on ridge top; petals white; anthers buff; flowers inodorous; rachis pale green; calyx pale green; leaves coriaceous, dark green above, dull green below, very brittle; fruiting plants seen, most trees in late bud".

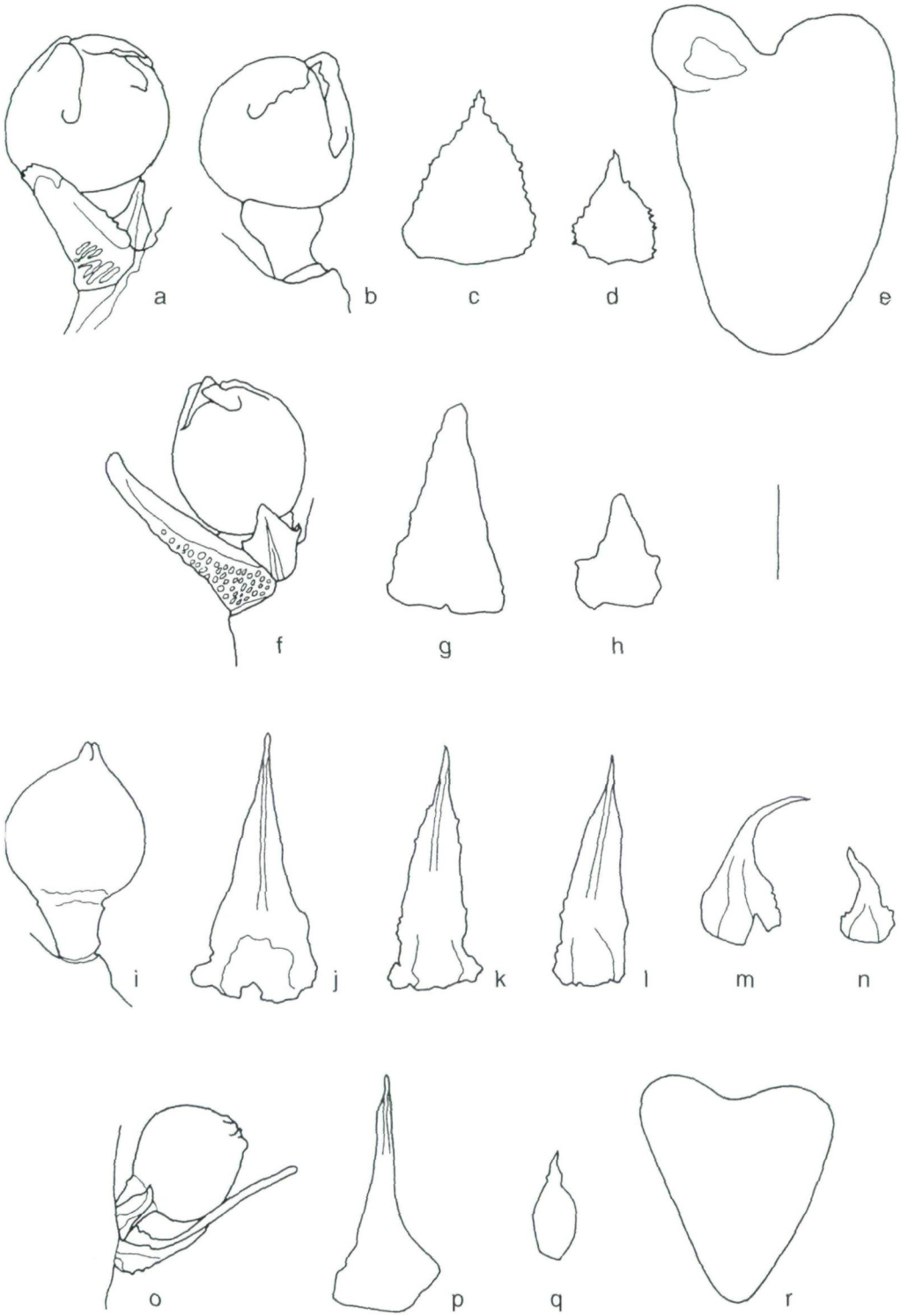
Note: Subspecies *tachirensis* was erected only based on differences in the shape of petals, and in geographical distribution. Of all the specimens ascribed by the authors to this subspecies, only the type collection possesses flowers. Unfortunately all flowers on the two sheets of this collection, which I

Fig. 7: *Perissocarpa steyermarkii* (MAGUIRE) STEYERM. & MAGUIRE (holotype).

received on loan for study, are either in bud or deflorate, and a comparison of mature petals was therefore, not possible. Considering all specimens studied of this species, I was unable to detect any other differences of note that could be used to distinguish any infraspecific taxa. I suppose that either the authors compared petals of different age, or that there is a certain variability in the size and shape of petals, which, taken alone, seems insufficient to distinguish taxa. According to the protologue, subsp. *tachirensis* is restricted to the westernmost Venezuelan Andes, whereas the typical subspecies is found only in the easternmost coastal Cordillera, geographically well separated from the former. Interestingly, specimens of this species from the area of the Guayana Shield are not cited, despite the fact that an earlier collection made in this region by the first author exists (Steyermark et al. 109701, from Cerro Jaua, distributed as "*Rocheria* ?", see also STEYERMARK & BREWER-CARÍAS [1976: 338]).

Small or medium-sized trees to 15 m tall; diameter to 15 cm (specified only on Prance et al. 29123); crown reported to be very dense and the bark reddish (Huber et al. 6317); wood heavy and hard, reddish-brown when dry; bark of a 4 cm thick stem (Liesner & González 10249) grey to brown, ± smooth and covered with minute lenticell-like emergences; **leaves**: petioles (0.3 -) 1 - 2 (- 2.5) cm long, 0.13 - 0.2 cm wide; stipules oblique-triangular, ca. 0.4 x 0.2 - 0.3 cm, mostly long-persistent; vernation lines not always, and often only hardly visible abaxially, ca. 0.7 cm distant from primary vein near leaf-middle; surface in between these lines in a slightly different shade, or often noticeably dirty, but not resinous; lamina completely flat (except for primary vein), dark green and shiny adaxially, light or dull green abaxially (Huber et al. 6317 and Steyermark et al. 109701), uniformly brown on both surfaces when dry, broadly lanceolate to elliptic, sometimes slightly obovate, (4.7 -) 9 - 16 (- 20) x (2 -) 4 - 7 (- 10) cm, broadest near middle; leaf apices acute to acuminate, rarely rounded or retuse; leaf bases long-angustate; primary vein adaxially yellow (Steyermark et al. 109701); **inflorescences** and infructescences lateral or sometimes pseudo-terminal (cf. chapter "Growth form"), (10 -) 14 - 18 (- 24) cm long, including the 2 - 10 cm long and 0.25 - 0.4 cm thick peduncle; main axis several cm long, mostly with some conspicuous, longitudinal angles, pale green; partial-inflorescences mostly 10 in number, 2 - 7 cm long, alternate on main axis, densely subspicate, flowerless proximally, ± finely verrucose, after abscission of fruits with very prominent pedicel-bases and decurrent angles; **flowers** (fig. 8: a - h): bracts narrow to broadly triangular, shorter or rarely as long as flower buds, often with rounded basal angles, with slightly hyaline and irregularly erose margins, ca. 1.9 - 2.2 x 1.2 - 1.5 mm; bracteoles similar to bracts, ca. 1.2 x 0.9 mm; pedicel up to 0.7 mm long and wide at apex; calyx of flower buds divided only in the distal 1/2 - 1/4 of the total length; longitudinally splitting into (2 -) 3 segments at anthesis; segments ca. 2 mm long; calyx-lobes auriculate at base; petals white, ca. 3.6 x 2.7 mm; stamens ca. 1.6 mm long; filaments ca. 0.5 mm long; anthers ca. 1.2 mm long and ca. 0.6 mm wide; pores relatively small, ca. 1/6 of anther-length; ovary ca. 0.7 mm long and 0.9 mm wide; style ca. 0.5 mm long; **fruits** brown to ferrugineous, depressed globose to subglobose, mostly surrounded by a faint longitudinal groove, markedly tapering into the 0.3 - 0.4 cm long and 0.4 cm wide, conical pedicel, which abscises with fruit; larger fruits 1.2 - 1.6 (- 2) cm long (excluding pedicel) and 1.5 - 2 (- 2.5) cm wide.

Fig. 8: **a - h** *Perissocarpa steyermarkii*: **a**) flower bud; **b**) flower bud without bract and bracteoles; **c**) bract; **d**) bracteole; **e**) petal; **f**) flower bud; **g**) bract; **h**) bracteole; — **i - r** *P. umbellifera*: **i**) flower bud; **j - l**) bracts; **m - n**) bracteoles; **o**) flower bud; **p**) bract; **q**) bracteole; **r**) petal; — (a - e: from Steyermark & Rabe 96342, holotype; f - h: from Steyermark & Manara 125174, isotype of "subsp. *tachirensis*"; i - n: from Prance et al. 29080; o - q: from Tavares & Silva 62; r: from Amaral 1561); Bar = 1 mm.



HUBER (1995b: 122 - 123) stated that this species has straight boles, and "typically" light green leaves, possibly with allelopathic properties when decomposing.

Illustrations: flowering and fruiting branch, flowers and various floral organs (STEYERMARK 1984: fig. 8): fig. 8C + H show the calyx segments; fig. 8L - M single calyx segments with 1 - 2 apical calyx lobes; fig. 8I - J actually represent a single cotyledon, not an entire seed; -- flowering branch [slightly modified from isotype at US, showing an untypical apical growth segment], flower and various floral organs (MAGUIRE 1968: fig. 6).

Distribution (fig. 4) and habitat: This species is known from evergreen cloud forests in Venezuela and northern Brazil. In Venezuela it occurs in the Andes (Estado Táchira), in the coastal cordillera (Estados Sucre and Monagas) and on several tepuis in the area of the Guayana Shield (Estado Bolívar, Territorio Federal Amazonas). In Brazil it is known only from the Serra Aracá in the State of Amazonas (STEYERMARK 1987; PRANCE & JOHNSON 1992). This species grows at an altitude between 450 and 1880 m, where it is generally reported to be common: "arbol muy frecuente" (Huber et al. 6317); "common in some spots" (Liesner & González 10249); "most abundant tree in cloud forest, where well over half the trees are of this species" (Prance et al. 29123); "common tree on ridge top" (Steyermark & Manara 125174).

BONO (1996: 148) names the vegetation type where this species grows in the Estado Táchira (western Venezuela) "Bosques ombrofilos submontanos subsiempreverdes, variante sobre areniscas". The area where this type of vegetation predominates is characterized by high and constant humidity, and very dense forests. The very rich flora is stated to be of a relictual character, possessing many endemics, and moreover showing affinities to the floras of the Guayana Shield and Amazon valley.

Perissocarpa (without indication of the species) has also been reported from cloud forests in the Sierra de Maigualida and Serranía Uasadi, where it is a dominant tree at an elevation of 2000 m, and 1900 m, respectively (HUBER 1995b: 122 - 123). Although no herbarium specimens from these localities are available, I suspect that these populations belong to *P. steyermarkii*. In the literature this species has been cited from the following areas: Venezuelan Andes (STEYERMARK 1984; BONO 1996: 686), coastal cordillera (STEYERMARK 1982: 187, 191, as *Elvasia*; 1984); Cerro Duida massif (DEZZEO 1993: erroneously as *P. umbellifera*; DEZZEO & HUBER 1995; HUBER 1995b: 128); Jaua-Sarisariñama massif (HUBER 1995b: 121); Serra Aracá (STEYERMARK 1987; PRANCE & JOHNSON 1992).

Specimens examined (photographs or photocopies of all collections are deposited at W; of specimens at VEN only photographs have been seen):

Venezuela, Estado Táchira, Distr. Uribante, in forest along road from La Siberia to entrance to Las Cuevas Represa, wet, mossy forest with many ferns, 10 Jul 1983 (fl buds), **van der Werff & González 5282** [MO, NY, VEN n.v.], "tree 15 m tall; flowers white; wood sample"; – on Rio San Buena, 10 km W [E!] of La Fundación, areas around Represa Dorada, primary, evergreen forest, soils tending to be sandy, derived from metamorphic rock (schist or gneiss), 7°47 - 48'N, 71°46 - 47'W, 700 - 1000 m, 13 - 15 Mar 1980 (fr), **Liesner, González & Smith 9655** [MO, NY, VEN n.v.], "3 m shrub; fruit brown"; – 10 (airline) km ESE of La Fundación, 23 km by road, around Represa Dorada, 0 - 3 km below dam, primary evergreen forest with patches of secondary vegetation, soils tending to be sandy, derived from metamorphic rock (schist or gneiss), 7°47'N, 71°46 - 47'W, 450 - 650 m, 29 Apr 1981 (fr), **Liesner & Guariglia 11577** [MO, VEN n.v.], "4 - 10 m tree; fruit brown; buds green"; – 10 (airline) km E of La Fundación, 13 to 23 km by road, around Represa Dorada, on ridges, primary evergreen forest with patches of secondary vegetation, soils tending to be sandy, derived from metamorphic rock (schist or gneiss), 7°47 - 48'N, 71°46 - 47'W, 600 - 900 m, 30

Apr 1981 (fl buds, fr), **Liesner & Guariglia 11593** [F, MO 2x, VEN n.v.], "4 - 10 m tree; fruit brown"; – same area, but: 600 - 1000 m, 10 - 13 Mar 1981 (fr), **Liesner & González 10249** [MO 2x + woodsample, NY, U (only photo + woodsample), VEN n.v., W + woodsample], "4 - 8 m tree, common in some spots, fruit brown".

Estado Monagas, Distrito Acosta, Serranía del Turumiquire [correctly: Turimiquire], altiplanicie en la Fila La Montaña, cabezeras del Río Negro (afluente del Río Colorado), en el borde sur de la meseta, en bosque medio adyacente a la fila, 10°02'N, 63°52'W, 1600 m, 12 May 1982 (fr), **Huber, Canales & Vasquez 6317** [MYF n.v., NY, VEN n.v.], "arbol muy frecuente, hasta 15 m de alto, con copa densa; frutos irregulares de aprox. 1 - 2,5 cm de díametro, marrón herrumbre; haz verde muy oscuro, brillante, envés verde claro; corteza rojiza".

Territorio Federal Amazonas, Depto. Atabapo, Cerro Duida, below Salto los Monos on tributary of headwaters of Río Iguapo, slope opposite heliport and camp, 3°35'N, 65°23'W, 1500 - 1650 m, 12 Mar 1985 (st), **Liesner 18603** [MO, NY], "5 m tree, sterile".

Estado Bolívar, Meseta del Jaua, Cerro Jaua, cumbre, porción sur-oeste, este del tributario del Río Marajano, este del campamento, selva de árboles promedio de 20 - 25 metros de alto, 4°48'50"N, 64°34'10"W, 1810 - 1880 m, 28 Feb - 5 Mar 1974 (fr), **Steyermark, Carreño Espinoza & Brewer-Carías 109701** [F, NY, VEN n.v.], [label of specimen at F slightly different: "selva de galeria al borde del tributario del Río Marajano, 1750 - 1800 m", 22 - 28 Feb. 1974"], "tree 15 m tall; leaves coriaceous, dark green above, dull green below, midrip below yellow, elevated; fruiting rachis and infructescence pale green; fruit obovoid, ferrugineous with soft exocarp and mesocarp".

Brazil, State of Amazonas, plateau of northern massif of Serra Aracá, north part of northern mountain near peak, cloud forest, 0°51 - 57'N, 63°21 - 22'W, 1400 m, 17 Feb 1984 (fr), **Prance, do Amaral, Pipoly, Tavares, da Silva, da Mota & Cress 29123** [MO, NY, US], "tree 12 m x 15 cm diam.; fruit ferrugineous; most abundant tree in cloud forest, where well over half the trees are of this species".

Perissocarpa umbellifera STEYERM. & MAGUIRE,
Ann. Missouri Bot. Garden 71: 320 (1984); (fig. 8 - 9)

Type: Venezuela, Amazonas, Cerro Duida, Río Cunucunuma, occasional along ridge trail from Culebra, between rim and camp, 1400 m, 18 Nov 1950 (fl), **Maguire, Cowan & Wurdack 29529** [holotype: VEN n.v. (photo at W); isotype: NY (photo at W)], "shrub to 3 m; flowers white".

Shrubs or small trees 1 - 3 (- 5) m tall; **leaves**: petioles 0.1 - 0.6 (- 1) cm long, 0.1 - 0.15 cm wide; stipules obliquely triangular, gradually tapering distally, ca. 0.5 x 0.2 cm, mostly long-persistent; lamina deep green on both surfaces and subcoriaceous (according to Steyermark et al. 108902), ± discolorous on both surfaces and greenish-brown to grey-brown or brownish when dry, mostly without vernation lines abaxially, flat or densely covered with short striae perpendicular to primary vein adaxially, broadly lanceolate to elliptic, often slightly obovate, rarely ovate, (1.5 -) 5 - 11 (- 13.8) x (1.2 -) 2.5 - 5 (- 6.2) cm, broadest mostly near middle; leaf apices rounded to retuse, sometimes acute, often ending in a small mucro; leaf bases markedly angustate; **inflorescences** and infructescences sessile, 3.5 - 8.4 cm long, surrounded at their base by (1 -) 3 - several crowded, usually smaller, sessile leaves (cf. chapter "Growth form"); partial-inflorescences (3 -) 5 - 10 in number, umbellately arranged on the less than 1 cm long main axis and ascending candelabra-like, subspicate, densely flowered down to the base, strongly grooved longitudinally and angular between pedicel-bases; **flowers** (fig. 8: i - r): bracts narrow triangular, gradually tapering into the acuminate apex, in most cases slightly longer than flower

Fig. 9: *Perissocarpa umbellifera* STEYERM. & MAGUIRE (Maguire et al. 29593).

buds, and with rounded basal angles, entire for most of the length, slightly hyaline and irregularly erose on margins near base, ca. 2.4 - 2.8 x 0.8 - 1.4 mm; bracteoles similar to bracts, but often with curved, tapering apex, ca. 1.0 - 1.6 x 0.5 - 0.8 mm; pedicel 0.4 - 2 mm long and up to 0.6 mm wide at apex; flower buds reported to be yellow (Amaral 1561), their calyx undivided up to the flat or mucro-like apex, at anthesis longitudinally splitting into 2 - 3, ca. 2 mm long segments; calyx-lobes less than 0.2 mm long and scarcely visible; petals white (Tavares & Silva 62) or cream-yellow (Maguire et al. 29712), 2.4 - 3.1 x 2.1 - 2.8 mm; stamens (AMARAL 1991: Abb. 7a) yellow (Amaral 1561), ca. 1.4 mm long; filaments ca. 0.4 mm long; anthers ca. 1 mm long and 0.8 mm wide; pores relatively large, ca. 1/3 of anther-length; ovary ca. 0.8 mm long and 0.7 mm wide; style ca. 0.4 mm long; **fruits** tan or ferrugineous-brown, brown to ferrugineous when dry, depressed globose to depressed globose-bilobate, surrounded by a marked longitudinal groove, abruptly constricted into the 0.1 cm long and 0.2 cm wide, cylindrical pedicel, which rarely abscises with fruit; larger fruits 0.8 - 1.2 cm long (excluding pedicel) and 1.4 - 2 cm wide.

Distribution (fig. 4) and habitat: This species is known to occur on some tepuis in the area of the Guayana Shield in Venezuela (Estado Bolívar, Territorio Federal Amazonas) and northern Brazil (Estado do Amazonas). It grows between 1150 and 2300 m altitude. According to STEYERMARK (1984, 1987) "a small shrub of dwarf forest and rocky, open sandstone terrain". In the Serra Aracá (Brazil) it is reported from "the lower savanna and rocky open slopes on the lower portion" (STEYERMARK 1987), and from "white sand scrub", "scrub forest" and "gallery forest along river" (PRANCE & JOHNSON 1992).

Specimens examined (photographs or photocopies of all collections are deposited at W; of specimens at VEN only photographs have been seen):

Venezuela, Territorio Amazonas, Cerro Sipapo (Paráque) [= probably northern section of the Cuao massif, according to HUBER (1995a: 46)], lower Caño Negro, 1400 m, 11 Jan 1949 (fr), **Maguire & Politi 28091A** [NY, VEN n.v.]; – Cerro Duida, arriba de la Culebra T.F.A., 1250 m, Oct 1983 (fl buds), **Colonnello 738** [MO, NY, VEN n.v.], "arbusto até 1.5 mts alto"; – Cerro Duida, Río Cunucunuma, north escarpment, along escarpment above Culebra, 1400 m, 20 Nov 1950 (young fr), **Maguire, Cowan & Wurdack 29593** [NY], "shrub 1.5 m high; fruit tan"; – Cerro Duida, Río Cunucunuma, Caño Negro basin, north slopes and ridges, 2000 - 2300 m, 23 Nov 1950 (fl), **Maguire, Cowan & Wurdack 29712** [NY], "small tree 4 m high; flowers cream-yellow".

Estado Bolívar, Distrito Sucre, Meseta del Jaua, Cerro Sarisariñama, cumbre, porción nor-este, formación de bosque achaparrado y árboles enanos, 4°41'40"N, 64°13'20"W, 1400 m, 14 Feb 1981 (fr), **Steyermark, Liesner & Brewer-Carías 124300** [MO 2x, NY, VEN 2x n.v.], [label of specimen at NY states behind "cumbre": "sección oriental-central, afloramientos de piedra arenisca en sitios expuesto con vegetacion herbácea y arbustos achaparrados, 2020 m, 4°35'N, 64°15'W"], "sprangling shrub, in early bud stage"; – same locality, 1410 m, 10 Feb 1974 (fr), **Steyermark, Carreño Espinoza & Brewer-Carías 108902** [NY, VEN n.v.], "small slender shrub 2.5 m tall; leaves subcoriaceous, deep green both sides; inflorescence with brown indumentum".

Brazil, State of Amazonas, Município de Barcelos, Platô da Serra Aracá, southern extremity of plateau of northern massif, shrub forest, 0°51 - 57'N, 63°21 - 22'W, 1200 m, 15 Feb 1984 (fl, old fr), **Prance, do Amaral, Pipoly, Tavares, da Silva, da Mota & Cress 29080** [F, MO, NY, US], "shrub 1 m tall; fruit ferrugineous brown"; – same area, parte SE da Serra Norte, vegetação tipo campina, solo arenoso (areia branca), 0°51'N, 63°22'W, 1150 - 1250 m, 14 Feb 1984 (fl), **do Amaral 1561** [NY], "arvoreta de 3 m de altura; flores, estames e botões florais amarelos"; – same locality, mata de galeria ao longo do 1° rio, 0°51'N, 63°22'W, 1150 - 1250 m, 16 Feb 1984 (fl), **Tavares & da Silva 62** [NY, US], "árvore de 5 m de altura, flor branca".

List of exsiccatae

Number in brackets: 1 = *P. ondox*; 2 = *P. steyermarkii*; 3 = *P. umbellifera*

Amaral, do 1561 (3)
Colonnello 738 (3)
Dudley 13127a (1); 13160 (1); 13161 (1)
Huber et al. 6317 (2)
Liesner 18603 (2)
Liesner & González 10249 (2)
Liesner & Guariglia 11577 (2); 11593 (2)
Liesner et al. 9655 (2)
Maguire & Politi 28091A (3)
Maguire et al. 29529 (3); 29593 (3); 29712 (3)
Morawetz & Wallnöfer 16-2288 (1)
Prance et al. 29080 (3); 29123 (2)
Steyermark & Manara 125174 (2)
Steyermark & Rabe 96342 (2)
Steyermark et al. 108902 (3); 109701 (2); 124300 (3)
Tavares & da Silva 62 (3)
Wallnöfer 115-13688 (1); 119-030188 (1)
Werff, van der & González 5282 (2)
Wolfe 12310 (1); 12310a (1); 12310b (1)

Acknowledgments

I gratefully acknowledge the help of many persons: T.F. Stuessy (WU), F. Lauria (W) and H. Rainer (WU) for critically reading the manuscript; M. Röser (LZ) and H. Rainer for photographing specimens at VEN and NY; H. Riedl (W) for helping with the Latin diagnosis; G. Oppel (W) for making photographs; H. Halbritter (WU) for preparing the SEM photographs; A. Farjon (K) for providing literature; R. Liesner (MO) for donating one of his specimens (including wood sample); O. Huber (VEN) for providing additional information; and the curator of the herbarium at Utrecht for sending wood samples of *Elvasia* and *Ouratea*. I am also grateful to the directors and curators of the herbaria F, MO, NA, NY, U, US, and VEN, who kindly made their herbarium material available for study. Field studies were made possible by the Austrian Science Foundation ("Fonds zur Förderung der Wissenschaftlichen Forschung in Österreich"), project Nr. P6399-Bio.

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