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First record of *Euphorbia golondrina* L. C. Wheeler (Euphorbiaceae) in Cameroon

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Abstract

New record of *Euphorbia golondrina* L.C. Wheeler, a species previously recorded as endemic for Mexico and the United States of America during the late 1930s and subsequently considered extirpated is presented for Cameroon and Africa. The present record obtained from a phytodiversity inventory carried out in Wabane sub division of the mount Bambouto Caldera and other sites in Cameroon, extends the distribution of *E. golondrina* to the southwest region of Cameroon and adds new marginal occurrence sites for this species. This study presents taxonomic comments, distribution maps and pictures of the species. The affinities of this species are discussed and its position within Chamaesyce's subgenus of the genus Euphorbia is indicated. The current status of the species in Cameroon is elucidated, and recommendations for its conservation are offered.

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Introduction

Among the four subgenera of Euphorbia L., the Chamaesyce subgenus is the second most-species-rich and largest lineage of C_4 plants within the eudicots, with over 350 species including both narrow endemics and cosmopolitan weeds (Yang and Berry, 2011;Sage *et al.*, 2011a,2011b). All plant species of the Chamaesyce clade habour the pseudanthial cyathium that is a synapomorphy for Euphorbia (Prenner and Rudall, 2007) but digress markedly from the rest of the genus in habouring opposite, mostly asymmetrical leaves with interpetiolar stipules. Most species are small, prostrate to ascending herbs, with a dichotomous branching pattern that is associated with the early abortion of the apical meristem (Degener and Croizat, 1938; Hayden, 1988). A majority of the species are restricted to southwestern United States and northern Mexico (Sage *et al*., 2011a). The Chamaesyce clade is probably best known for its globally pervasive weedy species, such as *E. maculata* L., *E. hirta* L. and *E. golondrina* L. C. Wheeler (Johnston, 1974).

E. golondrina was first described by B.H. Warnock in 1937 from material collected in Brewster, Texas, USA (Wheeler, 1940, 1941; Correl and Johnston, 1970). The specific name"*golondrina*" is attributed to the popular belief that the swallows which skim close to the ground upon which this plant grows are feeding on the seeds (Wheeler, 1940). Some taxonomists have lately considered the species under an independent genus Chamaesyce Gray and synonymously called it *Chamaesyce golondrina* (L.C. Wheeler) Shinners (Shinners, 1949; Mayfield, 1993).Recent molecular studies support its placement within the Euphorbia as the subgenus Chamaesyce, where *E. golondrina* anchor with other USA and Mexican species (Yang and Berry,2011;Yang *et al.,2012*).

E. golondrina posit native to Texas, USA (Webster and Bruch, 1967), is also found in adjacent Chihuahua desert, Mexico (Webster, 1994). This species is considered invasive and has been found as a weedy species in anthropogenically affected ecosystems (Aleksandroff, 2011) growing on sandy soils. Wheeler (1940) was the first to report *E. golondrina* as a weedy species growing on alluvial and marginal soils at roadside and geographically restricted to USA and Mexico. The weediness displayed by this and other species of the Chamaesyce subgenus is facilitated by precocious flowering, quick generation turnover (up to several generations per growing season), high seed set, and a specialized seed coat that becomes sticky when wet (Jordan and Hayden, 1992;Suzuki and Teranishi, 2005).

Until recently, *E. Golondrina* has never been collected in Africa and was considered as absent from the continent. During recent botanical explorations in Cameroon, it was collected from disturbed habitats and is reported here. The search for extant duplicates in over 30 Herbaria in 25 countries has been unsuccessful. Apart from the early collections in USA and Mexico, *E .golondrina* has not been recorded from other parts of the world. Plant species specific distributional records are valuable information for the management and conservation of a species and such information is urgently needed to develop baseline data for future population and threat assessment studies. Since, species with lower abundance and rare occurrences are useful for phytogeographical analyses, they also reflect the distribution patterns of common species and obviously have major role in community characteristics; even they can also be used to recognize more local or regional patterns of distribution of species. In addition, an analysis of the distribution of restricted plant species would be useful to understand patterns of evolutionary divergence, especially at the generic level, in unrelated groups, and help direct research efforts of conservationists, ecologists and evolutionary biologists (Sorrie and Weakle, 2001). This study results from field work and herbaria research aimed at documenting the floristic diversity in Wabane subdivision of the mount Bambouto Caldera and other sites in the Southwest Region of Cameroon. The project`s accentuation on the discovery of plant

species new to the study area and or botanical science motivated the quest for new records of plants in the area.

Materials and methods

Study Site

This study results principally from fieldwork and plants inventory of the project "Flora of the western flank of the mount Bambouto Caldera" (latitudes 5°38 N and 5°43 N and longitudes 9°58 E and 10°06 E) and field observations in other parts of the southwest region of Cameroon. The climate of this region is marked by high winds and low sunshine. The average daily temperature varies very much with season and ranges from 17 to 32°C (Nkembi, 2004). The area has two seasons, the rainy period that runs from March to October and the dry season that spans from November to February. The annual rainfall is between 2000 and 3000 mm. The soil is very fertile and of volcanic origin (Zogning *et al.*, 2007). The region surrounded by the Littoral, West and Northwest regions in three sides, assumes a special significance in the biogeography of Cameroon due to its unique location and habitat heterogeneity. It is located at the confluence of the Guinea-Congolian biogeographical zone and is part of the 35 biodiversity hotspots in the world (Myers, 2000). The undulating topography, high rainfall and varied altitudes are main factors that have contributed to its rich hilly ecosystem and habitat diversity.

Plant species collections

The Cameroonian collections of *E. golondrina* were made in the southwest region from disturbed sites on rocky ground, forest edge, and where horticultural plants and Maize had recently been cultivated (69-569 m.a.s.l).The modified 20 m x 50 m Whittaker design with nested subplots was used to profile and collect data on the vegetation of the study area. At each study site, three laid out modified Whittaker plots were scanned for plant species inventory. *E. golondrina* was first observed as a noxious and recalcitrant weed on 15th July 2014 and specimen collected at one site at Afala hill(5*40'50.3"N and 9*57'26.7"E) in Wabane Municipality of the Mt Bambouto Caldera,western Cameroon and seen at two separate sites , at Banga Bakundu(4*23'53.8"N and 9*26'38.6"E), 3 km north west of Muyuka and at Bolifamba mile16 (4*8'39.1"N and 9*18'34.2"E) directly opposite Government High School Bolifamba,Buea , though only vouchered from one. The herbarium specimen was prepared following standard herbarium techniques (Jain and Rao,1977) and deposited in the herbarium of the Limbe Botanic garden(SCA).The plant was photographed live using a digital camera (Nikon 300, Japan) .The species was critically examined and confirmed using relevant literature and reference herbarium collections located in Herbaria in Cameroon .The flora of West tropical Africa, online Herbarium specimens of the Missouri Botanic gardens, Kew Botanic gardens and New York Botanic gardens were compared with the collected specimen at SCA, together with a loan of members of the genus Euphorbia from the Limbe Botanic gardens. A morphological species concept developed during the course of taxonomic research in the Mt Bambouto Caldera was employed to delimit and compare taxa. The plant material was further examined under a Wild M3C binocular microscope and Planapo lens at X64 to X400 magnifications and confirmed to be *E. golondrina*.

Results and discussion

The first records for *E. golondrina* as an alien invasive weed in Cameroon and Africa are here presented, along with distribution maps showing the location of the study area and geographical distribution of the species in the world (Fig.1 and Fig.3B), and pictures (Fig.2 and Fig.3. A, C, D, E). This extends the geographical distribution of *E. golondrina* to the southwest region of Cameroon (Fig.3b) to more than 250 km² and above 55.000 km² and adds new marginal occurrence sites for this species. The species is described following standard classification with accepted binomial name, a short description, phenology , distribution range, geographical coordinates, altitudinal data, fruit type and present herbarium voucher (fig.3A:SCA/1687).

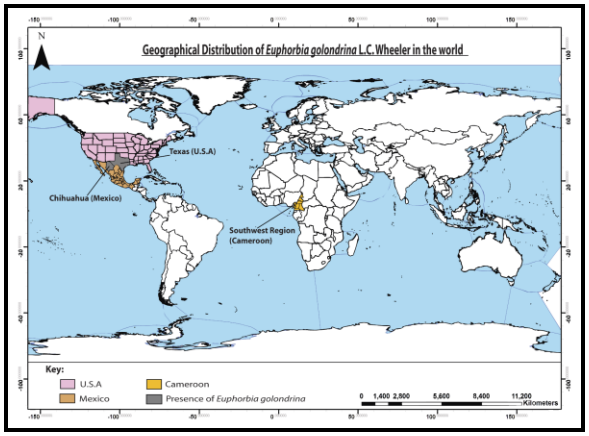

Fig.1. Distribution of *Euphorbia golondrina* L.C. Wheeler in the World.

Fig. 2. *Euphorbia golondrina* L. C. Wheeler,whole plant ,growing on rocky-ground with dense branching at Afala hill in Wabane Municipality of the Mt Bambouto Caldera,Western Cameroon in July 2014. Photograph by Ndam L.M.

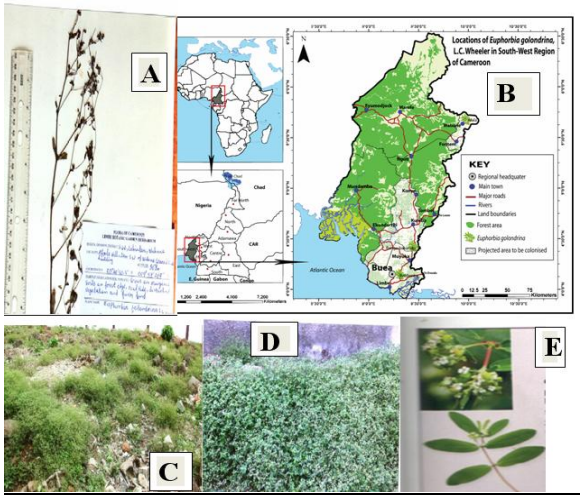

Fig.3. Morphology and distribution of *E. golondrina* L.C. Wheeler in the southwest region of Cameroon. A. *E. golondrina* voucher from Afala hill., Wabane Municipality,southwest region, Cameroon (Ndam L.M.,1687, SCA), B. Distribution of the newly discovered population of *E. golondrina* in the southwest region of Cameroon, C. *E. golondrina* invading an open field and chocking out other weed species, Bolifamba, Western Cameroon, D. *E. golondrina* habit at Banga Bakundu,western Cameroon, E. *E. golondrina* white flower ,bracts, and opposite leaves.

Voucher: **CAMEROON**. **Afala hill**. Wabane Municipality: 2 km on the roadside at Afala hill, SW of Wabane council building, 15 July 2014, Ndam L.M. 203 (SCA/1687).

Type: **USA**. Along sandy beach at entrance to Boquillas Canyon, Chisos Mountains Area, Brewster County, Texas, Aug. 5, 1937, B. H. Warnock 998 (U. S. Nat. Herb. #1726028).

E. golondrina is very morphologically variable and distinct, as discussed by Wheeler (1940). It is a glabrous, erect annual invasive weedy herb of about 5-50 cm long. Leaves are opposite, petioles 1-2 mm long, blade oblong to elliptic oblong or rarely suborbicular 5-10 mm long, wide 2-8 mm, margin entire, base rounded and inequilateral, apex rounded, stipules subulate, 0.7-1 mm long, separate on upper side of stem, united on lower side of stem into a single bifid structure, occasionally with a few minute hair at apex. Cyathia are solitary at nodes and in axils, penducles 0.5-1.5 long, involucres turbinate, Ca. 1 mm long, rimmed by 4 erect, stipulate, rounded but cupped or concave glands 0.2-0.5 mm in diameter, petaloid appendages white, semilunate, very small or sometimes obsolete, staminate flowers 28-40 (-50) mm, style stout, 0.2-4 mm long, notched or bifid. Fruit: a more or less ovoid, glabrous, 3 seeded, vaguely 3 angled capsule 1.8-2 mm long, seeds 1.6-1.8 mm long, oblong-quadrangular, apex acute, with a white coat and 6-8 faint transverse wrinkles, sometimes essentially smooth. Flowering and fruiting have been observed from June-November. The combination of foliage glabrous save for perhaps

occasionally a few hairs on the stipules, glands circular or nearly so yet with evident white appendage, tetragonal seeds, and 39-50 staminate flowers per cyathium, is an exclusive combination of characters.

The information on geographical extension of *E. golondrina* is important from taxonomical and phytogeographical points of view and will also contribute towards the conservation of this restricted herbaceous species. Although, it is difficult to quantify the total number of additional species that still exists within different locations of the southwest region without a comprehensive assessment of the flora, it might be possible to having lost many species and also have recruited some from adjacent areas. However, proximity of the Afala Hills of Wabane, Bolifamba mile16 in Buea and Banga Bakundu near Muyuka to a mosaic of neighboring vegetation types and locations might contribute to increase the chances of occurrence of the present additional weedy species.

The species *E. golondrina* reported in the present article is a poor endemic restricted to a narrow stretch of marginal habitats in USA, Mexico and Cameroon. The population studies and their distributional reports in perspective need a new assessment in order to assign it an IUCN conservation status. Relying on the data collected from our botanical exploration and previous observations and as per the criteria of IUCN Red list (IUCN, 2013), the authors suggest categorization of *E. golondrina* as threatened species. Anthropogenic factors such as habitat disturbance, land encroachment and deforestation might result to depletion of their numbers.

The southwest region is remarkably known for showing high rates of endemism for different taxa, representing different biogeographic units in the tropics (Sunderland *et al.*, 2003; Focho *et al.,* 2009; Harvey *et al.,* 2010; Fonge *et al.,* 2013). There are numerous taxa in the southwest region known only from few collections made during the 19th and early 20th centuries. Fortunately, some of them have been recently rediscovered during botanical explorations (Harvey *et al.*, 2010). Such is the case with the herb *E. golondrina*, which was reported in USA in 1940 in the county of Brewster (Wheeler, 1940) and rediscovered in the southwest region of Cameroon. Even though the flora of Cameroon is one of the best documented in the Central African region,

its flora remains incompletely known(Cheek *et al.*,2008;Sonké *et al.*,2008, Droissart *et al.*,2009;Sonké *et al.,* 2009;Lachenaud and Séné 2010, 2012).), with new species and populations of rare and endangered plants still being found (Van der Burgt and Newbery,2006;Mackinder *et al.*,2010; Harvey *et al.*,2010).The southwest region comprises 1% of West tropical Africa's flora, and is considered as part of the 35 Biodiversity Hotspot (Myers *et al.*,2000). The combination of high biodiversity with high deforestation rates, climate change, and the presence of invasive species emphasizes the need for conservation. This should go hand in hand with further botanical exploration of the flora, because species long thought to be extirpated or extinct may still be around in very small numbers, and may be in need of local protection and conservation. There is also need to investigate the mechanism of invasion and establishment of *E. golondrina* as well as exploit this in biological weed control.

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