A RE-ASSESSMENT OF THE NEW TAXA OF FIRS (*ABIES* MILL.) REPORTED FROM MEXICO IN 1995

Zs. DEBRECZY¹ and I. RÁCZ²

¹International Dendrological Research Institute, Box 812910, Wellesley, MA 02482, USA, E-mail: d-zs-gy@juno.com ²Department of Botany, Hungarian Natural History Museum H-1476 Budapest, Pf. 222, Hungary; E-mail: iracz@bot.nhmus.hu

In the years 1994 and 1995, 10 new taxa of conifers were described and published [IDRI Newsbrief No. 6, September 1994; Phytologia 78(4): 217–243, April 1995]. The authors of the above publications and taxa intend to complement the former contributions with new data and additional illustrations, first, regarding the genus *Abies*.

Key words: new taxa of conifers, Mexico, Abies hidalgensis, Abies neodurangensis, Abies zapotekensis, Abies guatemalensis var. longibracteata, Abies lowiana var. viridula, Hidalgo, Guerrero, Oaxaca, Chihuahua

INTRODUCTION

Following three expeditions to Mexico by the Dendrological Atlas Project team (Zsolt Debreczy, Gyöngyvér Biró, István Rácz and associates), 10 new taxa of conifers (species: *Abies hidalgensis, A. neodurangensis, A. zapotekensis, Pinus yecorensis*; infraspecific: *Abies guatemalensis* var. *longibracteata, A. lowiana* var. *viridula, Pinus yecorensis* var. *sinaloensis, P. oaxacana* var. *diversiformis, P. lawsonii* var. *gracilis, Pseudotsuga menziesii* var. *oaxacana*) were described and published (DEBRECZY and RÁCZ 1994, 1995). The paper which contained limited illustrations only referred to the No. 6 issue of the Newsbrief of the International Dendrological Research Institute, Inc. which publication sufficiently figured all proposed taxa. Circulated mostly for the IDRI membership, only a few libraries received them on regular basis or obtained them upon request; thus, the photos of the habitats and figures of the morphology of the (then) new species were not readily available.

After visiting the regions of these taxa again, and considering the importance of a good illustration for better understanding the concept of the distinguished taxa, we decided to update the former publication with sufficient illustrations and explanation. Three papers are scheduled regarding the subject, the first one on the 5 *Abies* taxa published in 1995.

VIEWS AND SPECIES IN TAXONOMY

This paper does not aim to overview the convoluted problematics of the species concepts and taxonomy, however, we briefly touch the problem regarding the taxa which were published by us from Mexico, and draw attention to the fact that to lump species without further thorough (if possible, population) study often does not solve the initial problem while hinders possible conservation of a genotype.

The Flora Neotropica Monograph 75 on Pinus (FARJON and STYLES 1997) did not accept any of the four pine taxa we proposed and described, although we studied all species of the Mexican pines very carefully before we published them. Also, the well compiled "World checklist and bibliography of conifers" (FARJON 1998) lists only Abies hidalgensis as valid among the firs we described in the 1995 paper, while the rest were considered synonymous (Abies neodurangensis = A. durangensis, Abies zapotekensis = A. guatemalensis, Abies lowiana var. viridula = A. concolor, Abies guatemalensis var. longibracteata = A. guatemalensis, Pinus yecorensis = P. pseudostrobus, P. y. var. sinaloensis = P. pseudostrobus, Pinus oaxacana var. diversiformis = P. apulcensis, Pinus lawsonii var. gracilis = P. lawsonii, Pseudotsuga menziesii var. oaxacana = P. menziesii). While on one hand we very much agree that taxonomists should accept/assign a much wider range of variability from/to a taxon (actually the study of a population of offsprings in different climates would be ideal before the description of a taxa), that to avoid the labyrinthine fragmentation of the species, it often the case that a lumper's view may cause more damage to species knowledge and conservation than add to it. The discovered Oaxacan Pseudotsuga menziesii var. oaxacana, e.g. can be considered as P. menziesii (as did the mentioned checklist), however, its different morphology (of which we obviously cannot separate out what is climatic adaptation, pheno- or genotypic changes, but will, however, appear in a larger populations in cultivation, particularly in a different climate) and resistance to ecological factors may not support the drop of its variety rank. Its different growth and hardiness also may disappoint the applied botanical field, just to mention a single factor, which supports the distinguishing name and may indicate a higher rank of difference than a simple "provenance". The name P. menziesii var. oaxacana therefore may survive as a distinguished taxon, just like that of the continental race/taxon of P. menziesii, the "var. glauca" which "secretly" survives in practice for many good reasons (appearance, growth, hardiness, etc).

One could easily say that the long bracted Guatemalan Fir (*Abies guatemalensis* var. *longibracteata*) with exserted bracts – formerly known only from the Tacaná volcano (*A. g.* var. *tacanensis* – there, however, also with recurved leaf margin) is not enough for distinguishing it from the typical *A. guatemalensis*. Indeed the character of exserted bract may randomly appear in quite a wide range of fir species, which typically have included bracts (*i.e. A. cilicica, A. numidica, A. balsamea*, etc.). If, however, it appears regionally, it may deserve a variety rank – simply to get a clearer indication regarding the plant we may expect. Lumping them, again, is not indeed helpful before making a larger population study and convincing evidence that the "*exserted*" and "*included*" bract, recurved leaf margin etc. in these species (even if regionally typical) have no taxonomic value.

Abies lowiana var. viridula is the only record of A. lowiana in Mexico. The "continental A. grandis" has not been distinguished earlier from A. concolor in Mexico. Although foliage colour in general is not an important character, this variety was quite unique with the uniform green colour contrasting the grey hue of the northern types.

While accepting the different views in taxonomy, the good in both the conception of lumpers and splitters, we feel that we have to redraw the botanists' attention to the species noted and described by us for two reasons: because they are completely different than those they were lumped with and because lumping them may harm conservation goals. A taxon which is a good species or marked variety can be saved if recognised on the proper level, while it may become extinct before saving its genotype, simply because it was considered unjustly the same as another one. The difference *i.e.* between *A. neodurangensis* and *A. durangensis* is as marked as, for instance, that of *A. grandis* and *A. magnifica.* The small population of *A. neodurangensis* in the Sierra Madre Occidental near the border regions of Sinaloa and Durango states, as far as we know, is critically endangered.

Abies zapotekensis which was found very similar to the (widely accepted; also in FARJON 1998) A. hidalgensis grows in a hidden valley of Oaxaca east of Ixtlan de Juarez in a transitional oak-pine/cloud-forest region among scattered specimens of A. hickelii. It differs from A. guatemalensis at least in the scale of A. grandis and A. lowiana and, as described below, has twice as many (4) resin canals as the Guatemalan Fir.

The original descriptions of the new *Abies* taxa found in Mexico (the text is complemented here with 38 new images and reference captions)

For a long time (since 1932), only *Abies hickelii* Flous et Gaussen, a species of southern Mexico, was known to have more than two (typically 8–12) resin canals in its leaves (*A. oaxacana* Martinez is treated here as a synonymous with *A. hickelii*). A new species was found in the montane "cloud forest" region of Hidalgo (*Abies hidalgensis* Debreczy, Rácz et Guízar, see below) with (typically 4–5) up to

7 median resin canals in the leaves; and soon after, surprisingly, another species with 4 resin canals was located in the similarly mild and humid habitat of a hidden valley in the state of Oaxaca (A. zapotekensis Debreczy, Rácz et Ramírez, see below). The taxonomic value of the number and position of the resin canals is well discussed in the literature (ORR 1937, LIU 1971, etc.), GAUSSEN (1964) thinks that marginal position of the resin canals is a younger character than median, supported by the observation that leaves on sterile shoots usually have marginal resin canals. while fertile ones of the same specimen are typically median (FERRÉ 1941). The phylogenetic importance of the resin canal number is little understood. Except for A. hickelii in Mexico, only two species: A. firma Sieb. et Zucc. of Japan and A. bracteata (D. Don) A. Poit, of Pacific North America were known so far occasionally to have more than two, namely 4, resin canals. We suspect that this is either an ancient, "primitive" character or the consequence of rapid changes in climatic circumstances during the history of the species. In the ancient group of Gymnosperms, Podocarpus (in a broad sense) there are several species with more than two resin canals (e.g., up to 10 in sect. Eupodocarpus such as in P. rostratus Laurent) and their position is typically median. Further study for a better understanding of the systematic position of these newly discovered relict, endemic species, should involve the investigation of questions relating to the number of the resin canals.

There were only a few fir species known in Mexico having enclosed bracts: excluding the southernmost types of *Abies concolor* (Gord. et Glend.) Lindl. ex Hild. known from northern Mexico, together with *Abies magnifica* A. Murr. in Baja California, only *Abies guatemalensis* Rehd. (not including *A. g. var. tacanensis* (Lund.) Mart. and the variety described here (var. *longibracteata* Debreczy et Rácz)), *Abies durangensis* Mart., *A. d. var. coahuilensis* (I. M. Johnst.) Mart. and *Abies guatemalensis* was described by Alfred Rehder in 1939, the others by Maximino Martinez in 1942. More recently, biol. Sergio Zamudio Ruiz (Instituto de Ecologia, C. R. Del Bajio, Patzcuaro, Michoacán) reported (pers. comm.) a species from the state of Querétaro with two resin canals and short, enclosed bracts. Our recent exploration extended this list by three more species having this character: *Abies hidalgensis*, *A. neodurangensis* Debreczy, Rácz et Salazar, and *A. zapotekensis* (see below).

Abies guatemalensis, a species with enclosed bracts (Figs 19–20, 31, 34), has an extended population in Guerrero with relatively large cones and exserted bracts described here as *A. guatemalensis* var. *longibracteata* (Figs 1, 29–30, 32). So far only a southern form with fine needles, hairy branchlets, and smaller, narrow cones was known to have bracts exceeding the cone scales (var. *tacanensis* (Lund.)

Mart.) from the high region of the Volcán Tacaná, Chiapas. The new variety appears to be much more extended in Mexico than the species itself.

Abies lowiana (Gord.) A. Murr., a species not consistently recognised by botanists and mistakenly, often included in A. concolor (A. c. var. lowiana (Gord.) Lemm.) is reported here from "south of the Rio Grande", north of the town of Madera, Chihuahua. With its A. grandis (Dougl. ex D. Don) Lindl.-like pectinate arrangement of the leaves on shade branches (Figs 27–28) and young trees, a character that never appears in A. concolor, A. lowiana is more related to the previous species than to A. concolor in a strict sense. It is important to distinguish this species from the latter taxon, which is fairly frequent in the northwestern region of Mexico. Found here with surprisingly lustrous green foliage (always pruinose grey in the north), it is considered a new variety of A. lowiana.

DESCRIPTIONS

1. Abies hidalgensis Debreczy, Rácz, et Guízar¹, Figure 1: c1–c3; Plate I: 1 in *Phytologia* (April 1995) **78**(4): 217–243; "Abies A" in *NewsBrief* (IDRI) No. **6** (Sep. 1994); Figs 2, 9–10) in the present article. – TYPUS: Mexico, eastern Hidalgo: 4–5 km north of Metepec, 2,300 m, June 12, 1994. Debreczy, Rácz, Biró *et al.* #40323 (Holotypus: BP; Isotypi: A, CHAP, E, MEXU, NA).

Arbor ad 18 m alta, trunco simplici; habitus columnari-conicus; cortex rasilis, in arboribus juvenilibus pallide cinereus, postea in laminas irregulares magnas ruptus, in arboribus vetustis valde crassus et suberosus, pars interior corticis sanguinea; rami fusci, vel cinereo-fusci, usque ad 5-6 annos pilosi; ramuli validi, rasiles, pilis 0.2-0.3 mm longis, densis, flavo-brunneolis diaphanis cooperti; gemmae (partim foliis brevibus, incurvatis, terminalibus occultae) rotundato-desectae, tenuiter resinosae, squamis usque ad 15 triangularibus vel saltem apicibus squamorum tectae; folia pectinatim distributa, (1-)3-5(-6) cm longa, abrupte abbreviata (usque ad 1 cm longa) in ramulis externis leviter deorsum et/vel versus apicem ramulorum inclinata, aciebus parallelis, apicibus rotundata et breviter (0.2-0.4 mm), sed conspicue emarginata vel subtiliter bifida, in positione umbrosa mollia flexibilia vel in acumine arboris aliquantum quasi succulenta; pagina dorsalis eorum atroviridis vel glauco-viridis, lineis stomatum usque ad 14, in ramulis ad lucem expositis deorsum medium folii attingentibus, sed in positione umbrosa plerumque 6 lineis brevibus, ad apicem folii litteram "V" formantibus; pagina ventralis argenteo-cinerea cum margine angusto (0.2 mm), viridi et costa media 0.2-0.4 mm lata, saepe cum lineis stomatum infractis; limitibus lateralibus bilateraliter singulis argenteis, lineis stomatum typice 14-15 (in positione umbrosa in foliis angustis 5-6) instructis; lineis stomatum cum stomatibus 9 pro 1 mm; stomata 0.06 mm longa, elongato-ovata, intense pruinosa; folia ramulorum infernorum in sectione transversali plano-triangularia, sed ramulorum fertilium triangularia cum canalibus resiniferis medianis usque ad 7(!); strobili feminei

M. C. Guízar N. Enrique, Div, de Ciencias Forestales, Universidad Autonoma Chapingo, México.

juveniles 2.5–3 cm longi, bracteae eorum initio adpressae postea reflexae (4–5 mm), rotundato-triangulares, irregulariter serrato-incisae, pallide virides; **strobili masculini** 12 mm longi, pedunculo 3 mm longo, squamis pilosis circa 100 (20 × 5), 1.8 mm latis; **strobili maturi** 6.5–8 cm longi, 3.5–4 cm lati, pedunculo 0.4–1 cm longo, cylindracei, apice rotundati, leviter umbilicati; **squamae** 130–170 (25–34 × 5) pro strobilis, flabellatae, virides, glauco-virides, dense velutinosae, pili 0.2 mm longi, albidi, adpressi; **bracteae** 0.5–0.8 cm longae, sessiles, leviter spathulatae, cum ala acute incisoserrata, rotundata, sine apice protrudenti; **axis** anguste-conicus; **semina** anguste-triangularia, resino-vesicularia cum ala cinereo-straminea.

Description: tree with straight, typically single trunk, columnar-conical crown, first ascending, later descending branches, shiny- (or in sunny and dryer places) dull grevish-green, pruinose foliage; bark: smooth, light grev in young trees, later ruptured to irregular large plates, very thick and subcrous on old trees with bloodred inner bark; branches: light brown, later greyish brown, hairy (up to 5-6 years); branchlets: rather strong, smooth, slightly prominent below the leaves on strong shoots, densely pubescent with 0.2-0.3 mm long yellowish brown, semi-clear hairs; buds: flat (partially hidden by short, incurving terminal leaves), covered by up to 15 triangular scales or their tips, thinly resinous; leaves: pectinately arranged, "distichous", abruptly shortened (to 1 cm) on the upper (dorsal) side of the branchlets, slightly downward and/or forward curving, (1-)3-5(-6) cm, parallel sided, rounded and shortly (0.2-0.4 mm), but markedly, emarginate or finely bifid, soft flexible (shade) or rather fleshy (upper crown), shiny dark- or dull greyish-green with up to 14 stomatophorus lines on the upper (dorsal) side reaching below the middle of their length on stronger exposed stems, usually 6 short lines form a (0.6-1.0 mm long) "V" below the apex on shade leaves; lower (ventral) side is silvery grey with narrow green margins (0.2 mm) and midrib (0.2-0.4 mm, often with broken lines of stomata), two broad silvery stripes, typically with 14-15 (in narrower shade leaves 5-6) stomatophorus lines with 9 stomata/mm; stomata 0.06 mm long, elongated ovate, intensively pruinose; leaves in cross section flat triangular on lower, triangular on fertile branchlets with up to 7(!) median resin canals; strobiles: female 2.5-3.0 cm long with short, first appressed later reflexed (4-5 mm) rounded-triangular, irregularly serrate-incised pale green bracts; male strobile 12 mm on 3 mm peduncle, consists of about 100 (20 × 5) 1.8 mm wide, hairy fertile scales; cones: 6.5-8.0 × 3.5-4.0 cm, short (0.4-1.0 cm) stemmed (peduncled), cylindrical with about 130-170 (25-34 × 5) cone scales (Fig. 9); rounded, slightly impressed (umbilicate) at apex, pruinose green at maturity; cone scales: flabellate (wide cyathiform), green, greyish green, densely velutinous with short (0.2 mm), white, appressed hairs; bracts (0.5-0.8 cm) short, enclosed (sessile), slightly spathulate with sharply incised-serrate, rounded wings and without a protruding tip; axis narrow conical; seeds: narrowly triangular with resin blisters and narrow, light yellowish gray wings (not fully developed at the time of the description).

Named after the central Mexican state of Hidalgo where the species was found. The name also recalls Miquel Hidalgo y Costilla (1762–1811), a prominent personality of the post-Columbian Mexican independence movement, after whom the state itself was named.

Discussion: this rare and distinct tree with 5-7 resin canals in the needles and green cones with short, enclosed bracts was found in the state of Hidalgo in an area where (in the wider region) only Abies religiosa (H., B. et K.) Schlecht. et Cham. was known. The latter is completely different with its strongly curved, pointed (not bifid) leaves with two resin canals (not up to 7) and 2-3 times larger cones with long exserted, recurved bracts of prominent tip. Abies guatemalensis Rehd., a southern species with (typically) "bractless" cones, not known as far north as Hidalgo, has twice as many leaves on an equal length of (shade) branchlet with straight needles curving to almost a right angle from the stem (not curved, directed forward), with two resin canals (not up to 7). In A. guatemalensis the cones are typically pruinose blue (not pruinose green changing to light brown), have wide cyathiform "wing shaped" (not flabellate) cone scales with elongated (not short) basal section and slightly enclosed or finely exserted (not short, sessile) bracts with finely protruding (not absent) tip. Other species such as A. vejarii Mart. of northeastern Mexico (with short, curved, succulent needles with two resin canals, close to or exserted bracts) are too distinct even to be compared with the new species.

Discovery: the species was found in a deep canyon running eastward, a few miles above the small village of Metepec (Fig. 10). The first tree was seen on April 3, 1994 on the upper rim of the canyon near a sharp turn downward toward Poza Rica and Tampico at an elevation of 2,350 m. The tree, old and struggling with only a few upper branches alive, had no cones or cone axils, but the distinct foliage and bark immediately suggested that it does not belong to any species known. In this extremely cloudy area we had no opportunity to continue the exploration at that time. Sterile branches were transferred to the Division de Ciencias Forestales, Universidad Autónoma Chapingo (DCF/UACH) to preserve the (possibly sole) tree under #38672.

We returned to the area on June 12. This time we saw more trees deep in the valley along with old cypress trees (*Cupressus lusitanica* Mill.). In spite of an early start, we had only a few minutes before the clouds filtered up and hid the valley. Realising the difficulty of reaching the trees from our position and having no evidence of cones, we went to the section of the canyon where the lone tree was found a few months earlier. We had good fortune for a few seconds and located a tree on a nearly vertical slope, 20 m above the right side of the river. The tree has had many cones, which were not ripe yet but seemed to be fully developed in size. Soon we found it to be identical to our #38672, but it was much younger with different bark

and less glaucous needles (DRB #40323; type). Conifers associated with this fir are *Pinus patula* Schltdl. et Cham., *P. pseudostrobus* Lindl. var. *apulcensis* (Lindl.) Mart.), and *P. teocote* Schltdl. et Cham. in its upper distribution, and (a few) *P. patula* trees in the evergreen cloud forest in the canyon. At the site of the specimen we found 36 accompanying species among which the dominating were *Quercus laurina* H. et B., *Ternstroemia pringlei* Rose and *Cestrum fasciculatum* (Schltdl.) Miers / *purpureum* (Lindl.) Standl. with *Alnus firmifolia* Fern., *Buddleia cordata* H., B. et K., *Ptelea trifoliata* L., *Sambucus mexicana* Presl and *Syngonium podo-phyllum* Schott.

Preservation: declaring the entire canyon as conservation land was proposed. Further study and conservation was planned in collaboration with Dr. Enríque Guizar Nolazco, DCF/UACH.

Participants in field work: Dr Gyöngyvér Biró, Dr Zsolt Debreczy, Dr István Rácz (IDRI and Hung. Nat. Hist. Museum, Budapest, Hungary), Éva Kertész (Botanical Collection, Munkácsy Mihály Múzeum, Békéscsaba, Hungary), Vince Zsigmond (University of Horticulture, Budapest, Hungary), Yinghao Zhao (Botanical Garden of the Chinese Academy of Sciences, Beijing, P. R. China).

2. *Abies neodurangensis* Debreczy, Rácz et Salazar², Figure 1: a1, a2; Plate I: 2 in *Phytologia* (April 1995) **78**(4): 217–243; "*Abies* B" in *NewsBrief* (IDRI) No. **6** (Sep. 1994); Figs 4, 24, 27–28 in the present article. – TYPUS: Mexico, southwestern Durango: near Los Bancos (Ejodi la Victoria Paraje, San Antonio, Ejido El Brillante Paraje, Santa Barbara, Arroyo del Infierno), 2,500 m, May 13, 1994, Debreczy, Rácz, Biró *et al.* #39936 (Holotypus: BP; Isotypi: A, CHAP, E, MEXU, NA).

Arbor ad 40 m alta, trunco simplici; **habitus** initio laxe conicus, postea densior, vertice rotundata; **cortex** rasilis, in arboribus juvenilibus pallide cinereus, postea in arboribus vetustis in laminas irregulares magnas ruptus, pars interior corticis sanguinea; **rami** ferruginei, usque ad 5–6 annos sporadice pilosi, pilis subtiliter pellucidis; **ramuli** pallide virides ad cinereo-brunnei, dense vel in positione umbrosa parce pilosi, pilis pellucidis 0.1-0.15 mm longis; **gemmae** in ramulis vegetativis typice subglobosae, 2–3 mm longae, non-resinosae, gemmae in ramulis terminalibus planae (6–7 × 3 mm) cum 12–18 squamis triangularibus, 3 mm longis, nitidis, brunneis costa prominenti et margine eroso instructis; **folia** dichotoma, late distantia, leviter ascendentia, in latere superiori ramulorum prorsus inclinata, aciebus parallelis, apicibus rotundata et leviter (0.1 mm) emarginata; flexibilia, in pagina dorsali viridia, lineis stomatum usque ad 7 paene apicem attingentibus et lineis aliquot prope basin foliorum praeter costam impressam; in pagina ventrali argenteo-alba, cum margine angusto viridi (0.1 mm) et costa (0.25 mm lata), et limitibus lateralibus bilateraliter singulis argenteis, lineis (6–)9(–10) stomatum instructa; stomata 0.03 mm, ovata; folia in ramulis fertilibus saepe asymmetrice acuta, aliquantum succulenta cum limite pruinoso 0.2 mm lato superne lineis stomatum usque 8;

2 Rosalva Miranda Salazar, UCODEFO No. 6, El Salto, Durango, México.

costa crassa usque 0.7 mm lata, praeter costam lineis 6–8 stomatum angustis 0.35 mm latis; folia ramulorum infernorum in sectione transversali elliptico-avicularia, obovata, folia ramulorum fertilium in sectione transversali obovata (elliptica), canalibus resiniferis marginalibus 2, latero-ventralibus; **strobili** breves, columnares, 6.5–8.5 cm longi, 3–3.6 cm lati, initio virides, postea virido-brunnei, umbone prominenti; strobili velutini, pilis 0.1–0.13 mm longis, pellucidis, erectis; **squamae** 150–200 (30–40 × 5), flabellatae; **bracteae** sessiles, 0.5–0.8 cm longae, ala angulari, protrudenti, apice 3–4 mm longo; **axis** anguste-conicus; **semina** $0.8–1 \times 0.8$ cm, ala 1–1.4 cm longa, obtusato-triangulari instructa.

Description: tree up to 35-40 m tall with single trunk, loose conical, later dense, round-topped crown with first ascending, later descending branches; bark: smooth light grey first, later ruptured, in old trees very thick, suberous with bloodred inner bark; branches: reddish brown, sporadically hairy with fine clear hairs up to 5-6 years; buds: vegetative buds typically subglobose, 2-3 mm long, terminal one flat $(6-7 \times 3 \text{ mm})$ on strong fertile shoots with 12–18 triangular, 3 mm long, wide, shiny brown scales with prominent midrib and eroded margin, not resinous; branchlets: light green to greyish brown, densely or sparsely (shade) hairy with 0.1-0.15 mm long clear hairs; leaves: on stem, "dichotomous", widely spreading, slightly ascending, forward curving on the upper side, 3-5 cm long, 1.5-2.2 mm wide, parallel sided, rounded and slightly (0.1 mm) emarginate at apex, flexible, shiny dark green above with up to 7 stomatophorus lines near the apex and a few lines down near the base of the leaves along the impressed midrib, the ventral side is silvery white with narrow green margins (0.1 mm) and midrib (0.25 mm) and two silvery stripes with (6-)9(-10) stomatophorus lines, stomata 0.03 mm, ovate, leaves on fertile shoots often asymmetrically (on one side) acute, more succulent with wide (0.2 mm) pruinose stripe above, with up to 8 stomatophorus lines, midrib strong, up to 0.7 mm wide, the stomatophorous stripes are narrower (0.35 mm) with 6-8 lines of stomata. In cross section the leaves are ellipto-avicular, obovate (elliptical) on lower, obovate on fertile branchlets with 2 marginal latero-ventral resin canals; cones: short, columnar $(6.5-8.5 \times 3-3.6 \text{ cm})$ with prominent umbo, consist of $150-200 (30-40 \times 5)$ cone scales, bright light green first, greenish brown later, velutinous with 0.1-0.13 mm long upright clear hairs, cone scales: flabellate with short (0.5-0.8 cm), enclosed (sessile) bract with protruding angular wings exceeding the 3-4 mm long apex; axis narrow conical; seeds: 0.8-1 × 0.8 cm with 1-1.4 cm long, rounded-triangular wing; fully developed but not mature when studied.

Named after the state where the species was found with *neo*- (Lat. prefix = new-) as anterior is to distinguish it from *Abies durangensis* Mart., the well known and widely distributed (although not common) species of the region.

Discussion: this fir with "Abies grandis (Dougl. ex D. Don) Lindl,-like" appearance is characteristic with two resin canals in its needles, the early appearance of the strobiles, and green cones with enclosed, sessile bracts. It was found in a canyon on the Pacific side of the sierra close to the Durango-Sinaloa border. Although enclosed bracts and two resin canals exist in the leaves of both, it can readily be distinguished from A. durangensis by its densely hairy, dark purplish brown (not subglabrous-glabrous vellow or pruinose) branchlets, glabrous (not thickly resinous), straight (not curved), green (not grey pruinose), rounded-emargianate (not pointed) leaves (Figs 23, 25-26, versus Figs 24, 27-28) with median (not marginal) resin canals, cones with very short, enclosed (sessile) bracts with prominent laminal wings forming a "V" exceeding the shortly protruding tip (not subsessile), nearly reaching the "exposure line" (the inner limit of the exposed part, "scale head" of the cone scale) and triangular-acute at end. It has cones almost fully developed in size by the time A. durangensis "blooms". It is very distinct from, and not even comparable to, A. concolor (Gord. et Glend.) Lindl. ex Hild. or A. lowiana (Gord.) A. Murr.

Discovery: on May 13, 1994, while heading from Capilla Textla, Sinaloa to El Salto, Durango, just 3 miles before reaching the plateau, that is on the warmer, western side of the sierra (identified later as Ejido la Victoria Paraje, San Antonio and Ejido l Brillante Paraje, Santa Barbara) we noticed a fir with fully developed, although not mature, green cones. Travelling to document the cone-inflorescences (strobiles) of *Abies durangensis*, we were surprised to see a species in cone. Having the samples in hand, we realised that it was a completely different species, at first sight most similar to *A. grandis*, a species of the Pacific North. At an altitude of 2,500 m, the trees are growing in the margin and upper part of deep canyons associated with the dominating *Hydrangea seemannii* Riley and 12 other species such as *Alnus firmifolia* Fern., *Cornus disciflora* DC., *Garrya laurifolia* Hartw., *Litsea glaucescens* H., B. et K. and *Quercus magnoliifolia* Nee.

Conservation: we found only a few mature trees. Although the difficult site seems to secure the species, the preservation of the habitat(s) is immediately necessary. Young plants are present, but not many. We reported to Dir. Tec. Felipe Norberto Coria Quinone and Biol. Rosalva Miranda Salazar at Unidad Conservacion y Desarollo (UCODEFO) No-6, El Salto, and proposed to establish at least a few hectares of conservation land in the canyon. The protection seems to be secured and further studies are ongoing.

Participants in field work: Dr Gyöngyvér Biró, Dr Zsolt Debreczy, Dr István Rácz (IDRI and Hung. Nat. Hist. Museum, Budapest, Hungary), Éva Kertész (Botanical Collection, Munkácsy Mihály Múzeum, Békéscsaba, Hungary), Vince Zsigmond (University of Horticulture, Budapest, Hungary). 3. Abies zapotekensis Debreczy, Rácz et Ramírez³, Figure 1: d; Plate I: 3 in *Phytologia* (April 1995) **78**(4): 217–243; "*Abies* C" in *NewsBrief* (IDRI) No. **6** (Sep. 1994); Figs 5–8, 17, 21–22 in the present article. – TYPUS: Mexico. Oaxacana: Sierra de Juárez, near Portillo, 2,700 m, June 30, 1994, Debreczy, Rácz, Biró *et al.* #40675a (Holotypus: BP; Isotypi: A, CHAP, E, MEXU, NA).

Arbor ad 20 m alta, trunco simplici; habitus laxe-conicus; cortex rasilis, arboris juvenilis pallide cinereus, postea in laminas irregulares ruptus; rami castaneo-brunnei, usque ad 5-6 annos sporadice pilosi; ramuli virides-flavovirides, tenuiter pubescentes, pilis 0.10-0.13 mm longis, leviter infuscato-subpellucidis, basin versus leviter contractis; gemmae (foliis brevibus, incurvatis, terminalibus partim occultae) rotundato-desectae, squamis usque ad 15 triangularibus tectae; externe non-resinosae; folia subdisticha, ascendentia, ad apicem leviter inclinata, litteram "V" patentem formantia, in ramulis lateris dorsalis aliquantum breviora et conspicue reflexa, 3-5 cm longa, 2 mm lata, aciebus parallelis, apice rotundata et breviter (0.14-0.20 mm) emarginata; flexibilia, aliquantum coriacea nitide atroviridia; folia cum/sine lineis stomatum usque ad 5, 2-3 mm longis, prope apicem folii, vel in ramis crassis lineis 2-3 deorsum infra medium folii; pagina ventralis argenteo-cinereus cum margine angusto (0.15-0.20 mm) viridi et costa media 0.2-0.4 mm lata, saepe cum lineis stomatum infractis vel a stomatibus omnino tecta, limitibus bilateraliter singulis argenteis, lineis stomatum typice 14-18 (in positione umbrosa in foliis angustis 10-12) instructis; stomata 12-13 pro 1 mm, 0.03-0.04 mm longa, anguste elongata; folia in sectione transversali plana, avicularia usque epsilon-formia cum canalibus resiniferis medianis 2-4(!); strobili feminei juveniles 3-4 cm longi, bracteis brevibus, initio adpressis postea reflexis (4-5 mm), rotundatis, irregulariter serratis, pallide viridibus, sine costa protrudenti marginem excendenti; strobili masculini 1.2 cm longi, squamis pilosis circa 100 (20 × 5) 1.8 mm latis; strobili maturi 8-9 cm longi, 3.6-4.2 cm lati, cylindracei, rotundati, virides, glauco-virides, pedunculus 0.4-0.8 cm longus; squamae 150-190 (25-38 × 5) pro strobilis, aliformes, subtiliter velutinosae, pilis 0.03-0.06 mm, erectis; bracteae 0.8-1 cm longae, sessiles, apice leviter litteram "V" formantes cum alis 2 inciso-serratis, fimbriatis costam non-prominentem excendentibus; axis anguste-conicus; semina 11 mm longa, 3 mm lata, ala 21 mm longa, 12 mm lata, cucullo 7 mm longo.

Description: tree up to 20 m with straight, usually single trunk, loose columnar-conical crown, ascending and horizontally spreading, later slightly descending branches, with shiny dark green foliage; **bark**: thin, smooth, light grey in young age, later ruptured to irregular plates; **branches**: chestnut brown, sporadically hairy up to 5–6 years; **bud**: (partially) hidden by short, incurving terminal leaves, flat, covered by a few, up to 15 triangular scales, not resinous outside; **branchlets**: green, yellowish green, thinly pubescent with fine (0.10–0.13 mm long), faintly brownish subclear hairs, slightly contracted toward their base; **leaves**: on stem "subdistichous", ascending, and slightly forward directed, forming an open "V" on the upper (dorsal) side of the branchlets, somewhat shorter and conspicuously re-

3 Biól. Gustavo Ramírez Santiago, of Ixtlán de Juárez, Oaxaca, México (in 2003: Director General, Corredor Biológico Mesoamericano – México Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, Tlalpan, México, D.F.)

flexed when (in helical order) they reach or leave their uppermost position on the branchlets, 3-5 cm long, 2 mm wide, parallel sided, rounded and shortly (0.14-0.20 mm) emarginate, flexible and rather leathery, shiny dark green with or without up to 5 (2-3 mm long) stomatophorus lines on the tip of the leaves or on stronger branches with 2-3 lines reaching below the middle of the length of the leaves, their ventral side silvery grey with narrow green margins (0.15-0.20 mm) and midrib (0.2-0.4), often with broken lines of, or completely covered by stomas and two broad silvery stripes, typically with 14-18 (in narrower shade leaves 10-12) stomatophorus lines with densely set (12-13 mm), fine (0.03-0.04 mm) narrow elongated stomata; leaves in cross section flat, "avicular" to "epsilon" shaped with 2-4(!) median resin canals; strobiles: female: 3-4 cm long, with short (4-5 mm), first appressed, later reflexed, rounded, irregularly serrate, pale green bracts with sessile midrib exceeded by margins: male: 1.2 cm long on 3 mm peduncle, consist of about 100 (20×5), 1.8 mm wide, hairy fertile scales; cones: $8-9 \times 3.6-4.2$ cm, short (0.4-0.8 cm) stemmed, "peduncled", cylindrical, rather smooth in outline with $150-190 (25-38 \times 5)$ cone scales; rounded at apex, green, greyish green before fully ripened, cone scales: "wing-shaped", finely velutinous with very short (0.03-0.06 mm), upright hairs; bract short (0.8-1.0 cm), enclosed (sessile), slightly "V" shaped at end with incised serrate, fimbriate wings exceeding the nonprominent midrib; axis narrow conical; seeds: 11 × 3 mm, wing 21 × 12 mm with 7 mm long hood.

Named after the indigenous people living in the area where the species was found. Zapotecs (here *Zapotek* to avoid the sound modification in Latin of "c" before "e") are the largest native nation of Oaxaca, with a macro-otomangue language and old culture (Monte Albán). They are by nature friendly and excellent in forest management and conservation.

Discussion: this rare species with two to four resin canals in the leaves, green cones with short (sessile), inserted bracts, was found in a hidden valley of the cloud forest region northeast of the town of Ixtlán de Juárez, Oaxaca, in an area where only *Abies hickelii* and (very locally in the wider region but not near the site) *A. guatemalensis* was known. Although crown and foliage is similar at first sight, *Abies hickelii* is completely different with its slightly emarginate (not bifid) and very dark green leaves with up to 13 resin canals (not 2–4) and larger (10–12 cm long), blue-pruinose (not pruinose green) cones with long exserted, upright, pointed (not enclosed, sessile) bracts with prominent tip (Figs 15, 17–18, 21–22). *Abies guatemalensis* has similarly "bractless" cones (Figs 19–20), but it has a denser foliage (close to twice as many leaves as it is in this species on equal length of comparable shade branchlets), straight and vertical (not subdistichous, partially ascending on the stem) and has two (not 2–4) resin canals. The cones of that spe-

cies are typically pruinose blue (not green) with wide cyathiform "wing shaped" (not flabellate) cone scales with elongated (not short) base section, its bracts are slightly enclosed or occasionally finely exserted, (not short, "sessile"), with finely protruding (not absent) tip.

Discovery: the species is known so far only from a wide valley about 10 km directly northeast of Ixtlán de Juárez, toward the place called Portillo, at an altitude of about 2,700 m. We first visited this site in December 1991 and later on February 4, 1992. Faced with logging roads, often muddy and with many divisions, we asked the help of Mr Gustavo Santiago Ramírez, a native of Ixtlán (then a biology student at the Instituto Politécnico Nacional, Ciudad de México) to help us in exploring the area. During our second trip with the local commissariat and with the guidance of Sr Ignacio Crisoho, we made collections of a fir we considered to be Abies hickelii from a distance, but curious because of its green cone-inflorescences (DRB # 32957a, Fig. 17). On the basis of the different shape of the bracts and green colour of the strobiles, we suspected that it was a new species and decided to make a new collection later. On June 30, 1994, we made a third trip to the area and we obtained full size cones, which proved it to be a new species to science. Finally, in October, Mr Gustavo Santiago Ramírez (DRB # 41300) collected fully developed cones for further study. The cones this time of the year seemed to be mature, but still green. This new fir of the humid cloud forest region ("bosque mesófilo de montana") grows on steep slopes in rich, mixed evergreen forests, associating with 65 (or more) species, including Alnus glabrata Fern., Arbutus xalapensis H., B. et K., Clethra mexicana (Lindl.) DC., Comarostaphylis conzattii Small /arguta Zucc., Cornus disciflora Moc. ex Sessé ex DC., Crusea coccinea DC., Gaultheria hirtiflora Benth., G. acuminata Schltdl. et Cham., Quercus castanea Nee, Q. crassifolia H., B. et K., Q. laurina Humb. et Bonpl., Senecio andrieuxii DC. Completion of a vegetation profile of the habitat is in progress. More study is necessary to establish the full distribution of the species.

Conservation: the habitat of this distinct, rare species is very important to preserve. Mr Ramírez, in collaboration with Dr Enríque Martínez y Obeja (Instituto Tecnológico de Oaxaca) works to secure conservation land around the habitat of the species and conduct further investigation of the distribution and habitat of the species. Seeds will be distributed from Ixtlán later.

Participants in field work: Sr Ignacio Crisoho (Commisariat, Ixtlán de Juárez), Dr Gyöngyvér Biró, Dr Zsolt Debreczy, Dr István Rácz, (IDRI and Hung. Nat. Hist. Museum, Budapest, Hungary), Vince Zsigmond (University of Horticulture, Budapest, Hungary), Mr Gustavo Santiago Ramírez (SERBO Inc., Oaxaca). 4. Abies guatemalensis Rehd. var. longibracteata Debreczy et Rácz, Plate I: 4 in *Phytologia* (April 1995) **78**(4): 217–243; "Abies D" in *NewsBrief* (IDRI) No. **6** (Sep. 1994); Figs 1, 29–32 in the present article. – TYPUS: Mexico. Guerrero: Sierra Madre del Sur, near Yextla, 2,400 m, January 10, 1994, Debreczy, Biró, Rácz *et al.* # 34763 (Holotypus: BP; Isotypi: A, CHAP, E, MEXU, NA).

A specie typica strobilis maturis 10-12 cm longis, 4 cm latis et bracteis 2.0-2.2 cm longis, excertis differt.

Name: *longus* (Lat. adj.) = long; *longibracteata* = long bracted; refers to the differentiating character of the variety in comparing the species.

Description: tree, identical with the species except for the larger cone (10–12 cm), the wider and longer cone scales $(3.0-3.2 \times 2 \text{ cm})$ with longer (2.0-2.2 cm) and prominently (4 mm) exserted, acuminate, upcurving bracts, and the wider, more angular, flabellate seed scale, wing.

Discussion: comparing the variety with the typical Abies guatemalensis, it differs from the type in the size of the cones $(10-12 \times 4 \text{ cm}; \text{not } 8-11)$, in the wider, longer $(3.0-3.2 \times 2 \text{ cm})$ cone scales with 2.0-2.2 cm (not 1.5-1.7 cm) long, acuminate bracts with long (4 mm) exserted, upcurving tip (not short, enclosed, abruptly acute or rounded at apex or with lateral wings, exceeding the tip) and by the more angular and flabellate (not rounded) wings. Other characteristics of the variety are identical with those of the species. Abies guatemalensis var. tacanensis (Lund.) Mart., reported from Volcán Tacaná from the state of Chiapas from between 3,500-3,800 m is similar, but the branchlets of var. longibracteata are glabrous or faintly hairy (not densely hairy), its leaves are longer, 3.5-5.5 cm (not 1.2–3.6 cm) long, the cones larger (not 10×4 cm), the cone scales larger (3.0–3.2 × 2 cm, not 2.7×1.5 cm) with consistently long exserted (not subequal to slightly exserted bract). The tree is fairly common in the Yextla area associating with over 65 higher plant species. Its plant communities are dominated by Cupressus lusitanica Mill., Quercus spp. (4), Chiranthodendron pantadactylon Larreagui; among shrubs, Dahlia excelsa auct., Mahonia lanceolata Fedde, Oreopanax xalapense (H., B. et K.) Decne. et Planch., Philadelphus mexicanus Schltdl., Solanum cervantesii Lang. are frequent.

Conservation: The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) lists *Abies guatemalensis* among the most protected conifers. This will not save the species itself: for example, logging in most areas where this conifer grows is common. Taking further steps toward full protection is needed, including preservation of the beautiful conifer stands with var. *longibracteata* (Fig. 32). It is doubtful whether the new variety will be recognised

as "CITIES I" and distinguished from Abies religiosa (H., B. et K.) Schltdl. et Cham., frequent in the area.

Participants in field work: Dr Gyöngyvér Biró, Dr Zsolt Debreczy, Dr István Rácz (IDRI and Hung. Nat. Hist. Museum, Budapest, Hungary), Éva Kertész (Botanical Collection, Munkácsy Mihály Múzeum, Békéscsaba, Hungary), Yinghao Zhao (Botanical Garden of the Chinese Academy of Sciences, Beijing, P. R. China).

5. *Abies lowiana* (Gord.) A. Murr. var. *viridula* Debreczy et Rácz, "Abies E" in *NewsBrief* (IDRI) No. 6 (Sep. 1994); Fig. 3 in the present article. – TYPUS: Mexico. Chihuahua: Sierra Madre Occidental, near Ciudad Madera, 2,700 m, May 6, 1994, Debreczy, Biró, Rácz *et al.* # 39711 (Holotypus: BP; Isotypi: A, CHAP, E, MEXU, NA).

A specie typica foliis ramulorum sterilium conspicue regulariter dichotomice ordinatis, in latere dorsali lucide viridibus; illis ramulorum fertilium prorsum directis et parum declinatis differt.

Description: tree with straight, usually single trunk, loose conical crown, ascending and horizontally spreading, later slightly descending branches, with shiny light green foliage; bark: think, smooth, light grey in young age, later ruptured to irregular, thick plates; branches: brownish yellow, sporadically hairy up to 5-6 years; bud: ovate, thickly covered by resin; branchlets: yellowish green when mature, thinly pubescent with fine (0.08-0.13 mm long) brownish, faintly brownish or subclear hairs, often long pointed widened at their base; leaves: on stem "subdistichous", spreading, slightly forward directing (shade) or upcurving (exposed) at right angle, forming an open "U" on the upper (dorsal) side of the branchlets, slightly shorter when (in helical order) they reach or leave their uppermost position on the branchlets, 3-5 cm long, 2.2 mm wide, parallel sided, rounded (fertile) pointed or very finely (0.04 mm) emarginate on shade leaves; leathery, shiny dark green above with up to 10 stomatophorus lines all along on middle of leaves, their ventral side greenish gray with narrow (0.2-0.3 mm) green margins and wider midrib (0.5 mm), often with few broken lines of stomas and two broad silvery stripes, typically with 9 (in narrower shade leaves 4-6) stomatophorus lines with moderately densely set (9/mm), fine (0.03-0.04 mm), oval stomata; leaves in cross section elliptical, with 2 median resin canals; strobiles: female: 5-6 × 0.8 cm with first appressed, later reflexed, short (4 × 5 mm), rounded triangular; irregularly serrate bracts with slightly prominent tip of the bract-needle (midvein), pale green or less often reddish green; cones: not seen, cone scales regular, as in the species.

Name: *viridulus, viridula* (Lat. adj.) meaning greenish, refers to the colour of the foliage, markedly distinguishes this geographically isolated variety from the northern type with grey, pruinose needles.

Discussion: Abies lowiana has not been distinguished and recorded in México so far. The species, mistakenly considered as a variety of A. concolor (A. c. var. lowiana (Gord.) Lemm.), should be considered as the "continental vicariant" of the Pacific species A. grandis. It is easy to separate it from A. concolor in the strict sense even by some prominent, easily available, outer morphological characters: in A. lowiana the shade branches and branchlets are rough and hairy (not smooth and glabrous), the winter branchlets are brownish yellow (not greenish grey or grey); the leaves, positioned in regular helical order are evenly spreadout to a horizontal position appearing "dichotomous" or "pectinate" on sterile, or pectinately upcurving in right angle to both sides of the branchlet on fertile shoots (not diverging in all directions according to the helical order and often curving back- and forward when in upper position). On primary terminal shoots, "leaders", the leaves are abruptly upcurving to parallel the shoot such as in A. grandis (not spreading or ascending up to 45°). They are 3-5 cm long, rounded at apex on regular shoots (not up to 10 cm or more, acute and abruptly pointed); the stomata arranged in two silvery stripes below, with up to 9 stomatophorus lines in each and in a defined central stomatophorus band near the central longitudinal grove above the midvein with up to 11 lines (not evenly spread on both sides); in cross section the shade leaves are elliptical (not rectilinear); the cones of A. lowiana are typically conspicuously uneven in outline, light reddish brown, rarely green (not more or less even in outline, purplish, less often green). The variety (var. viridula) differs from the northern type by having less pruinose leaves above and shiny green leaves below. This could be a result of the ecological differences in the habitat of the two plants: such as the canyon environment with shorter dormancy period in the southern type, while exposed high mountain slopes with long winter and hot, dry summer in the northern one.

Discovery: the species, represented here by the variety, is found in a canyon north of Madera, Chihuahua. We saw several specimens in the shady north-northeastern side of the wide valley about 10 km northeast of Madera, Chihuahua at an altitude of about 2,700 m. We visited this site on May 4, 1994 and found the tree with well developed female and male cone-inflorescences (strobiles). We asked the help of Mr Leonel Iglesias Quitierrez, Director Forestal NC Chihuahua, Chihuahua, and M. C. Raul Narvaez Flores, Jefe del Campo Experimental Madera, associates of INIFAP (Instituto Nacional de Investigaciones Forestales y Agropecuarias), CIR (Centros de Investigación Regional del INIFAP) Noroeste to make this exploration possible. The trees formed a mixed stand with *Pseudotsuga men*- ziesii (Mirb.) Franco s.l., with particularly big (some 120 cm DBH) specimens of the latter along the little stream in a side valley, all cut down in the near past. Other associated species include *Pinus durangensis* Mart., *P. ayacahuite* Ehrenb. var. *brachyptera* Shaw, Acer glabrum Torrey, Arbutus glandulosa Mart. et Gal., Cestrum nocturnum L., Cornus sericea Michx., Juniperus deppeana Steud. var. robusta Mart., Lonicera involucrata (Rich.) Banks, L. pilosa (H., B. et K.) Willd., Mahonia repens (Lindl.) G. Don var. pumila (Greene) Fedde (or a form of M. eutriphylla Fedde), Populus tremuloides Michx., Quercus candicans Nee, Ribes madrensis Coville et Rose, Salix gooddingii Ball, Salix sp., Symphoricarpos rotundifolius A. Gray (the other 35 herbaceous or semi-woody species include Erigeron, Euphorbia, Fragaria, Galium, Gnaphalium, Lupinus, Luzula, Poa, Polypodium, Plantago, Potentilla, Ranunculus, Rubus, Senecio, Thalictrum, Valeriana, Veratrum, and Viola).

Conservation: the habitat of this distinct fir, probably rare in its southern range, would be very important to preserve. Sr Leonel Iglesias Quitierrez, Director Forestal Noroeste Centro, Chihuahua, and M. C. Raul Narvaez Flores, Jefe del Campo Experimental Madera had been asked to collaborate in securing the species and to work on the possibilities for conservation of the land around the habitat, also to conduct further investigation of the distribution and habitat of the species and this variety.

Participants in field work: Dr Gyöngyvér Biró, Dr Zsolt Debreczy, Dr István Rácz (IDRI and Hung, Nat. Hist, Museum, Budapest, Hungary), Éva Kertész (Botanical Collection, Munkácsy Mihály Múzeum, Békéscsaba, Hungary), Vince Zsigmond (University of Horticulture, Budapest, Hungary).

CONSERVATION OF THE NEW TAXA

The five true firs described from various locations in Mexico are considered rare, local, and threatened. In general, most of these new taxa can be saved mostly because of the difficult access to the locations where they grow. Their discovery brought the attention of flora researchers, forestry operators and the local conservation authorities. Since the range of distribution of these firs appears limited, and logging in these areas is still in practice, preservation of their habitat must be secured. Searching for additional merits of the forest stands where these firs occur and conducting synecological surveys to map their flora composition would also be important and may give further reasons to protect them.

Early steps made toward the conservation of these firs are showing results. Further exploration of the habitat of *Abies hidalgensis* has been undertaken by regional foresters based in Tulancingo in cooperation with the Division de Ciencias Forestales, Universidad Autonoma Chapingo (Enrique Guízar, pers. comm.). They found this fir in several locations in the vicinity of Metepec and Agua Blanca and are working on its *in situ* conservation. The habitat of *Abies zapotekensis* (along with the new Douglas fir population we discovered in 1994) has been protected by the local community of Santa Catarina Ixtepeji. The recently established Ecoturism Center at La Cumbre (Fig. 33) is another good sign of the conservation activity.

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Fig. 1. A photo plate of *Abies guatemalensis* var. *longibracteata*, compiled for the Dendrological Atlas, Vols 1–4 (in preparation).



Fig. 2. A photo plate of Abies hidalgensis, compiled for the Dendrological Atlas, Vols 1–4 (in prep.).



Fig. 3. A photo plate of *Abies lowiana* var. *viridula*, compiled for the Dendrological Atlas, Vols 1–4 (in preparation).



Fig. 4. A photo plate of *Abies neodurangensis*, compiled for the Dendrological Atlas, Vols 1–4 (in preparation).



Fig. 5. A photo plate of Abies zapotekensis, compiled for the Dendrological Atlas, Vols 1-4 (in prep.).



Fig. 6. A mature tree of *Abies zapotekensis* (ca 20 m high) in its native habitat (photograph by Boone Hallberg).

Figs 7–8. Trunk of the same tree, about 60 cm in diameter at breath height, in two aspects (photographs by Boone Hallberg).



Fig. 9. The cones and cone scales of *Abies hidalgensis* (from the type tree). Fig. 10. The habitat of *A. hidalgensis* near Metepec, at around 2,300 m a.s.l.



Fig. 11. The habitat of *Abies lowiana* var. *viridula* near Ciudad Madera, at about 2,700 m a.s.l, with the type tree in the middle.

Figs 12–14. Bark details of A. lowiana var. viridula. – 12: old tree (ca 100 yrs) with trunk diameter about 80 cm DBH (35 × 50 cm detail shown). – 13: medium-aged tree, diameter about 45 cm at base. – 14: young tree, about 10 cm DBH; note the resin blisters on the bark.



Figs 15–17. Comparison of the strobiles ("cone-inflorescences") of the Abies species growing in the Ixtlán de Juárez area, Oaxaca state of Mexico. Scale: about 1/2 natural size. – 15: Abies hickelii (DBR #38589). – 16: A. guatemalensis (DBR #40162). – 17: A. zapotekensis (DBR #32957a).

Figs 18–22. Comparison of mature cones of the same fir species. – 18: Abies hickelii (DBR #31121).
– 19: A. guatemalensis (DBR #31188). – 20: A. guatemalensis (DBR #37243). – 21: A. zapotekensis (DBR #40675a). – 22: A. zapotekensis (DBR #40675b). Scale about 1/3 natural size.



Figs 23–28. Comparison of leaf and shoot morphology in *Abies durangensis* and *A. neodurangensis*.
-23: Fertile shoot of *A. durangensis* (DBR #58908) from nr. El Salto, Durango, Mexico. – 24: Fertile shoot of *A. neodurangensis* (type tree). Scale about 3/4 natural size. Note the down curving needles in *A. durangensis* while those in *A. neodurangensis* are spreading. – 25–26: Two views of a sterile shoot of *A. durangensis* (DBR #58908). – 27–28: Sterile branchlet of *A. neodurangensis* (type tree). Scale about 1/2 natural size.



Fig. 29. Mature cones of *Abies guatemalensis* var. *longibracteata* (collected from the same [type] tree), and ...

Fig. 30. ... their ovuliferous scales. Note the remarkably long (exserted) bracts.

Fig. 31. Ovuliferous scales of he type specimen of *A. guatemalensis* (coll. by J. N. Faull, Las Cumbres del Aire, Guatemala; photographed in the type collection of the Gray Herbarium of Harvard University).

Fig. 32. The habitat of *A. g.* var. *longibracteata* with specimens of the *Abies* (A) and *Cupressus lusitanica* (C).



Fig. 33. The recently established Centro Ecoturismo near La Cumbre, at about 2,500 m a.s.l., along the Oaxaca-Ixtlán-Tuxtepec road north of the city of Oaxaca.

Fig. 34. The habitat of *Abies guatemalensis*, a rare, local and endangered (CITES I) species, one of the merits for which the conservation land in the San Felipe mountains was established (note a large specimen of the fir on the right at about 2,600 m a.s.l.).