

2002

New Species of Phoradendron (Viscaceae) from Mexico and Guatemala and a Synopsis of Species in Section Pauciflorae

Delbert Wiens

University of Utah; Rocky Mountain Forest and Range Experiment Station

Frank Hawksworth

Follow this and additional works at: <http://scholarship.claremont.edu/aliso>



Part of the [Botany Commons](#)

Recommended Citation

Wiens, Delbert and Hawksworth, Frank (2002) "New Species of Phoradendron (Viscaceae) from Mexico and Guatemala and a Synopsis of Species in Section Pauciflorae," *Aliso: A Journal of Systematic and Evolutionary Botany*: Vol. 21: Iss. 1, Article 5.
Available at: <http://scholarship.claremont.edu/aliso/vol21/iss1/5>

NEW SPECIES OF *PHORADENDRON* (VISCACEAE) FROM MEXICO AND GUATEMALA AND A
SYNOPSIS OF SPECIES IN SECTION *PAUCIFLORAE*

DELBERT WIENS¹ AND FRANK HAWKSWORTH²

¹Department of Biology
University of Utah
Salt Lake City, Utah 84112
and Rocky Mountain Forest and Range Experiment Station
Ft. Collins, Colorado 80526-8121
²deceased

ABSTRACT

As presently interpreted *Phoradendron* section *Pauciflorae* consists of 15 species. These mistletoes parasitize primarily conifers. We describe seven new species, make status changes for four species, and provide information on the hosts and distribution of all members of the section. New species described are: *Phoradendron abietinum* Wiens, on *Abies durangensis* in Chihuahua, Durango, and Jalisco, Mexico; *P. acuminatum* Wiens, on *Cupressus lusitanica* in Guatemala; *P. flavomarginatum* Wiens, on *Juniperus flaccida* in Nuevo León, Mexico; *P. hawksworthii* Wiens, on *Juniperus* in New Mexico, west Texas, and Coahuila, Mexico; *P. olivae* Wiens, on *Cupressus lusitanica* in Colima and Jalisco, Mexico; *P. rufescens* Wiens, on *Juniperus* spp. in San Luis Potosí, Mexico; and *P. sedifolium* Wiens on *Cupressus lusitanica* in Chiapas, and Hidalgo, Mexico. Three taxa previously recognized as subspecies are raised to specific rank: *P. densum* Torr. ex Trel., *P. pauciflorum* Torr., and *P. libocedri* (Engelm.) Howell. Also *P. saltillense* Trel., which had been placed in synonymy under *P. bolleanum* subsp. *densum*, is accorded species status. In addition, three new epiparasitic species of *Phoradendron* are described. Epiparasitic mistletoes are known to parasitize only other species of mistletoes—in this instance *Phoradendron* or *Cladocolea* (Loranthaceae).

Key words: epiparasitism, new species, parasitic plants, *Phoradendron*, Viscaceae.

INTRODUCTION

Since the publication of the acataphyllous species of *Phoradendron* (Wiens 1964), considerable additional information has accumulated regarding sect. *Pauciflorae*. This is primarily the result of our extensive field studies in Mexico and Guatemala over the course of approximately 26 years. All the taxa discussed here have been studied in the field and the critical, defining characteristics of the new species were evaluated at the population level. In addition to reporting new species, several taxa previously recognized as subspecies in 1964 are elevated to species status and one species, *Phoradendron saltillense* Trel., previously synonymized under *P. bolleanum* (Wiens 1964), is also accorded species status. There are no subspecies presently recognized among these species. We include a synopsis of the species currently included in section *Pauciflorae* (Table 1), and a key to the species.

The earlier taxonomic conservatism of Wiens (1964), who gave subspecific recognition to a number of taxa now regarded as species, was partially a re-

action to the numerous species named by Trelease (1916); however, the classification of taxa as subspecies that are widely distributed over thousands of kilometers seems inappropriate for subspecific recognition. We suspect that additional research will demarcate the existence of geographically definable elements (subspecies) within some of the wide ranging species, e.g., the populations of *P. densum* occurring in central Arizona on *Cupressus*, and perhaps various population systems of the widespread *P. saltillense* in northern Mexico.

MATERIALS AND METHODS

The morphological differences most useful in the construction of keys for separating the species, often leaf size, are notoriously variable characters. Nonetheless, leaf size tends to fall out statistically, as well as internode length, since the latter is generally a correlate of overall plant size. Characters, such as stature and size, are not especially useful for constructing keys, but are still important features in defining the species, along with host differences. The specifics of these quantitative features are described in Wiens (1964), or in the descriptions of the new species presented herein. The problem is well illustrated by the relationship between *P. juniperinum* and *P. libocedri*.

¹ Present address: White Mountain Research Station, 3000 East Line Street, Bishop, California 93514, and Rancho Santa Ana Botanic Garden, 1500 North College Avenue, Claremont, California 91711.

Table 1. Synopsis of *Phoradendron* Section *Pauciflorae*.

Taxon	Hosts	Distribution
1. <i>P. abietinum</i> Wiens sp. nov.	<i>Abies durangensis</i>	Chihuahua to Jalisco, Mexico
2. <i>P. acuminatum</i> Wiens sp. nov.	<i>Cupressus lusitanica</i>	Guatemala
3. <i>P. bolleanum</i> (Seem.) Eichl.	<i>Juniperus, Arbutus</i>	Chihuahua to Jalisco, Mexico
4. <i>P. capitellatum</i> Torr. ex Trel.	<i>Juniperus</i>	Southwestern U.S.A.; northwestern Mexico
5. <i>P. densum</i> Torr. ex Trel.	<i>Juniperus, Cupressus</i>	Southwestern U.S.A.; northern Baja California, Mexico
6. <i>P. flavomarginatum</i> Wiens sp. nov.	<i>Juniperus flaccida</i>	Nuevo León, Mexico
7. <i>P. hawksworthii</i> Wiens sp. nov.	<i>Juniperus</i>	New Mexico, Texas, U.S.A.; Coahuila, Mexico
8. <i>P. juniperinum</i> Engel.	<i>Juniperus, Cupressus</i>	Southwestern U.S.A.; northern Mexico
9. <i>P. libocedri</i> (Engelm.) Howell	<i>Calocedrus decurrens</i>	Southern Oregon, California, U.S.A.; Baja California Norte, Mexico
10. <i>P. minutifolium</i> Urban	<i>Juniperus</i>	Northern and central Mexico
11. <i>P. olivae</i> Wiens sp. nov.	<i>Cupressus lusitanica</i>	Colima, Jalisco, Mexico
12. <i>P. pauciflorum</i> Torr.	<i>Abies concolor</i>	Southwestern U.S.A.; Baja California, Mexico
13. <i>P. rufescens</i> Wiens sp. nov.	<i>Juniperus</i>	San Luis Potosí, Mexico
14. <i>P. saltillense</i> Trel.	<i>Juniperus, Cupressus</i>	Northeastern and eastern Mexico
15. <i>P. sedifolium</i> Wiens sp. nov.	<i>Cupressus</i>	Chiapas, Hidalgo, Mexico

The latter species has internodes that are significantly longer than those of *P. juniperinum*, and long internodes are correlated with the distinctive pendulous habit. Yet neither morphology nor molecular data (Ashworth 2000) identify clear-cut interspecific differences.

In addition to the description of new species in sect. *Pauciflorae*, we also include descriptions of three new species of epiparasitic species of *Phoradendron*, i.e., mistletoes that are known to parasitize only other mistletoes. In this instance the host mistletoes are either other species of *Phoradendron* or *Cladocolea* (Loranthaceae). The subject of epiparasitism is a fascinating phenomenon deserving of further study. More detailed information on the subject is available in Wiens and Calvin (1987), and in Polhill and Wiens (1998).

Unfortunately, Kuijt (pers. comm., 1996) has indicated that there are potential nomenclatural difficulties with the maintenance of the name *Pauciflorae* as a section of *Phoradendron* sensu Wiens (1964). This issue will not be addressed here, as there is no question of the species involved or the cohesiveness of the group, regardless of what name is ultimately attached to it.

RESULTS AND DISCUSSION

The species of section *Pauciflorae* (Wiens 1964) parasitize primarily *Juniperus*, *Cupressus*, and to a lesser extent, *Abies*. Members of the group are typically reduced in terms of their overall size, as well as their floral and vegetative features, when compared to most other members of *Phoradendron*. Overall the species are rarely over 0.5 m high (exceptions are *P. acuminatum* and *P. olivae*, which may be over 1 m). Reduced overall size is typically correlated with shortened internode lengths and widths (mostly < 25 × 4

mm). The leaves are likewise either comparatively small (mostly < 25 × 8 mm) or reduced to scales. The length of the inflorescence, the number of fertile internodes produced, and the number of flowers per fertile internode are also relatively small in comparison with species in other sections. The staminate inflorescences are usually < 10 mm long with mostly 1–2 (3) fertile internodes, with each fertile internode commonly bearing < 20 flowers. The pistillate inflorescences typically have 1 (2) fertile internodes, and consistently produce only two flowers per fertile internode; two pistillate flowers per fertile internode is the best single morphological feature defining sect. *Pauciflorae*. In addition to the morphological and host affinities that characterize the group, Ashworth (2000) showed that molecular data also confirm the uniformity of the group, as well as its monophyletic origin.

CHANGES IN TAXONOMIC STATUS

Specimens are cited only for those species for which we have significant new distributional data. For distributional information of other species, see Wiens (1964).

Phoradendron densum Torrey ex Trelease. Genus *Phoradendron*, 27, 1916. (= *P. bolleanum* (Seem.) Eichler subsp. *densum* (Torr.) Wiens, Brittonia 16: 29, 1964).

Phoradendron densum, as here defined, occurs on *Juniperus* and *Cupressus* and has a distribution ranging from southern Oregon (Jackson Co.) throughout California to the Sierra San Pedro Martír, Baja California Norte, Mexico. There are interesting outlying populations in central Arizona on *Cupressus* (Coconino, Yavapai, Maricopa, and Gila Counties), that de-

serve further study as possible subspecies. The known elevational range is 200–2300 m.

Known hosts are *Juniperus californica*, *J. occidentalis*, *J. osteosperma*, *Cupressus arizonica*, *C. bakeri*, *C. forbesii*, *C. goveniana*, *C. macnabiana*, *C. macrocarpa*, *C. montana*, and *C. sargentii*. *Phoradendron densum* was reported on *Pinus monophylla* in the Mt. Pinos area of Ventura County, California (McMinn 1939), but this host has not been confirmed. The reports of *P. densum* in New Mexico and west Texas (Wiens 1964) are based on populations now transferred to *P. hawksworthii*.

Phoradendron libocedri (Engelm.) Howell. Flora NW Amer. 1: 608, 1902. (= *P. juniperinum* Engelm. subsp. *libocedri* (Engelm.) Wiens, Brittonia 16: 24, 1964).

We now consider *P. libocedri* a distinct species. It is an obligate parasite of *Calocedrus* (*Libocedrus*) *decurrentis*, and it co-occurs in the Lake Tahoe region of California with *P. juniperinum*, which infects *Juniperus occidentalis*; each mistletoe is restricted to its particular host in this area. Also, *P. libocedri* becomes pendulous with age, and is a larger plant than *P. juniperinum*. This size difference is reflected in the longer internodes of *P. libocedri* (> 10 mm) (Wiens 1964). The distribution of *P. libocedri* ranges from southern Oregon (Jackson County), southward in both the Cascade and Sierra Nevada cordillera to southern California and Baja California Norte to the Sierra Juarez and Sierra San Pedro Martír (Wiggins 1980). An outlier population occurs on San Benito Peak in the south Coast Range in Monterey County (Raven 1957). The known elevational range is 400–1900 m.

Phoradendron pauciflorum Torrey. U.S. Rept. Expl. Miss. Pac. 4: 134, 1857. (= *P. bolleanum* (Seem.) Eichler subsp. *pauciflorum* (Torr.) Wiens, Brittonia 16: 30, 1964).

We give species status to this taxon because it differs from *P. densum* in a number of features: leaf size, color, hosts, and distribution (Wiens 1964). The distributional range of *P. pauciflorum* extends from the central Sierra Nevada of California (Calaveras County) southward to the Transverse Ranges of southern California and to the Sierra San Pedro Martír in Baja California. Throughout its distribution it is a consistent parasite of *Abies*, especially *A. concolor*. An extreme outlying population occurs in southern Arizona in the Santa Catalina Mountains (Pima County) and it has also been recorded in the nearby Rincon Mountains (Bowers and McLaughlin 1987). *Abies concolor* is the typical host of *P. pauciflorum* throughout its range, but in the Sierra San Pedro Martír in Baja California it rarely parasitizes *Cupressus montana*, where this tree

is associated with infected *Abies concolor* (Hawsworth and Wiens 1966). There is also a report of autoparasitism in this species (Felix 1970), which is an uncommon phenomenon among mistletoes in general. The known elevational range is 1400–2600 m.

Phoradendron saltillense Trelease. The Genus *Phoradendron*, 27, 1916. Univ. Ill. Press. (= *P. bolleanum* (Seem.) Eichler subsp. *densum* (Torr.) Wiens, pro parte, Brittonia 16: 29, 1964).

We recognize *P. saltillense* as a distinct species since it differs from typical *P. bolleanum* in leaf shape, color, hosts, and distribution, and from *P. densum* in leaf size, hosts, and distribution. Its relationship to *P. hawksworthii* is discussed under that species. The distribution of *P. saltillense* ranges from eastern and east central Mexico in Coahuila, Nuevo León, San Luis Potosí, and Puebla, on both *Juniperus* and *Cupressus* hosts. This species is separated from the closest known *P. densum* populations in central Arizona by more than 1000 km. The known hosts of *P. saltillense* are *Cupressus arizonica*, *C. benthamii*, *C. flaccida*, *Juniperus deppeana*, and *J. saltillense*. The species is common in the Sierra del Carmen in northern Coahuila, just east of the Chisos Mountains in Big Bend National Park, Texas, and might be expected in Texas. The known elevational range is 1850–2850 m.

Noteworthy collections examined.—MEXICO: COAHUILA: Mpio. Arteaga, 5 km E of Las Vigas, on *C. arizonica*, Bailey in 1982 (FPF); Sierra de la Marta, on *Cupressus* sp., Robert & Passini 43-4288 in 1975 (IBUG); Sierra de la Madera, Desiderio Cyn, on *C. arizonica*, Hawsworth et al. 1512 in 1975 (FPF) and on *J. flaccida*, Hawsworth et al. 1515 in 1975 (FPF); Sierra del Carmen: 1 mi W of Asseradero Maderas del Carmen (Ocampo) on *J. deppeana*, Hawsworth et al. 1035 in 1967 (FPF); 0.5 mi W of Asseradero, Maderas del Carmen (Ocampo) on *J. flaccida*, Hawsworth et al. 1036 in 1967 (FPF); 2 mi W of Asseradero Maderas del Carmen (Ocampo) on *J. deppeana*, Hawsworth et al. 1040 in 1967 (FPF); 5 mi W of Asseradero Maderas del Carmen (Ocampo), on *C. arizonica*, Hawsworth et al. 1028 in 1967 (FPF); 15.9 mi S of Saltillo on *Juniperus*, Clark et al. 672, in 1967 (FPF); 40 mi S of Saltillo, on Hwy 57, on *Juniperus*, Wiens & Cameron 2607 in 1959 (RSA); Hwy 57 near San Roberto, on *J. monosperma*, Villareal 560 in 1987 (IBUG); 12 mi S of General Cepeda, on *J. flaccida*, Hawsworth & Wiens 399 in 1963 (FPF); Sierra de Parras en El Capulin, on *J. saltillense*, Rodriguez & Carranza 214 in 1981 (IBUG).—NUEVO LEON: 6 mi S of Hwy 58 on Hwy 69, on *Juniperus*, Hawsworth 1832 in 1978 (FPF).—SAN LUIS POTOSÍ: 8 km ENE of San Bartolo, on *Juniperus*, Hawsworth et al. in 1979 (FPF).—PUEBLA: Cerro de los Humeros, on *C. benthamii*, Chazaro & Chazaro 4318 in 1986 (IBUG); 2 km NE of Guadalupe Sarabia, on *C. benthamii*, Oliva et al. Hor-36 in 1981 (IBUG).

NOTES ON HOSTS AND DISTRIBUTION

Phoradendron bolleanum (Seem.) Eichler

This species has the widest geographical distribution of any species in sect. *Pauciflorae* in Mexico. It occurs throughout the Sierra Madre Occidental from Chihua-

hua to Jalisco, including the states of Sonora, Durango, Sinaloa, Nayarit, and in central Mexico in Hidalgo and Querétaro. The report of it in Texas (Wiens 1964) was based on collections now transferred to *P. hawksworthii*. The known elevational range is 1900–2500 m.

In the section, *P. bolleanum* is unique because it commonly parasitizes two diverse hosts, a conifer (*Juniperus* spp.) and an angiosperm (*Arbutus*) (Wiens 1964; Hawksworth and Wiens 1966). We know of no other instance where a mistletoe is restricted to two such diverse hosts. Trelease (1916) questioned whether the same mistletoe actually occurred on two such distantly related species. Without experimental evidence the question remains moot. We find, however, no morphological basis for a separation of the two populations on the two hosts. Although infection of *Juniperus* and *Arbutus* frequently occurs together, we have also observed a number of instances from Chihuahua to Jalisco, where only one of the two hosts is parasitized, even though the other host is present. For example, in Jalisco we have found *P. bolleanum* only on *Arbutus* (also occasionally on associated *Arctostaphylos*), but *Juniperus* also occurs in the same area (Chazaro pers. comm., 1989). This suggests the possibility of two host races, and areas where both hosts are infected may simply represent instances of the co-occurrence of the two host races. Such morphologically indistinguishable host races are known in the related dwarf mistletoes (*Arceuthobium*) (Hawksworth and Wiens 1996). Controlled cross-inoculation experiments are necessary to resolve the problem.

Although this mistletoe is typically bright brownish, some greenish populations were observed in central Chihuahua (Hawksworth and Cibrian 1985).

Phoradendron capitellatum (Torr.) ex Trelease

This highly distinctive parasite of junipers is characterized by its small, densely stellate-pubescent leaves. The distribution of *P. capitellatum* is restricted to central and southeastern Arizona, southwestern New Mexico, northeastern Sonora, and northwestern Chihuahua. The known elevational range is 800–1700 m.

The hosts of *P. capitellatum* include *Juniperus deppeana*, *J. erythrocarpa*, *J. monosperma*, and *J. osteosperma*. Typically, *P. capitellatum* occurs at elevations below *P. juniperinum*, but the two species sometimes co-occur, and rarely parasitize the same host tree, e.g., on the south side of the Santa Catalina Mountains, Pima County, Arizona (Gilbertson pers. comm., 1978). For whatever reason, *P. capitellatum* tends to be under-collected, so we cite a number of collections to give a better understanding of its distribution.

Noteworthy collections examined.—U.S.A. ARIZONA. Cochise Co.: Guadalupe Mts, Guadalupe Cyn, on *J. erythrocarpa*, Gilbertson 7756 in 1967 (FPF); Chiricahua Mts, Paradise, Blumer 1524 in 1906

(MO); Gila Co.: 5 mi S of Payson, Wiens 2707 in 1960 (RSA); Tonto National Monument, Strong 118 in 1961 (ASU); Pinal Co.: 5 mi E of Superior on Hwy 60, on *J. erythrocarpa*, Hawksworth 2149 in 1986 (FPF); Graham Co.: Graham Mts, Tripp Cyn, on *J. deppeana*, Hawksworth & Lightle 145 in 1962 (FPF); Galiuro Mts, 1 mi N of Deer Cr Cabin, on *J. deppeana*, Mathiasen 7702 in 1977 (FPF); Peloncillo Mts, Microwave Tower, 11.5 air miles WNW of Duncan, Holmgren & Holmgren 7073 in 1973 (WTU); Greenlee Co.: 8 mi NE of Guthrie on Rte 78, on *J. erythrocarpa*, Hawksworth & Bailey 1771 in 1977 (FPF); near Clifton, Greene in 1880 (MO); Pima Co.: Santa Catalina Mts, Molina Basin, on *J. erythrocarpa*, Hawksworth & Gilbertson 1808 in 1977 (FPF); Santa Cruz Co.: Pajarito Mts., 1.7 mi S of Pajarito Peak, on *J. deppeana*, Van Devender & Toolin s.n. in 1981 (ARIZ, FPF); Yavapai Co.: 8 mi W of Sedona, on Hwy 89, Wiens 2692 in 1960 (RSA); 10 mi E of Camp Verde on Pine Rd, Wiens 2699 in 1960 (RSA). NEW MEXICO. Grant Co.: Summit Mts, 10 mi E of Duncan on East Mine Camp Rd, on *J. erythrocarpa*, Hawksworth & Bailey 1772 in 1977 (FPF); Hidalgo Co.: Steins Pass, Toumey in 1895 (UC); Guadalupe Cyn, on *J. erythrocarpa*, Hawksworth 1624 in 1975 (FPF); Lightning Dock Mtn, 18 mi S of Lordsburg, on *J. erythrocarpa*, Hawksworth s.n. in 1985 (FPF); Luna Co.: Florida Mts, N slope, on *J. erythrocarpa*, Mathiasen 75-53 in 1975 (FPF); Crook Mts, near Crook Peak, on *J. erythrocarpa*, Hawksworth & Bailey 1762 in 1977 (FPF).—MEXICO. CHIHUAHUA: Sierra de Moscos, Chaing et al. 3851 in 1979 (FPF, TEX). SONORA: Palm Cyn, 13 mi SE of Magdalena, on *J. deppeana*, Mathiasen 7604 in 1976 (FPF).

Phoradendron juniperinum Engelm.

This distinctive scale-leaved species has the broadest distribution of any member of section *Pauciflorae*, and ranges from Oregon southward and eastward to California, Nevada, Utah, western Colorado, Arizona, New Mexico, and western Texas into Chihuahua and Durango in northwestern Mexico. It occurs in the Chisos Mts, but has not been reported from adjacent Coahuila. The known elevational range is 1000–1600 m.

Common hosts of *P. juniperinum* include *Juniperus californica*, *J. deppeana*, *J. erythrocarpa*, *J. flaccida*, *J. monosperma*, *J. occidentalis*, *J. osteosperma*, and *J. scopulorum*. *Cupressus arizonica* is commonly parasitized in central Chihuahua, but this host is only rarely infected in Arizona (Hawksworth and Wiens 1966). Other rare hosts are *Cupressus bakeri* in California (Hawksworth and Wiens 1966) and *Chamaebatiaria millefolium* (Rosaceae) in Arizona (Hawksworth 1952; Hawksworth and Mathiasen 1978).

Geographically, *P. juniperinum* co-occurs with *P. capitellatum* in Arizona, with *P. hawksworthii* in New Mexico, and with *P. densum* in California. Natural hybrids between *P. densum* × *P. juniperinum* that are apparently sterile F₁ plants are known in the Inyo Mts. of California (Wiens and DeDecker 1972) and San Bernardino Mts. (Vasek pers. comm., 1973). These are among the few reports of natural hybridization for mistletoes.

Phoradendron minutifolium Urban

In 1959 this mistletoe was known only from the

type locality near Perote, Sierra Madre Oriental, Veracruz, Mexico. *Phoradendron minutifolium*, however, is now known to have a wide, but apparently localized, distribution in Mexico. It is most common in central Mexico (Tlaxcala and Veracruz) and in the Sierra Madre Occidental in southern Chihuahua and Durango. A widely disjunct population occurs in the Sierra del Carmen of northern Coahuila, where it co-occurs with *P. saltillense* on junipers and the two mistletoes have been found parasitizing the same tree. The Sierra del Carmen is just across the border from Big Bend National Park, Texas, and *P. minutifolium* might be expected to occur there. The known elevational range is 2000–2750 m.

The closest relative of *P. minutifolium* appears to be *P. olivae*. *Phoradendron olivae* has even smaller leaves (ca. 2 mm)—but these are still expanded (as opposed to scales)—whereas *P. minutifolium* typically has leaves ca. 2–4 mm long. *P. olivae* is known only from one locality in Jalisco, near the Colima border, where it parasitizes *Cupressus lusitanica*.

Noteworthy collections examined.—MEXICO. CHIHUAHUA: Mpio Ballenza, Alto de Pilares, on *Juniperus*, Flores & Oliva 15 in 1984 (INIF). COAHUILA: Sierra del Carmen, on *J. deppeana*, Hawksworth et al. 1039 in 1967 (FPF). DURANGO: 73 km W of Hwy 39 on Altares Rd, on *J. deppeana*, Hawksworth & Reid 2237 in 1987 (FPF); La Ermita on Hwy 40, W of El Salto, on *J. deppeana*, Hawksworth 2117 in 1986 (FPF); near summit of escarpment, W of El Salto on Hwy 40, Wiens 2641 in 1959 (RSA). PUEBLA: 16 mi S of Zacatepec on Hwy 140, on *Juniperus*, Wiens & Hawksworth 3342 in 1963 (COLO, FPF). TLAXCALA: 13 mi NW of Apizaco on Hwy 119, on *Juniperus*, Wiens & Hawksworth 3349 in 1963 (COLO, FPF); 2 km E of San Simion on Hwy 139, on *J. deppeana*, Hawksworth 2109 in 1986 (FPF). VERACRUZ: 1 mi S of Perote, on *Juniperus*, Wiens 2578 in 1959 (RSA).

NEW SPECIES IN SECTION PAUCIFLORAE

Phoradendron abietinum Wiens, sp. nov.

Holotype (US): MEXICO: DURANGO: Hwy 40, 54 km W of El Salto, near Puerto Buenos Aires; el 2700 m. On *Abies durangensis*, Wiens, Hawksworth, Bailey, and Mathiasen 5230 in 1975. Isotypes FPF, MEXU, MO, RSA.

Plantae maturae frutices globosos 3–4 dm altos efformantes, furcatae dioeciae, acataphyllae; internodia 12–18 mm longa, 2–3 mm lata; folia sublinearia, adaxialiter applanata, abaxialiter rotundata, praecipue in juventate minute puberula, ca. 12–19 mm longi, 2–3 mm lati, ad apicem saepe attenuatae, ad apicem acuminate, ad basim sessilia; inflorescentia staminate et florum ignota; inflorescentia pistillata plerumque 4–6 in nodo quoque, segmentis 1–2 per inflorescentiam quamque, segmentis singulis flores 2, interdum 3 ferentibus; anthesis et fructus ignota.

Host: Abies durangensis

Distribution: Coniferous forests of the Sierra Madre Occidental from southern Chihuahua, through Durango to northern Jalisco. The known elevational range is 2600–2850 m.

Discussion: *Phoradendron abietinum* is distinguish-

able from *P. bolleanum*, with which it sometimes co-occurs, by a number of features: host, shoot color, and leaf and floral morphology. In fact, *P. abietinum* perhaps resembles most closely the Guatemalan species, *P. acuminatum*, especially the leaves (see discussion under the latter species). *Phoradendron abietinum* is yellow-green, a color common to most species of the section, whereas *P. bolleanum* is typically rusty brownish, especially the leaves, a feature that makes *P. bolleanum* easily detectable on the host plant from a considerable distance. The leaves of *P. bolleanum* tend to be oblong to occasionally sub-oblongate, with a rounded to obtuse apex, whereas the leaves of *P. abietinum* are generally linear with an attenuated, acuminate apex, abaxially rounded, but flattened adaxially; in *P. bolleanum* the leaves are dorsiventrally flattened. The perianth lobes of *P. abietinum* (which remain adnate to the fruit during development) have a minute basal tube 0.2–0.3 mm long and the lobes remain erect or sometimes reflex at the midpoint. The style is mostly cylindrical, but some lateral compression may occur. By contrast, the perianth lobes on the fruit of *P. bolleanum* are free and strongly inflexed distally and the style is only slightly elongated. These are minute structures, usually < 0.1 mm long, but the relative differences are nonetheless considerable.

The occurrence of a mistletoe specific to such a rare tree as *Abies durangensis* presents an interesting evolutionary situation. Although the host tree is known from only a few widely scattered localities in the Sierra Madre Occidental (Martinez 1963), all the populations of *A. durangensis* we have surveyed are parasitized by *P. abietinum*. The dispersal of host specific mistletoes between small, highly disjunct populations would appear to be difficult. Thus, the occurrence of this mistletoe on *A. durangensis* is perhaps best explained in terms of the parasite becoming evolutionarily “stranded” along with its host. In fact, the presence of a host specific mistletoe on such a rare species supports the proposition that the host at one time had a larger, more continuous distribution.

Specimens examined: CHIHUAHUA: Cerro Mohinora, Conkle s.n. in 1985 (FPF); near Guadalupe y Calvo, Oliva s.n. in 1987 (FPF). DURANGO: Puerto Buenos Aires, near km 54 W of El Salto, Hwy 40, Wiens & Hawksworth 4422 in 1969 (FPF), and Hawksworth et al. 1420 in 1972 (FPF); Mpio Otaez, 16 km SW of Altares on Banome Rd, Hawksworth & Reid 2247 in 1987 (FPF). JALISCO: Mpio Mexquitic, 40 km NW of Bolanos, Flores et al. 1609 in 1989 (FPF, IBUG).

Phoradendron acuminatum Wiens, sp. nov.

Holotype (US): GUATEMALA: SOLOLA: 12 km E of Nahuala, Pan American Hwy near km 146; mixed broadleaf-conifer forest, elevation 2500 m; parasite on *Cupressus lusitanica*, Wiens & Hawksworth 4396 in 1969. Isotypes: EAP, ENCB, MEXU, MO, RSA.

Plantae maturae massas pendulas usque ad 2 m longas efforman-

tes, furcatae, dioeciae, acataphyllae; internodia 15–25 mm longa; folia linearia, 15–20 mm longa, ca. 2 mm lata, abaxialiter applanata, adaxialiter rotundata, ad basim sessilia, ad apicem acuminata; inflorescentia staminata ignota; inflorescentia pistillata ca. 5 mm longa, pendunculo ca. 1 mm longo praedita, in segmenta fertilia 1–2 decussatim dispositis divisa; segmento quoque flores 2 ferente segmentis e bracteis minute ciliatis navicularibus flores parce superantibus subtentis; anthesis probabiliter Juli–Septembri; fructus roseo-albidus, orbicularis, 4–5 mm diam; in Cupresso et Junipero parasiticum.

Hosts: *Cupressus lusitanica*, rarely *Juniperus* spp.

Distribution: Broadleaf-coniferous woodlands of northern Guatemala; possibly also in southern Mexico. The known elevational range is 2500–3150 m.

Discussion: Morphologically this species is most closely related to *P. sedifolium*, a parasite on *Cupressus* in the Chiapas and Hidalgo highlands, Mexico. The two species are readily distinguished, however, by the short (mean = 9.3 mm long), markedly succulent, glaucous leaves of *P. sedifolium*. In *P. acuminatum* the leaves are longer (mean = 16.0 mm long) and lack significant succulence or glaucousness. Also, *P. acuminatum* is a much larger plant often a meter or more high, whereas *P. sedifolium* is a smaller plant rarely larger than 5 dm high. The berries of *P. acuminatum* are pink, and larger (ca. 4 mm) than those of *P. sedifolium* which are white and smaller (ca. 3 mm).

Phoradendron acuminatum also shows some morphological resemblance to *P. abietinum*, but differs from that species by its occurrence primarily on *Cupressus* (secondarily on *Juniperus*), whereas *P. abietinum* is known only from *Abies*; *P. acuminatum* is also a larger plant than *P. abietinum*, sometimes forming masses a meter or more in length and characteristically producing severe infestations in *Cupressus*, where it may occupy a large proportion of the crown in host trees. *Phoradendron abietinum* is a relatively small plant producing globose bushes 2–5 dm in diameter. In *P. acuminatum*, the leaves are mostly a dull, brownish green, generally less than 3 mm wide and the internodes fuscous, whereas in *P. abietinum*, the leaves are usually more than 3 mm wide and both the blades and internodes are yellowish green.

An interesting characteristic of *P. acuminatum* is its role as a host for two epiparasitic species of *Phoradendron*, i.e., species that parasitize only other species of mistletoes: cf. *P. auriculatum* Trel. and *P. calyculatum* Trel. Infrageneric epiparasitism in *Phoradendron* is a fascinating phenomenon; for further details see the discussion under new epiparasitic species of *Phoradendron*.

E. Clark (pers. comm., 1973) found that this mistletoe causes frequent mortality in cypress in Guatemala, particularly in the Department of San Marcos.

Specimens examined: GUATEMALA: HUEHUETENANGO: 25 km N of Huehuetenango, on Rd to Chermal, on *C. standleyi*, Wiens & Hawksworth 4408 in 1969 (FPF); Paquix, on *J. standleyi*, Clark

& Ramirez s.n. in 1972 (FPF). SAN MARCOS: Mpio Bosque del Astilero, El Cascajo, on *C. lusitanica*, Clark s.n. in 1972 (FPF); between Cumbre Cotzic and Serchil, on *C. lusitanica*, Clark & Ramirez s.n. in 1972. SOLOLA: 10 km W of Nahuala, on *C. lusitanica*, Clark & Ramirez s.n. in 1972 (FPF).

Phoradendron flavomarginatum Wiens, sp. nov.

Holotype (US): MEXICO: NUEVO LEON: Rd to San Francisco, 10.8 mi E of Hwy 61 turnoff at km 80, N of the town of Doctor Arroyo, elevation 2400 m, parasite on *Juniperus flaccida*, Wiens 7779 in 1995. Isotypes: MEXU, UC, MO.

Plantae usque 1 m alta, brevis pubescentes; dioeciae, acataphyllae; caules in maturitate lignescens, et teretes; internodia ca. 18 mm longa; folia linearia-oblonga, sessilia ca. 25 (35) mm longa, 3 mm lata; inflorescentia staminata ca. 6–8 mm longa, segmentis 1–2, cum 8–15 floribus; inflorescentia pistillata ca. 2 mm longa, segmentis 1, cum 2 flores; anthesis Juli (?)–Septembri; fructus ovatus, albus, 4–5 mm; in *Juniperus flaccida* parasiticum.

Hosts: known only on *Juniperus flaccida*.

Distribution: known only from several populations near the type locality, where it is locally abundant.

Discussion: *Phoradendron flavomarginatum* is separated elevationally and by host from *P. saltillense*, which is the common *Phoradendron* at lower elevations in this region. There is considerable variation in *P. saltillense* throughout its extensive distribution. These two species appear separable on the basis of morphology as well as host and elevation. *Phoradendron flavomarginatum* can become a large, brownish plant and becomes pendulous with age (1 m long), whereas *P. saltillense* is typically ca. 3–4 dm high, more or less globose, as well as yellow-green, the common color of most species of sect. *Pauciflorae*. The leaves of *P. flavomarginatum* are generally longer (ca. 25 mm) than those of *P. saltillense* (ca. 15 mm) and have a pale yellow margin (hand lens needed). The leaves of *P. flavomarginatum* tend to become oblanceolate, while those of *P. saltillense* are generally linear-oblong. When living, the leaves of *P. flavomarginatum* are also thinner by about 2/3 than those of *P. saltillense*, whose leaves are also slightly succulent. Preliminary observations in September suggest that *P. saltillense* produces continuous, successional crops of flowers, a feature not presently known among species of sect. *Pauciflorae*. This possibility requires further study.

Phoradendron hawksworthii Wiens, sp. nov.

Phoradendron bolleanum subsp. *hawksworthii* Wiens, in Manual of Vascular Plants of Texas, 1970, p. 504, nom. nud.

Holotype (US): TEXAS: BREWSTER CO: Big Bend National Park, Chisos Mts, The Basin (near campground), oak-juniper woodland, elevation 1650 m. Parasite on *Juniperus flaccida*, but also on *J. dep-*

peana and *J. pinchotii*. Hawksworth, Lightle, & Lampi 1044 in 1967. Isotypes: ARIZ, CAS, COLO, ENCB, FPF, GH, RSA, UC, UTC.

Plantae 1–2.5 dm altae, dioeciae, acataphyllae; bases ramorum in maturitate lignosae, glabrae vel in partibus junioribus puberulentae; internodia 6–12 mm longa, folia oblanceolate-lineararia, sessilia vel sessilia, 6–25 mm longa, 1.5–3 mm lata, ad apicem obtusa vel rotundata; inflorescentia staminata e segmento uno floribus 3–6 praedita constituta; inflorescentia staminata e segmento uno floribus 3–6 praedita constituta; inflorescentia pistillata e segmento uno cum floribus 3 constituta; anthesis paene Julio–Septembro; fructus albus vel roseolus, orbicularis, 4 mm lata; in *Junipero* parasiticum.

The species is named for Frank G. Hawksworth, life-long student of mistletoes, particularly the genus *Arceuthobium*.

Hosts: *Juniperus ashei*, *J. deppeana*, *J. erythrocarpa*, *J. flaccida*, *J. monosperma*, and *J. pinchotii*.

Distribution: Juniper-pinyon woodlands; common in west Texas, but localized in southern New Mexico, and known from only one locality in Coahuila. *Phoradendron hawksworthii* was reported from NW of Carrizozo, Lincoln Co., New Mexico, but attempts to locate this population were unsuccessful, and no extant populations are presently known in Lincoln County. The known elevational range is 1550–2000 m.

Discussion: *Phoradendron hawksworthii* shows affinities to *P. bolleanum*, *P. densum*, and *P. saltillense*. It differs from *P. densum*, with which it has been confused in the past, by its shorter internodes (mean 9.0 mm, range 6–12 mm, versus a mean of 11 mm and a range of 6–17 mm in *P. densum*). Such differences in internode length are generally positively correlated with total plant size. Finally, the number of fertile internodes per staminate inflorescence is apparently only one in *P. hawksworthii*, an uncommon characteristic in the section. *Phoradendron* typically has two fertile internodes on the staminate inflorescences.

Phoradendron hawksworthii is distinguishable from *P. saltillense* primarily by its narrower leaves (ca. 2 mm wide). Occasionally the young leaves of *P. hawksworthii* also show a tendency toward tereteness, with older leaves becoming flattened adaxially, but rounded abaxially. In *P. saltillense* the leaves are typically flattened dorsiventrally and usually exceed 3 mm in width. In *P. hawksworthii* young leaves are often mucronulate in the extreme, the mucro itself being only 0.2–0.3 mm long. Newly emerging leaves generally do not exhibit this feature, which apparently originates during mid-ontogeny. The mucro is also fugacious, and is largely absent on mature leaves; however, the apex of old leaves often exhibits a minute scar at the tip, presumably resulting from the loss of the mucro. Geographically, *P. hawksworthii* and *P. saltillense* approach each other in the Sierra del Carmen, but do not appear to co-occur there.

Phoradendron capitellatum is also a parasite of junipers in southern New Mexico, but its distributional

range does not appear to overlap with that of *P. hawksworthii*. *Phoradendron capitellatum* occurs from the Cook and Florida Mountains westward to central Arizona, whereas *P. hawksworthii* is found in New Mexico only east of the Rio Grande Valley in the San Andreas, Cornudas, and Sacramento Mountains.

Phoradendron juniperinum usually occurs at elevations above that of *P. hawksworthii*, but these two mistletoes sometimes co-occur, and rarely infect the same host tree, which was observed in La Luz Canyon, Otero County, New Mexico.

Specimens examined (all on Juniperus): U.S.A.: NEW MEXICO: DONA ANA CO: Dona Ana Mts, NE slope of Dona Ana Peak, Todson in 1967 (NMC); San Andreas Mts. 2.5 mi S of Ash Cyn, Dunn 8008 in 1952 (NMC). LINCOLN CO: 5 mi NW of Carrizozo, Hutchins 2434 in 1969 (UNM). OTERO CO: Alamogordo, Rehm & Vierech s.n. in 1902 (US); La Luz Cyn, 4 air mi E of La Luz, on *J. monosperma*, Hawksworth 2390 in 1989 (FPF); 7.5 mi W of Mescalero on Hwy 70, on *J. monosperma*, Hawksworth 2394 in 1989 (FPF); Cornudas Mts, Alamo Mtn, on *J. monosperma*, Peterson 85-23 in 1985 (FPF). TEXAS: BREWSTER CO: Basin, Big Bend National Park, near Park Headquarters, Lundell 13191 in 1944 (TEX, TAES, US); Basin, Sperry 585, 588, 1657, 1814, in 1937 and 1939 (SRSC, TAES, US); 101 Range SW of Alpine, Fletcher 1663 in 1929 (SRSC); Top Nine Point Mesa, 65 mi S of Alpine, Warnock & Johnston 17525, in 1957 (SRSC); 26 mi S of Alpine on Hwy 118, on *J. pinchotii*, Hawksworth et al. 1042 in 1967. CULBERSON CO: Gypsite, Travis 51-11 in 1950 (TEX); Apache Mts, 37 mi NE of Van Horn, on *J. monosperma*, Hawksworth et al. 1531 in 1975 (FPF); EDWARDS CO: near Blue Hole of Pulliam Cr, Cory 43770 in 1944 (NY); near Barksdale, Parks & Cory 26895 in 1937 (TAES). EL PASO CO: 3.8 mi W of Hueco Tanks State Park, on *J. erythrocarpa*, Adams 2539 in 1978 (FPF). HUDSPETH CO: near Sierra Blanca, Ferris & Duncan 2638 in 1921 (DS, MO). KIMBLE CO: 5 mi W of Roosevelt, Parks & Cory 21204, 21105, 21106 in 1937 (TAES). PRESIDIO CO: Pinto Cyn, midway btw Ruidosa and Marfa, Hinckley 2660 in 1943 (SRSC); Sierra Vieja, Cottonwood Cyn, Hinckley 1959 in 1941 (TEX). SUTTON CO: 5 mi N or Sonora on Hwy 277, on *J. pinchotii*, Hawksworth 1817 in 1978 (FPF). TERRELL CO: Independence Cr, 2 mi below Sheffield-Dryden Crossing, Hinckley 383 in 1949 (SRSC). VALVERDE CO: Del Rio, Schulz s.n. in 1921 (TEX); Vinegrove, Parks & Cory 7700, 7701, 7703 in 1934 (TAES); 40 mi S of Sonora, Sharp 6378 in 1928 (SRSC, TEX); 2.5 mi N of Loma Alta, on *J. pinchotii*, Hawksworth 1818 in 1978 (FPF); 31 mi NE of Dryden on Hwy 349, on *J. ashei*, Van Devender & Van Devender 86-64 in 1986 (ARIZ, FPF).

MEXICO: COAHUILA: Sierra de la Encantada, near La Cuesta Pass, 70 mi NW of Muzquiz on Boquillas Rd, on *J. ashei*, Hawksworth et al. 1520 in 1975 (FPF).

Phoradendron olivae Wiens, sp. nov.

Holotype (IBUG): MEXICO: JALISCO: Mpio Minatitlán, Sierra de Mamitlán, Cerro Grande, 14 km N of Colima-Minatitlán Hwy, on Rd to Terrero, elevation 2000 m, on *Cupressus lusitanica*, Wiens, Hawksworth, Chazaro, Oliva 7051 in 1989. Isotypes: FPF

Plantae maturae massas pendulas usque ad 1–1.5 m longas efformantes, dioeciae, acataphyllae; internodia 15–25 mm (mean 18) longa; folia lineararia, 1–2 mm longa, 1 mm lata, abaxialiter applanata, adaxialiter rotundata, ad basim sessilia, ad apicem acuminata; inflorescentia staminata ca. 4 mm longa, segmentis 1, cum 8 floribus, pedunculo 3 mm longa praedita; inflorescentia pistillata ca. 3 mm longa, pedunculo ca. 2 mm longa praedita, in segmentibus fertilibus

1 decussatim divisa; segmento quoque flores ferente segmentis e bracteis minute ciliatis navicularibus, flores parce superantibus subtentis; anthesis probabiliter December-Januario; fructus roseo-albidus, orbicularis, 4–5 mm, in Cupresso parasiticum.

The species is named for Hector Oliva Rivera of the University of Veracruz, Cordoba, and student of Mexican mistletoes.

Host: Cupressus lusitanica.

Distribution: Known only from the vicinity of El Sauz and Terrero, Sierra de Mamitlán, Jalisco, and in adjacent Colima. The known elevational range is 2000–2300 m.

Discussion: The species most closely resembles *P. minutifolium*, but is distinguishable from that species by (1) its smaller, almost scale-like leaves ca. 2 mm long, whereas the leaves of *P. minutifolium* are 3–5 mm long; (2) its much larger size, and open habit, forming pendulous masses over 1 m long, as compared to *P. minutifolium* which is rarely larger than 0.5 m high. This size difference is again reflected by the internode lengths, averaging 18 mm in *P. olivae*, but only 8 mm in *P. minutifolium*; (3) the host difference—*P. olivae* is known only on *Cupressus* and *P. minutifolium* is known to parasitize only *Juniperus*; and (4) the known distribution of *P. olivae* is far to the west and south of *P. minutifolium* and occurs at higher elevations.

Specimens examined: MEXICO: JALISCO: Mpio Minatitlán, Sierra de Mamitlán, 2 km de El Terrero hacia el Sauz, Chazaro, et al. 4479 in 1987 (IBUG). COLIMA: Mpio de Toluiman, km 14 sobre camino Sauz-Terrero, de la Rosa, Villareal, & Tamayo 1677 in 1988 (IBUG).

Phoradendron rufescens Wiens, sp. nov.

Holotype (US): MEXICO: SAN LUIS POTOSI: 22 km E of Zaragoza on Rd to La Cuevas mine, elevation 2150 m, on *Juniperus flaccida*, Wiens, Hawksworth, Bailey, and Mathiasen 5244, in 1975. Isotypes: ENCB, FPF, MO, RSA.

Plantae usque ad 6–7 dm altae, dioeciae, acataphyllae; caules in maturitate lignescentes et teretes, breve pubescentes, leniter scabrelae; internodia 15–25 mm longa; folia linearia usque sublanceolata, 7–15 mm longa, 1.5–2.5 mm lata, minute et breviter pubescentia, in maturitate applanata, sed in juventate adaxialiter subrotundata, ad basim sessilia, ad apicem acuta usque rotundata, interdum mucronulata; inflorescentia staminata ca. 10 mm longa, segmentis duobis 6–17 flores ferentibus, pedunculo 3–4 mm longa; inflorescentia pistillata ca. 10 mm longa, segmentis fertilibus flores duas ferentibus, pedunculo ca. 3 mm longo, segmentis perianthii in sexibus ambis conspicue rufis, anthesis in mensibus Januario–Februario (?); fructus orbicularis, 4–5 mm diam., rufo-roseus; in Junipero parasiticum.

Hosts: Juniperus flaccida and *J. deppeana*.

Distribution: Juniper-pinyon woodlands of San Luis Potosí, Querétaro, and Hidalgo. The known elevational range is 2100–2200 m.

Discussion: This is one of the most distinctive species in section *Pauciflorae*. It is perhaps most closely related to *P. bolleanum*, from which it is easily distinguished by the rusty-brown color of the perianth segments, and the dense short pubescence, which give the plants a somewhat scabrous character. The berries are bright, reddish-pink.

Specimens examined: MEXICO: QUERETARO: 15 km SW of San Joaquin on Rd to Vizarron, Rzedowski 31622 and 31623 in 1973 (ENCB). HIDALGO: Mpio. Cardonal, near Santuario, Quintero 2081 (ENCB). SAN LUIS POTOSI: 24 km E of Zaragoza, Robert 1194 in 1971 (ENCB).

Phoradendron sedifolium Wiens, sp. nov.

Holotype (US): MEXICO: CHIAPAS: 24 km southeast of San Cristobal de Las Casas on Hwy 190; elevation 2100 m, parasite on *Cupressus lusitanica*, Wiens, Hawksworth, Player & Hermann 5012 in 1975. Isotypes: ENCB, FPF, MO, RSA, UT.

Plantae 3–4 cm altae, dioeciae, acataphyllae; bases caulorum solum in maturitate lignescentes, teretes usque parum applanatae, glabrae; internodia 6–15 mm longa; folia linearia usque sublanceolata, 6–12 mm longa, 2–3 mm lata, in vivo valde succosa; incrementum novum conspicue griseo-glaucum, abaxialiter applanatum sed partem proximam versus leniter elevatum, adaxialiter rotundatum, ad basim sessile, ad apicem acutum usque rotundatum, interdum mucronulatum, margine in juventate interdum minute ciliato; inflorescentia staminata ca. 4 mm longa, segmento uno (raro 2) 6–7 flores ferente, pedunculo 1–1.5 mm longo; inflorescentia pistillata ca. 3 mm longa, segmento uno flores duas ferente, pedunculo 1–1.5 mm longo; anthesis in mensibus Januario–Februario; fructus ovatus albus, 3 mm diam.; in Cupresso parasiticum.

Hosts: Known only on *Cupressus lusitanica*.

Distribution: Broad-leaf coniferous forests of the Chiapan and Hidalgan highlands. The known elevational range is 1850–2200 m.

Discussion: This species most closely resembles *P. acuminatum* from Guatemala, but is readily separated from that species (even though they occur on the same host) by the characteristics mentioned in the discussion under *P. acuminatum*. *Phoradendron sedifolium* is also a host for one of the epiparasitic species of *Phoradendron* (*P. calyculatum*) which also regularly parasitizes *P. acuminatum*.

Specimens examined: MEXICO: HIDALGO: 18 km N of Metepec on Rd to Tenango de Doria, on *C. lusitanica*, Wiens & Hawksworth 5524 in 1979 (FPF, UT); Rio Moctezuma, Magana 571 (ENCB).

ARTIFICIAL KEY TO THE SPECIES OF PHORADENDRON SECTION PAUCIFLORAE

- a. Leaves < 5 mm long or leafless
 - b. Leaves reduced to scales
 - c. Parasitic mostly on *Juniperus* (occasionally on *Cupressus*); internodes usually less than 1 cm long; older plants mostly globose *P. juniperinum*

- c. Parasitic on *Calocedrus*; internodes usually over 1 cm long; older plants pendulous *P. libocedri*
- b. Leaves 2–5 mm long, generally expanded
 - d. Parasitic on *Juniperus*; leaves 3–5 mm long; plants 50–70 cm tall; Coahuila and Chihuahua to Veracruz . . . *P. minutifolium*
 - d. Parasitic on *Cupressus*; leaves ca. 2 mm long; plants 1–1.5 m long; Colima and Jalisco *P. olivae*
- a. Leaves > 5 mm
 - e. Parasitic on *Abies*
 - f. Parasitic on *Abies concolor*; leaves 5–8 mm wide; California, Arizona, Baja California *P. pauciflorum*
 - f. Parasitic on *Abies durangensis*; leaves 2–3 mm wide; Durango, Chihuahua *P. abietinum*
 - e. Parasitic on *Juniperus*, *Cupressus*, or *Arbutus*
 - g. Leaves oblanceolate or sublanceolate, usually < 5 times as long as wide
 - h. Leaves usually < 20 mm long; Oregon, California, Arizona, Baja California *P. densum*
 - h. Leaves usually > 20 mm long; northeast and central Mexico *P. saltillense*
 - g. Leaves linear, usually > 6 times as long as wide
 - i. Plants brownish or reddish brown
 - j. Plants brownish; not scabrous; berries mostly white, sepals glabrous
 - k. Leaves ca. 20–25 mm long, with a pale yellow margin (hand lens needed); parasitic only on *J. flaccida*; local in Nuevo León *P. flavomarginatum*
 - k. Leaves ca. 15 mm long, lacking a pale yellow margin; parasitic on various species of *Juniperus* or *Arbutus*; widely distributed in the Sierra Madre Occidental from Chihuahua to Jalisco *P. bolleanum*
 - j. Plants rusty-red, scabrous; berries reddish-pink, sepals short pubescent; San Luis Potosí *P. rufescens*
 - i. Plants greenish
 - k. Parasitic on *Cupressus*
 - l. Leaves usually > 10 mm long, ca. 2 mm wide; berries 4 mm in diameter, pinkish; Guatemala . . . *P. acuminatum*
 - l. Leaves usually < 10 mm long, 2–3 mm wide; berries 3 mm in diameter; Mexico (Hidalgo and Chiapas) *P. sedifolium*
 - k. Parasitic on *Juniperus*
 - m. Leaves and stems strongly stellate-pubescent; Arizona, New Mexico, NE Sonora, NW Chihuahua *P. capitellatum*
 - m. Leaves and stems glabrous or nearly so; W Texas, E New Mexico, Coahuila *P. hawksworthii*

NEW EPIPARASITIC SPECIES OF *PHORADENDRON* IN MEXICO*Phoradendron calvinii* Wiens, sp. nov.

Holotype (US): MEXICO: JALISCO: Mpio Minatitlán, Cerro Grande, 18 km N of Colima Hwy, on Rd to Terrero, elevation 2060 m, Wiens 7774 in 1995. Isotypes: IBUG, MEXU, UC, FPF, MO, RSA.

Plantae maturitata pendulas usque ad 2 m longa efformantes, dioeciae, acataphyllae; internodia 80–120 mm longa, 3–4 mm lata, folia lanceolata, falcate, 120–130 (165) mm longa, 15–45 mm lata; inflorescentia staminata 90–110 mm longa, 2 mm lata, segmentis 3–5; inflorescentia pistillata ca. 35 mm longa, 3–4 mm lata, segmentis 3–5; fructus albus, 3 mm alta. In *Phoradendron longifolium* parasiticum.

The species is named for Prof. Clyde L. Calvin, life-long student of mistletoe anatomy, particularly the haustorial systems.

Host: *P. longifolium*, but also occasionally on *P. cf. reichenbachianum*.

Distribution: Known only from the type locality.

Discussion: This amazing species parallels the size of the large epiparasite, *P. calyculatum*, forming huge, pendulous masses exceeding 2 m in length and parasitizing primarily *P. longifolium*, and to a lesser extent another species with which it co-occurs. *Phoradendron calvinii* is readily distinguished from *P. calyculatum*, with which it also co-occurs, by its long, thin staminate inflorescences that reach lengths up to 110 mm, but are only 2 mm wide. These inflorescences are borne on peduncles ca. 15 mm long and comprise 3–5 fertile segments, each bearing hundreds of flowers.

The fruits are small (ca. 2 mm) as are the seeds, which is typical of all epiparasitic Viscaceae so far known. The fruits of *P. calvinii* are also distinguished by the persistent sepals that form a short collar (1 mm) around the minute (< 0.5 mm) style.

Phoradendron chazaroi Wiens, sp. nov.

Holotype (US): MEXICO: JALISCO: 5 km S of Quila on Rd to Tecolotlán, elevation 1960 m, epiparasite on *Cladocolea grahamii* (Loranthaceae) on *Quercus obtusata*. Wiens, Chazaro, Hawksworth, Oliva 7047 in 1989. Isotypes: IBUG, MEXU, MO, UC, RSA.

Plantae ca. 1.5 (2) dm altae, monoeciae, cataphyllis, glabrae, internodia 35–40 mm longa, 2–3 mm lata; folia 50–55 mm longa, 6–8 mm lata, lanceolate-elliptica; inflorescentia 20–25 mm longa, in segmento fertilia 2–3, segmento cum flores 12–16; fructus ignota; in *Cladocolea grahamii* parasiticum.

The species is named for Miguel Chazaro Basañez, student of Mexican mistletoes.

Host: Known only from *Cladocolea grahamii* (Loranthaceae)

Distribution: Western Jalisco

Discussion: The plants branch profusely from a “basal cushion” when young, but the “cushion” becomes obscure in older plants. The young shoots are quadrangular, and often occur in whorls of 3–6, with the basal internode of each shoot bearing a sheathing cataphyll ca. 3 mm high. The inflorescences are often whorled with 3–8 inflorescences per node, with 2–3

fertile segments bearing 12–16 flowers. The type collection made on 30 July had berries that were just beginning development, but were probably destined to turn reddish at maturity. Some old seeds at the type collection site were seen on other plants and they appeared to be small (< 2 mm), as is typical of all epiparasites of *Viscum* and *Phoradendron* seen by us in Africa, Asia, Australia and Latin America.

At the time of collection no staminate flowers could be found in approximately 35 plants examined. The species is no doubt monoecious and the staminate flowers had likely dehisced at this time. If this is the case, the inflorescences likely bear relatively few staminate flowers, since most of the flowers on the spikes appeared to be developing fruits. In monoecious species of African *Viscum*, the ratio of pistillate to staminate flowers is often highly skewed (at least 4:1) in favor of pistillate flowers (Polhill and Wiens 1998), often to the point that it is difficult to find staminate flowers. Because the early collectors had only a few pressed samples available for study, at least one such species was originally described as being dioecious. Apparently *P. chazaroi* also has highly skewed flower ratios in favor of pistillate flowers. The evolutionary implications of such skewed flower ratios should be studied further. The reproductive advantages of high seed production for pioneering species, such as these parasites, would seem obvious. Among dioecious species of various mistletoes, there are a number of examples of species in which the sex ratio is also highly skewed toward pistillate plants (Wiens et al. 1996).

Specimens examined: MEXICO: JALISCO: 14 km S of Tequila on Rd to Volcán de Tequila, on *Cladocolea grahamii*, which in turn was parasitizing *Quercus castanea*, elevation 1860 m, Wiens et al. 7078 in 1989 (IBUG). Chazaró (pers. comm., 1989) indicates that this species also occurs on Nevado de Colima and Volcán de Tequila (Jalisco).

Phoradendron durangense Wiens, sp. nov.

Holotype (US): MEXICO: DURANGO: Mazatlán-Durango Hwy, 1.8 km E of El Palmito, elevation 2200 m, Wiens & Calvin 5993 in 1985. Isotypes: IBUG, MEXU, MO, UC, RSA.

Plantae usque ad 0.5 m alta, breve pubescentes, dioeciae, acataphyllae; internodia 35–45 (65) mm longa, ca. 10 mm lata; folia linearia-lanceolata, falcate, 70–200 mm longa, 12–25 mm lata; inflorescentia staminate 35–45 mm longa, 2 mm lata; inflorescentia pistillata 25–35 mm longa, 4–5 mm lata; fructus ignota; in *Phoradendron longifolium* parasiticum.

Host: *P. longifolium*; *P. durangense* was not observed on associated *P. schumannii*.

Distribution: Collected only from the type locality, but numerous young plants observed near a microwave station on the ridge top ca. 10 km W of El Palmito.

Discussion: Morphologically, *P. durangense* superficially resembles *P. calyculatum*, a widespread and

common epiparasitic species with a distribution from the Volcán de Tequila, northern Jalisco, to northern Guatemala. Herbarium specimens of *P. durangense* could be confused with *P. calyculatum*, but a number of characteristics separate the two species: *P. calyculatum* is a much larger plant, often forming pendulous masses over 2 m long, whereas *P. durangense* is commonly an erect plant, ca. 0.5 m high. *Phoradendron calyculatum* is grayish-green, due perhaps to the dense, short pubescence typical of the species, whereas *P. durangense* is brownish-green. The nodes of both species are dilated, but those of *P. calyculatum* are about twice the width of those of *P. durangense* (ca. 20 mm vs. 10 mm). The inflorescences of both sexes of *P. calyculatum* are approximately twice the length of those of *P. durangense*: staminate ca. 80 mm vs. 40 mm; pistillate ca. 60 vs. 30 mm. Each fertile segment of the inflorescences of *P. calyculatum* probably bear twice the number of flowers as those of *P. durangense*, e.g., the fertile pistillate segments of *P. calyculatum* are ca. 12 mm long, versus ca. 6 mm in *P. durangense*.

There is also a significant distributional difference between the species, but further collections might alter this situation. Presently *P. durangense* is the most northward ranging of any of the epiparasitic species of *Phoradendron*.

ACKNOWLEDGMENTS

We wish to express our gratitude to the many Mexican colleagues who assisted us in our field and herbarium studies, especially Miguel Chazaró Basañez, then at the Botanical Institute of the University of Guadalajara; Dr. Jerzy Rzedowski of the Institute of Ecology, Pazcuaro; and Hector Oliva of the University of Veracruz, Córdoba. We thank R. L. Mathiasen, V. Ashworth, and an anonymous reviewer for their constructive criticisms of the manuscript. This study was supported by a series of grants-in-aid to DW from the U.S. Forest Service, U.S. Forest and Range Experiment Station, Ft. Collins, CO.

LITERATURE CITED

- ASHWORTH, V. E. T. M. 2000. Phylogenetic relationships in Phoradendreae (Viscaceae) inferred from three regions of the nuclear ribosomal cistron. II. The North American species of *Phoradendron*. *Aliso* **19**: 41–53.
- BOWERS, J. E., AND S. P. McLAUGHLIN. 1987. Flora and vegetation of the Rincon Mountains, Pima County, Arizona. *Desert Pl.* **8**: 51–94.
- FELIX, L. 1970. Hyperparasitism and autoparasitism in true mistletoes. *Pl. Disease Reporter* **54**: 15.
- HAWKSWORTH, F. G. 1952. Unusual hosts for two Southwestern mistletoes. *Pl. Disease Reporter* **36**: 246.
- , AND D. CIBRIAN T. 1985. Observaciones sobre las enfermedades de arboles forestales en el norte de México y sur de los Estados Unidos. Memoria de los Simposia Nacionales de Parasi-

- tología Forestal II y III, Instituto Nacional de Investigaciones Forestales, Publ. Especial **46**: 57–66.
- , AND R. L. MATHIASSEN. 1978. Hosts of juniper mistletoe at Walnut Canyon National Monument, Arizona. *Great Basin Naturalist* **38**: 89.
- , AND D. WIENS. 1966. Observations on witches'-broom formation, autoparasitism, and new hosts in *Phoradendron*. *Madroño* **18**: 218–224.
- , AND ———. 1996. Dwarf mistletoes: biology, pathology, systematics. U.S. Dept. of Agriculture Handbook 709. 410 p.
- MARTINEZ, M. 1963. Las Pináceas Mexicanas, 3rd Ed. Universidad Nacional Autónoma de México, Mexico City. 400 p.
- MCMINN, H. E. 1939. An illustrated manual of California shrubs. J. W. Stacy, Inc., San Francisco. 689 p.
- POLHILL, R., AND D. WIENS. 1998. Mistletoes of Africa. Royal Botanic Gardens, Kew. 371 p.
- RAVEN, P. H. 1957. Plant records from San Benito County, California. *Leaflet. Western Bot.* **8**: 174–176.
- TRELEASE, W. 1916. The Genus *Phoradendron*: a monographic revision. Univ. Illinois Press, Urbana. 224 p + 245 plates.
- WIENS, D. 1964. Revision of the acataphyllous species of *Phoradendron*. *Brittonia* **16**: 11–54.
- , AND C. L. CALVIN. 1987. Epiparasitism in mistletoes. *The Golden Bough* (Royal Botanic Gardens, Kew) **9**: 3–5.
- , AND M. DEDECKER. 1972. Rare natural hybridization in *Phoradendron* (Viscaceae). *Madroño* **21**: 395–402.
- , D. L. NICKRENT, C. G. SHAW III, F. G. HAWKSWORTH, P. C. HENNON, AND E. J. KING. 1996. Embryonic and host-associated skewed adult sex ratios in dwarf mistletoes. *Heredity* **77**: 55–63.
- WIGGINS, I. L. 1980. Flora of Baja California. Stanford Univ. Press, California. 1025 p.