

# ***Toliara* (Poaceae, Chloridoideae, Cynodonteae), a new grass genus endemic to southern Madagascar**

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## **KEY WORDS**

Poaceae,  
Chloridoideae,  
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    *Perotis*,  
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## **ABSTRACT**

*Toliara arenacea* Judziewicz (Poaceae), a new genus and species endemic to coastal sand dunes in southwestern Madagascar, is described and illustrated. It is related to the widespread paleotropical genus *Perotis* Aiton (Chloridoideae, Cynodonteae), but differs in its spikelets with awnless glumes. Known only from the region of the type locality near the city of Toliara, it is critically endangered.

## **RÉSUMÉ**

*Toliara* (Poaceae, Chloridoideae, Cynodonteae), un nouveau genre endémique du sud de Madagascar.

*Toliara arenacea* Judziewicz, nouvelle espèce d'un nouveau genre monospécifique (Poaceae) endémique des dunes de sable du sud-ouest de Madagascar, est décrite et illustrée. On rapproche *Toliara* du genre paléotropical largement répandu *Perotis* Aiton (Chloridoideae, Cynodonteae), dont il diffère par l'absence d'arête sur les glumes de ses épillets. Il n'est connu que de la localité type, aux environs de la ville de Toliara, où il est en danger critique d'extinction.

## **MOTS CLÉS**

Poaceae,  
Chloridoideae,  
Cynodonteae,  
    Zoysiinae,  
    *Perotis*,  
    *Toliara*,  
conservation,  
Madagascar,  
genre nouveau,  
espèce nouvelle.

## INTRODUCTION

While examining undetermined Madagascar grasses (Poaceae) in the herbarium of the Muséum national d'Histoire naturelle, Paris, in 2006, an unusual grass was found from coastal sand dunes near the city of Toliara, Madagascar. It was remarkable for its solitary, extraordinarily slender inflorescence crowded with tiny, solitary (not paired), ascending to erect, 1-flowered spikelets. The spicate racemes were up to 20 cm long, yet only 1 mm wide, a length:width ratio of up to 200:1, which is perhaps a record in the Poaceae.

Using the keys to world grass genera in Clayton & Renvoize (1986: 232), the unknown grass keyed to subfamily Chloridoideae, tribe Cynodonteae, but could not be satisfactorily keyed to genus. In the key, it came out nearest to *Leptothrium* Kunth (arid tropical but not southern Africa or Madagascar) and *Lopholepis* Decaisne (southern India and Sri Lanka) in the subtribe Zoysiinae, but was clearly distinct from both genera: *Leptothrium* usually has paired spikelets and the lower glume has a "long flat recurved acuminate tail" (Clayton & Renvoize 1986), while in *Lopholepis* the bizarre upper glume is "obliquely constricted into a resemblance of a bird's head" (Clayton & Renvoize 1986). Further examination revealed the unknown grass to be a novel genus related to *Perotis* Aiton.

## MATERIALS AND METHODS

All Madagascar grass (Poaceae) specimens in the herbarium of the Muséum national d'Histoire naturelle, Paris (P) were examined in 2006, and species of this grass were found in the "undetermined to genus" folder. Later that year, specimens of undetermined Madagascar grasses (and *Perotis*) were examined from the following major herbaria: K, MO, NY, and US, without finding additional material of the new taxon.

## SYSTEMATICS

Genus *Toliara* Judziewicz, gen. nov.

A Perotide Aiton *spiculis non aristatis differt.*

TYPE SPECIES. — *Toliara arenacea* Judziewicz.

*Toliara arenacea* Judziewicz, sp. nov.  
(Fig. 1)

TYPUS. — Madagascar. Toliara Province, 35 km N of Toliara on road to Morombe, forest dominated by *Colvillea racemosa* Bojer [Fabaceae] and *Didierea madagascariensis* Baill. [Didiereaceae] and 5 km E by road, 23°05'05"S, 43°38'45"E, elev. 50 m, tufted annual grass, common in open places, inflorescence green, 21.II.1993, Peter B. Phillipson 4117, with J.R. Raharilala (holo-, P!; iso-, GRA, TAN!).

OTHER MATERIAL EXAMINED. — Madagascar. Environs de Tuléar, bush à *Didierea* sur sable, XI.1956, J. Bosser 10364 (P [2 sheets]; TAN). — Bush à *Didierea* sur sable, P.K. 15 Route Tuléar-Morombe, III.1960, J. Bosser 14975 (P).

## DESCRIPTION

Cespitose, somewhat sprawling, annual grass 10–35 cm tall. Culms unbranched or branching, geniculate, both the culms and the open sheaths glabrous; ligule 0.3–0.4 mm long, membranous, delicate, eciliate. Leaves with blades lanceolate to lanceolate-ovate, 8–40 × 2–6 mm, somewhat coriaceous, antrorsely-ciliolate on margins (especially near base), the cilia 0.2–0.3 mm long, otherwise glabrous, clasping at the base, acute at the apex. Inflorescence terminal, 4–20 cm long, 1–1.5 mm wide, a delicate, spicate, densely-flowered, erect, straight to slightly arching raceme, its base enclosed in the uppermost leaf sheath; spikelets sessile, produced spirally all around the rachis, their pedicels 0.2–0.3 mm long, cupulate, decurrent on the rachis as minute, antrorsely scabrous ridges. Spikelets appressed, 1.3–1.8 mm long, falling entire (the inflorescence shattering basipetally), laterally compressed, 1-flowered with no extension of the rachilla; glumes as long as spikelet, narrowly elliptical, membranous, rounded at base, obtuse to acute at apex, awnless, covered with minute antrorsely scabrous spicules (especially on the midnerve) 15–30 µm long; lower glume slightly wider, longer and more arcuate than the upper glume, when in flower each glume stramineous with a prominent green midnerve (no lateral nerves present), slightly gaping but soon closing so that the glumes enfold each other, the spikelet thus appears narrowly elliptical; glumes becoming firmly membranous and brownish, gaping again when in fruit to expose the upper



FIG. 1. — *Toliara arenacea* Judziewicz, P.B. Phillipson 4117 (P): **A**, habit of plant; **B**, base of leaf showing blade clasping culm; **C**, apex of inflorescence showing basipetally deciduous spikelets and persistent spikelet pedicels; **D**, spikelet, lateral view just after flowering showing “closed” glumes; **E**, fruiting spikelet, lateral view showing gapping glumes and protruding caryopsis; **F**, lemma, dorsal view; **G**, palea, dorsal view; **H**, caryopsis, lateral view showing basal embryo. Illustration by Eva Hathaway. Scale bars: A, 2 cm; B, 2 mm; C, 1 mm; D-H, 0.25 mm

TABLE 1. — Distinctive characters of the genera *Perotis* Aiton and *Toliara* Judziewicz.

Character	<i>Perotis</i>	<i>Toliara</i>
Distribution	widespread tropical (including Madagascar) and warm temperate areas of Old World	southern Madagascar
Spikelet pedicels	present or absent	present
Spikelet stipe or callus	present, 0.1-2.3 mm long, or absent in <i>P. patens</i> Gand.	absent
Spikelet length (excluding awns if present)	1.2-11 mm	1.3-1.8 mm
Spikelet orientation at maturity	ascending, divergent, or reflexed, or less commonly appressed	appressed
Glume awns	present, (3)-5-45 mm long	absent
Stamen number	reportedly 3 in all species	apparently 2
Ovary	reportedly glabrous	pubescent

half the caryopsis. Floret solitary; lemma lanceolate, 0.5-0.9 mm long, 1-nerved, weakly keeled, hyaline-diaphanous, tapering to an attenuate apex; palea 0.5-0.7 mm long, slenderly lanceolate, evidently nerveless, hyaline-diaphanous. Flower with lodicules not evident; stamens evidently 2, the anthers orange-brown, 0.3-0.4 mm long; ovary hairy at base, *c.* 0.4 mm long, the stigmas 2, hispid. Fruit a caryopsis 1.3-1.4 mm long, slenderly ellipsoidal, brown, laterally compressed by a ratio of about 1.25:1, its width 0.4 mm dorsally and 0.3 mm laterally; embryo basal, dark brown, 0.5-0.6 mm long; hilum basal, punctate. Chromosome number unknown.

#### REMARKS

*Toliara arenacea* grows only on sand dunes near the coast of southwestern Madagascar. The genus name is derived from the city near which it grows, and the specific epithet from the sandy soil it prefers to grow in. Using the latitude and longitude provided by the collectors and inserting these coordinates into the Google Earth website, the type locality was found to be located in a forested area approximately 30 km by air north of the city of Toliara, and approximately 5 km inland (east) of the Mozambique Channel.

*Toliara arenacea* is assessed as Critically Endangered because its EOO (extent of occupancy) is less than 100 km<sup>2</sup>, it is only known to occur at a single location outside a protected area, and there is both current and predicted decline from human pressure, thus the criteria CR B1ab(i,ii,iii) of the IUCN (2001) apply.

#### DISCUSSION

Based on its vegetative, inflorescence, and basic spikelet structure, *Toliara arenacea* is clearly related to *Perotis* (Table 1). Both genera share an annual habit with small, lanceolate, clasping leaf blades with marginal cilia; inflorescences that are spicate racemes; and deciduous, one-flowered spikelets with prominent, subequal, scabrid or asperous glumes enclosing a much smaller, hyaline floret.

*Toliara* differs from *Perotis* (Clayton *et al.* 2006) in the following characters:

- 1) the spikelets of *Toliara* are awnless, whereas all species of *Perotis* have glumes with awns (3)-5-45 mm long;
- 2) *Toliara* spikelets lack a distinct stipe or callus, whereas all species of *Perotis* (except *P. patens* Gand.) have spikelets with a distinct stipe or callus 0.1-2.3 mm long;
- 3) *Toliara* spikelets are appressed at maturity, in *Perotis* they are usually spreading to ascending, or uncommonly appressed.

Two other possible differences between *Perotis* and the new genus – and both of these characters require verification – are that *Toliara* has two rather than three stamens (Watson & Dallwitz 1992), and a pubescent rather than glabrous ovary (Watson & Dallwitz 1992).

*Perotis* Aiton is a widespread Palearctic genus of about 10 species occurring throughout tropical southern and eastern Africa (including Madagascar), southern Asia, and Australia (Clayton & Renvoize

1986; Watson & Dallwitz 1992; Cope 1995; Clayton *et al.* 2006). All of the species tend to prefer weedy, often ruderal habitats. Three *Perotis* species have been reported from Madagascar: the widespread southern African *P. aff. patens* (Bossler 1969); the widespread paleotropical weed *P. indica* (L.) Kuntze; and the endemic *P. humbertii* A. Camus (Camus 1960). *Perotis humbertii* is known from only a single collection from sandy soil at the mouth of the Linta River (approximately 25°S, 44°E) in the far southwestern part of Madagascar, about 175 km south of Toliara; it has glume awns 5–6 mm long (Camus 1960). There is also a collection of an undetermined *Perotis* species from Beza Mahafaly (*Phillipson 3491*, P, 23°40'S, 44°37'E) about 125 km southeast of the type locality of *Toliara arenacea*; it has spikelets with glumes 2.0–2.2 mm long surmounted by 10–15 mm long awns.

Based on its close relationship with *Perotis*, *Toliara arenacea* appears to be assignable to subfamily Chloridoideae, tribe Cynodonteae, and subtribe Zoysiinae within the grass family (Clayton & Richardson 1973; Clayton & Renvoize 1986; Hilu & Alice 2001; Roodt-Wilding & Spies 2006; Clayton *et al.* 2008). Clayton & Richardson (1973) point out the distinctiveness of *Perotis* within the Zoysiinae. Based on molecular data, other authors find some (but weak) support for relationships with other chloridoid genera such as *Gymnopogon* P. Beauvois (Hilu & Alice 2001) or *Eleusine* Gaertner (Roodt-Wilding & Spies 2006), or else unresolved polychotomies.

The endemic, monotypic Madagascar grass genus *Decaryella* A. Camus (*Decaryella madagascariensis* A. Camus; Camus 1931) bears some distant resemblance to *Toliara*, and is found near the southern tip of Madagascar near Ambovombe (25°10'S, 46°05'E). It is also a member of the Zoysiinae and Clayton & Renvoize (1986) point out that in this subtribe the spikelets are “much modified and oddly shaped [...] with [an] insignificant lemma and large, often bizarre, protective glumes” *Toliara* appears to be exceptional in the Zoysiinae, in that its glumes are neither awned nor otherwise highly modified. *Decaryella madagascariensis*, *Perotis humbertii*, and *Toliara arenacea* all occur in sandy, coastal, subtropical, seasonally dry forests in far southwestern Madagascar; does the subtribe Zoysiinae have a previously unidentified node of diversity in this region?

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