

PHARUS PRIMUNCINATUS (POACEAE: PHAROIDEAE:
PHAREAE) FROM DOMINICAN AMBER

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ABSTRACT

A grass spikelet with a cylindrical, sigmoidal, uncinete floret in Dominican amber is described as the new species *Pharus primuncinatus* Judz. & Poinar (Poaceae: Pharoideae: Phareae). The fossil can be distinguished from all extant members of the genus by the small (9.9 mm long), curved female floret; relatively short glumes; and the uncinete portion of the floret extending downwards to the middle or slightly below the middle of the lemma. The closest extant relative may be the Mesoamerican *P. mezii*. This is the earliest record of a fossil grass that can be assigned to an extant genus; the earliest record of a member of the basal subfamily Pharoideae; and the only known fossil *Pharus* spikelet.

KEY WORDS: fossil grass, *Pharus*, *P. latifolius*, *P. mezii*, *P. primuncinatus*, Poaceae, Pharoideae, Phareae, Dominican amber

RESUMEN

En base a una espiguilla fósil con un flósculo cilíndrico, sigmoide y uncinado se describe una nueva especie, *Pharus primuncinatus* Judz. & Poinar (Poaceae: Pharoideae: Phareae), del ámbar de la República Dominicana. Se diferencia de todas las especies del género existentes por su espiguilla pistilada pequeña (9.9 mm de largo), flósculo pistilado curvado; glumas relativamente cortas; y la porción uncinada del lema extendida de la mitad hasta el ápice. La especie existente más relacionada es posiblemente *P. mezii* de América Central. Este es el registro más antiguo de una gramínea fósil que puede asignarse a un género existente; el registro más antiguo del miembro de la subfamilia Pharoideae; y el único fósil de una espiguilla de *Pharus*.

INTRODUCTION

Grass fossils are rare. Those that have been reported mostly occur in sedimentary deposits and their identification at the generic level is problematic. However, amber has remarkable preservative qualities for both plant and animal fossils (Poinar 1992) and a number of angiosperm remains identifiable to extant genera occur in Dominican Republic amber (Poinar & Poinar 1999). Dominican amber originated from resin of the extinct tree, *Hymenaea protera* Poinar (Leguminosae: Caesalpinioideae) that thrived some 20–40 million years ago in Hispaniola (Poinar 1991; Poinar & Poinar 1999). One especially interesting fossil in this amber was a spikelet belonging to the grass genus *Pharus* P. Browne which was associated with mammalian hair (Poinar & Columbus 1992).

Pharus was long placed in the Bambusoideae (Judziewicz 1987; Watson & Dallwitz 1992), but recent molecular evidence indicates that it is much more basal than the bamboos and indeed is the second earliest-diverging basal clade in the Poaceae (Clark & Judziewicz 1996; Judziewicz et al. 1999; Grass Phylogeny Working Group 2001).

Daghlian (1981) considered at least 11 reported macrofossils as true fossil grasses but cautioned against assigning fossil pollen grains to the Poaceae since other members of the Poales have similar pollen types. In his review of paleoagrostology, Thomasson (1987) listed 11 published reports of fossil grasses, but determined only three of these to be undoubted representatives of the Poaceae. While the oldest-known unequivocal fossil grass is from the Paleocene/Eocene boundary in Tennessee (Crepet & Feldman 1991), bambusoid-like monocots extend back into the Early Cretaceous (Poinar 2004), thus the origin of the family may be quite ancient. The present study describes the fossil female *Pharus* spikelet reported earlier (Poinar & Columbus 1992).

MATERIALS AND METHODS

The small triangular piece of amber (7 gm, 37 mm longest length \times 25 mm longest width, 15 mm thick) containing the fossil came from La Toca mine, situated between Santiago and Puerto Plata in the Cordillera Septentrional of the northern portion of the Dominican Republic. Dating of Dominican amber is still controversial with the latest proposed age of 20–15 mya based on foraminifera (Iturralde-Vinent & MacPhee 1996) and the earliest as 45–30 mya based on coccoliths (C pek in Schlee 1999). A range of ages for Dominican amber may be likely since the amber fossils are associated with turbiditic sandstones of the Upper Eocene to Lower Miocene Mamey Group (Draper et al. 1994). Dominican amber is secondarily deposited in sedimentary rocks, which makes a definite age determination difficult (Poinar & Mastalerz 2000). Observations and photographs were made with a Nikon stereoscopic microscope SMZ-10 R and Nikon Optiphot TM at magnifications up to 600 \times .

RESULTS

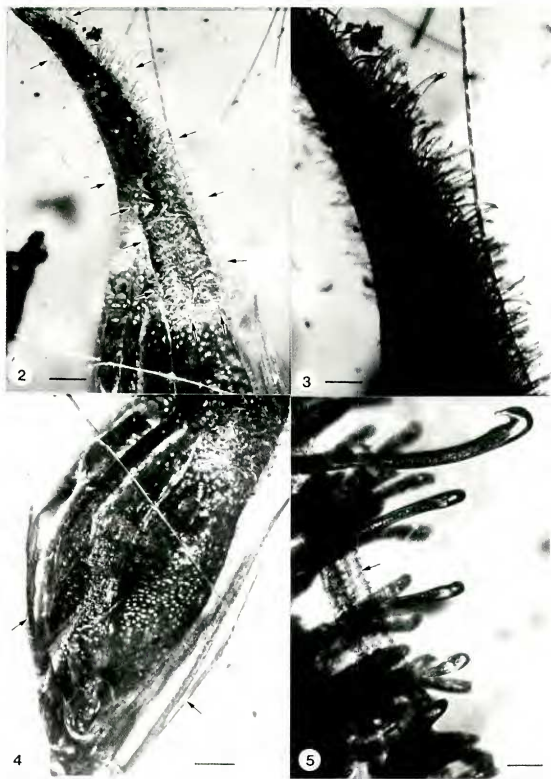
The following characters of the fossil place it in the genus *Pharus*: A single-flowered female spikelet with relatively short, glabrous glumes and an inrolled, cylindrical, tapering, 7-nerved lemma covered with uncinata (hooked) macrohairs.

Order Poales, Family Poaceae, Subfamily Pharoideae (Stapf) L.G. Clark & Judz., Tribe Pharace Stapf

***Pharus primuncinatus* Judz. & Poinar, sp. nov. (Figs. 1–5).** TYPE: DOMINICAN REPUBLIC: La Toca amber mine located between Santiago and Puerto Plata in the Cordillera Septentrional of the northern portion of the Dominican Republic. A female spikelet depos-



FIG. 1. Spikelet of *Pharus primuncinatus* in Dominican amber. Bar = 860 μ m.



FIGS. 2–5. *Pharus primuncinatus* in Dominican amber (elongate strands in all photos are segments of mammalian hair). 2. Tip of lemma showing bearded portion (delineated with arrows) covered with uncinata macrohairs. Bar = 36 μm . 3. Upper portion of lemma showing range in size of uncinata macrohairs. Bar = 278 μm . 4. Lower portion of lemma and two glumes (arrows). Note papillose surface of lemma. Bar = 450 μm . 5. Detail of uncinata macrohairs. Note one strand of mammalian hair (arrow) enclosed by the plant macrohairs. Bar = 56 μm .

ited in the George Poinar amber collection (accession # M-1-4) maintained at Oregon State University, Corvallis, OR 97331.

Fossil female spikelet 9.9 mm long (without pedicel) and 2.3 mm wide subtended by a short pedicel (0.93 mm long), consisting of two glumes and a single floret. First glume 5.2 mm long; second glume 3.3 mm long (the tip bent back and could have been damaged, thus it may have been longer); lemma approximately twice the length of the glumes, somewhat sigmoid, tapered apically into a beak, 7-nerved, with strongly inrolled margins; with a discrete area, beginning approximately 2/5 from the base of the lemma and extending all the way to the tip, densely covered with uncinata macrohairs, the hairs extending from the tip 1/3 of the length of the lemma on the ventral side (3.5 mm from apex), but over half the length of the lemma (5.4 mm from the apex) on the dorsal side; macrohairs 0.22–0.56 mm in length; basal portion of the lemma covered with numerous small papillae (Fig. 4).

Currently, seven extant species of *Pharus* are recognized; they range from Mexico and Florida to Argentina and Uruguay. Using the keys provided by Judziewicz (1987, 1991), the fossil falls into a group of three species with curved to sigmoid female lemmas: *P. latifolius* L., *P. mezii* Prodoehl, and *P. vittatus* Lem. *Pharus vittatus* has female lemmas 19–26 mm long, much longer than those of the fossil, which has a mature lemma 9.9 mm long. The extant species *P. latifolius* and *P. mezii* (Table 1, Fig. 6) have smaller female spikelets than *P. vittatus*, but the floret (9.9 mm long and 2.3 mm wide) and first glume (5.2 mm long) of *P. primuncinatus* are significantly shorter yet wider than those of *P. latifolius* [florets (12–)13–17(–19) mm long, 1–2.3 mm wide, first glume 9–13 mm long] and *P. mezii* [florets 10.5–13.5 mm long, 0.9–1.8 mm wide, first glume 5.3–7.3(–8) mm long]. Also, the female floret of the fossil is bearded with uncinata macrohairs over the majority of its exposed (i.e., not covered by the glumes) surface, while in *P. latifolius* and *P. mezii* the beard is restricted to the apex of the floret (Fig. 6).

Etymology.—The specific epithet *primuncinatus* is from the Latin “first uncinata one,” alluding to the first fossil record of hooked macrohairs on a spikelet.

DISCUSSION

Presently, four species of *Pharus* occur in Hispaniola, including *P. lappulaceus* Aubl., *P. latifolius*, *P. parvifolius* Nash, and *P. virescens* Doell. *Pharus mezii*, perhaps the closest relative of the fossil species, is a Mesoamerican and northern South American species of seasonally dry forests. The morphological evidence does not exclude the possibility that *P. primuncinatus* is directly ancestral to both *P. latifolius* and *P. mezii*.

The manner by which the female spikelet arrived in amber has already been cited as the first example of epizoochory in the fossil record (Poinar & Columbus 1992). This condition is obvious from the number of mammalian hairs associated with the spikelet, one of which is still attached to the lemma

TABLE 1. Comparison of *Pharus primuncinatus* to two closely related species.

	<i>Pharus latifolius</i>	<i>Pharus primuncinatus</i> sp. nov.	<i>Pharus mezii</i>
Distribution	Widespread in wet forests in the Neotropics, including Hispaniola	Fossil (Eocene to Miocene) from Hispaniola	Seasonally dry forests, mostly along the Pacific coast from Mexico to Panama; rare in dry forests of Colombia, Venezuela, and Ecuador; not in the West Indies
Female floret length (mm)	(12-)13-17(-19)	9.9	10.5-13.5
Female floret width (mm)	1-2.3	2.3	0.9-1.8
Female floret: Length/width ratio	7.5-12	4.3	7.5-10
Female first glume length (mm)	9-13	5.2	5.3-7.3(-8.0)
Female first glume: Female floret ratio	0.6-0.8(-0.9)	ca. 0.5	0.5-0.6
Distribution of uncinata hairs on the female	Restricted to apical 10-20%; rarely sparse hairs	Found over most of the exposed surface (33-60%)	Restricted to apical 15-25%; rarely sparse hairs elsewhere

by the uncinata macrohairs (Fig. 5). These hairs were identified as the guard hairs of a carnivore (Poinar & Columbus 1992).

There is circumstantial evidence that many species of mammals disperse the adhesive female florets of *Pharus* species, as attested by such local common names of *P. latifolius* and *P. lappulaceus* (Judziewicz 1987: 296-297, 387-388) as "fruta de perro" [fruit of the dog] (Cuba), "riz chien" [dog rice] (French Guiana), "alcusa" [dog in Quichua] (Ecuador), "barba de puma" and "barba de tigre" [beard of the jaguar] (Peru), "yaguá-arroz" [jaguar rice] (Paraguay), "barba de paca" [beard of the paca, a large rodent] (Brazil), and "barba de macuco" [beard of the monkey] (several Brazilian collections). The genus may apparently be dispersed by birds as well; common names include "pega pollo" [stick-to-the-chicken] (Dominican Republic), and herbarium specimens with feathers adhering to the inflorescence have been observed.

The present report is the earliest record of a fossil grass that can be assigned to an extant genus, the earliest undoubted record of a member of the basal subfamily Pharoideae and tribe Phareae, and the only described fossil spikelet of a member of the Pharoideae. In 1986, the second author also examined a plastic

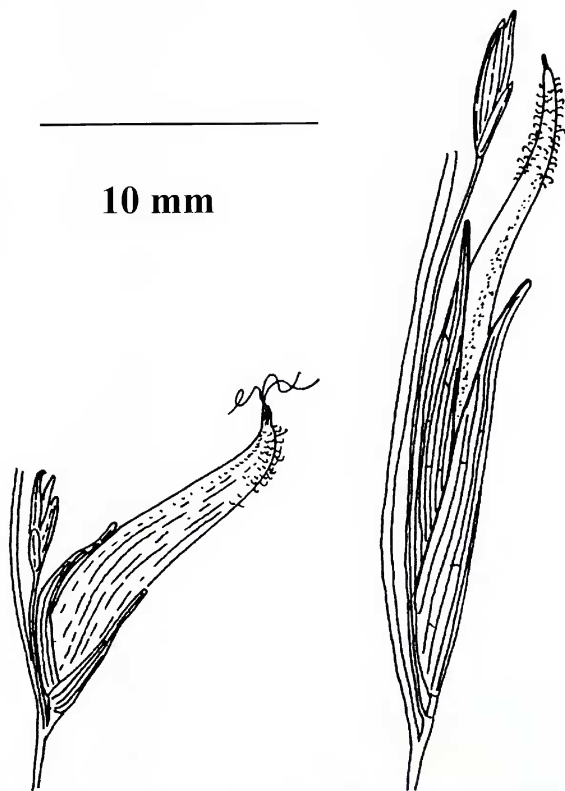


FIG. 6. Spikelet pairs of the extant species *Pharus latifolius* (left) and *P. mezii* (right). The pistillate spikelets are large and curved and the staminate spikelets small and pedicellate. Illustration by Judziewicz.

cast of a leaf blade of an undoubtedly pharoid grass (presumably *Leptaspis* R. Br., sister genus of *Pharus*), from mid-Miocene (12 million years old) volcanic ash northwest of Lake Baringo, Kenya (ca. 1°N, 36°E) kindly provided by Christine Kabuye and Bonnie F. Jacobs; a duplicate cast is on deposit at the University of Wisconsin-Madison herbarium (Judziewicz 1987; Clark & Judziewicz 1996).

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