SCIENTIFIC NOTE

Frost damage in a *Lobelia brasiliensis* (Campanulaceae) population at Reserva Ecológica do IBGE, Brasília – Federal District, Brazil

Angelita de Sousa Coelho

Betânia Tarley Porto de Matos Góes

Iona'i Ossami de Moura

Mariza Alves de Macedo Pinheiro

Leonardo Lima Bergamini

Brazilian Institute of Geography and Statistics (IBGE), Management of Natural Resources and Environmental Studies, IBGE State Unit in the Federal District. Rodovia DF001, Km 38, Lago Sul, Brasília, DF, Brazil, ionamoura@gmail.com

Abstract: *Lobelia brasiliensis* is a rare and endemic plant of the Federal District (DF), present in the Ecological Reserve of the Brazilian Institute of Geography and Statistics (IBGE), located in the south-central portion of the DF, in the center of the Cerrado biome. Low temperatures can impose restrictions on Cerrado vegetation. In May 2022, the temperature dropped sharply in the DF, reaching a minimum temperature of 2°C in the Reserve. Seeking to evaluate the effects of frost on the population of *L. brasiliensis*, a field survey was carried out in the area two months after the mentioned climatic event. For one hour, three people walked about 1,300 m along the area, covering approximately 1 ha. A total of 84 individuals of *L. brasiliensis* were located in the field, ranging from single rosettes with about 20 cm in diameter to individuals with multiple rosettes forming patches of approximately 2 m in diameter. All individuals had dry leaves and stems. Some individuals were observed again four months later, and were already in an advanced stage of regrowth, with several new leaves. Thus, although the low temperature event affected individuals, there is still no evidence of permanent damage to the population.

Keywords: rare plant, threatened species, Cerrado, frost.

Efeito de uma geada em uma população de *Lobelia brasiliensis* (Campanulaceae)na Reserva Ecológica do IBGE, Brasília – DF, Brasil

Resumo: *Lobelia brasiliensis* é uma planta rara e endêmica do Distrito Federal, presente na Reserva Ecológica do Instituto Brasileiro de Geografia e Estatística (IBGE), localizada na porção centro-sul do DF, no centro do bioma Cerrado. As baixas temperaturas podem impor restrições à vegetação do Cerrado. Em maio de 2022 a temperatura apresentou uma queda acentuada no DF, atingindo a temperatura mínima de 2°C na Reserva. Buscando avaliar os efeitos da geada sobre a população de *L. brasiliensis*, efetuou-se uma vistoria na área dois meses após o evento climático citado. Foram percorridos, durante uma hora, cerca de 1.300 m ao longo da vereda, abrangendo uma área de aproximadamente 1 ha. Foram localizados 84 indivíduos de *L. brasiliensis*, variando desde rosetas únicas com cerca de 20 cm de diâmetro a indivíduos com múltiplas rosetas formando manchas de aproximadamente 2 m de diâmetro. Todos os indivíduos apresentavam ressecamento das folhas e caules. Parte dos indivíduos foi observada novamente 4 meses depois do evento, e já se encontravam em avançado estágio de rebrota, com diversas folhas novas. Assim, embora o evento de baixa temperatura tenha afetado os indivíduos, ainda não há indícios de danos permanentes na população.

Palavras-chave: planta rara, espécie ameaçada, Cerrado, geada.

Lobelia brasiliensis A. O. S. Vieira & G. J. Shepherd (Campanulaceae) is a rare plant endemic to the Federal District, Brazil (Freitas et al., 2014; Vieira & Shepherd, 1998). A species can be considered rare when its individuals are restricted to a small area (restric occurrence area), when they only occur under specific circunstances (restricted occupation area) and/or when they have low populational density along its distribution (Kruckeberg & Rabinowitz, 1985). Two metrics are used by the International Union for the Conservation of Nature (IUCN) to describe a species' distribution (IUCN, 2012). The first one, Extent of Occurrence (EOO), is defined as the area occupied by the minimum convex polygon comprising all occurrence sites of a species, inferred or projected. The second one is the Area of Occupation (AOO), and is computed as the area inside the EOO that is actually occupied by the species, excluding sites where the species does not occur. *L. brasiliensis* has a small EOO of, aproximately, 778 km² and AOO of 100 km² (Freitas et al., 2014).

L. brasiliensis is an herbaceous plant presenting long racemes that can be over 1,5 m long (Vieira & Shepherd, 1998). The flowers are numerous, with purple color (Fig. 1). They can be found fertile all year (Zanatta, 2012), and grow in wet areas, next to riparian forests, cerrado vegetation or other open phytophysiognomies, between 700 and 1175 m above sea level (Vieira & Sherpherd, 1998). Herbarium records show that the species was, historically, found in over 20 localities in the Federal District (DF), with more recent surveys indicating the existence of nine populations in five protected areas: Guará Ecological Reserve, Fazenda Água Limpa/ University of Brasília, Brasília Botanical Garden Ecological Station, Brasília National Park, and the Ecological Reserve of the Brazilian Institute of Geography and Statistics (IBGE) (Zanatta, 2012).

The IBGE Ecological Reserve is a protected area of scientific interest. With about 1,400 hectares, it is located in the south-central portion of the DF, 26 km south of central Brasília (Fig. 2), in the center of the Cerrado biome (Ribeiro, 2011). It has great phytophysiognomic diversity, being composed of cerrado *sensu stricto*, gallery forests and grassland formations, both in humid and dry areas (Pereira & Furtado, 2011). In the Reserve, *L. brasiliensis* was recorded in areas of vereda (a type of savanna formation with *Mauritia flexuosa* L.f. palm trees that occurs in wet areas) and humid grasslands (Pereira & Furtado, 2011).

Fig. 1. Fertile individual of *Lobelia brasiliensis* A. O. S. Vieira & G. J. Shepherd (Campanulaceae) in the Taquara stream vereda, IBGE Ecological Reserve. Brasilia - Federal District, Brazil. Photo: Leonardo Bergamini, 07/06/2018.

Thus, *L. brasiliensis* is present in the center of the Cerrado biome. The Cerrado climate is predominantly classified as AW (Megathermic or humid tropical, with dry winter and maximum summer rainfall), according to the Köppen classification (Silva et al., 2008). There are two well-defined seasons. The rainy season, with higher temperatures, from September to April, and the dry season, with lower temperatures, from April to September. In some areas to the south of the biome, the CWA climate can be observed (Mesothermal or hot temperate, with dry winter and average temperature of the hottest month greater than 22º C). During winter, polar cold fronts are common, causing a drop in temperature in the southern and western half of the region (Dias, 1992).

Low temperatures can impose restrictions on the Cerrado vegetation, and the biome can be delimited, among other factors such as fire

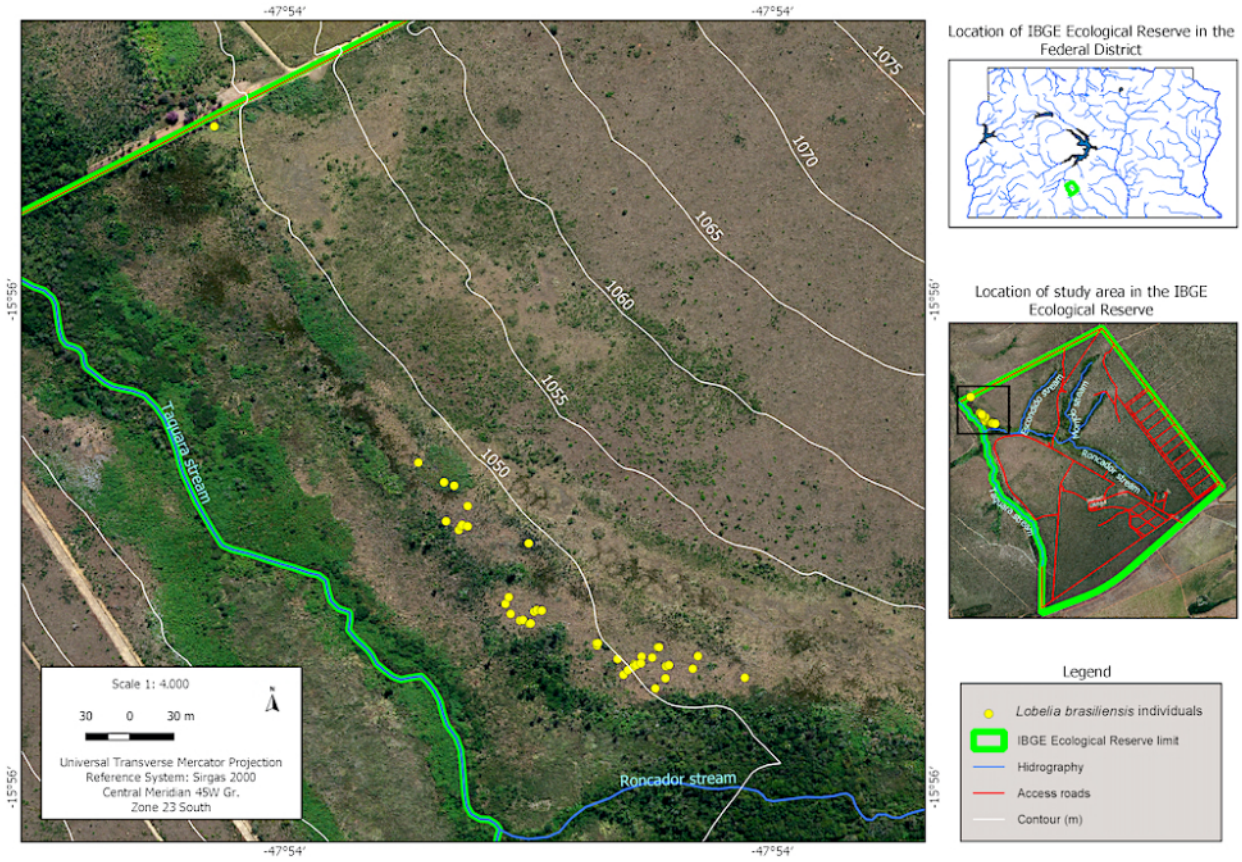

Fig. 2. Distribution of *Lobelia brasiliensis* A. O. S. Vieira & G. J. Shepherd (Campanulaceae) individuals in the studied area. IBGE Ecological Reserve, Brasília - Federal District, Brazil. Aerial orthophotos, from the year 2015, with 24 cm resolution, and topographic data provided by Terracap.

and herbivory, by low temperature. According to Eiten (1972), savanna vegetation only occurs in places where very low temperatures, which cause frost, are infrequent, occurring at intervals of several years. Some authors consider that intense cold, especially temperatures below zero, may be a disturbance that exerts a selective force that directs the evolution of Cerrado species, resulting in resistance characteristics (which present little damage at low temperatures) and tolerance characteristics (which minimize the negative impacts of damage), as well as the distribution of species across the biome (Antonio, 2019; Brando & Durigan, 2005; Filgueiras & Pereira, 1989; Franco & Álvarez-Yépiz, 2022; Hoffman et al., 2019; Silberbauer-Gottsberger et al., 1977).

Between 05/17 and 05/19/2022, the temperature dropped sharply in the DF, reaching 4.9°C at the INMET 83377 conventional station (Nonato, 2022). This value corresponds to the third lowest temperature recorded for autumn, behind the 3.3°C on 06/10/1985 and 3.2°C on 05/18/1977 (Nonato, 2022). At the meteorological station located in the IBGE Ecological Reserve, minimum temperatures below 5°C were recorded between the 19th and 05/22/2022. On 05/20/2022, the minimum temperature reached 2°C, the lowest value recorded by the station, in operation since 1980, with the average annual minimum temperatures between 1980 and 2020 being 6.9°C.

Frost events are rare in the Reserve, the last similar episode recorded occurred on 06/09/1985, when a minimum temperature of 4.9°C was observed (Filgueiras & Pereira, 1989). On that occasion, the effects of the cold on the vegetation of *campo sujo* were evaluated, where it was found that all 62 species that occurred in the area presented damage about two days after the event.

The temperature drop between 05/19 and 05/22/2022 caused marked damage to some areas of the Reserve's vegetation: several individuals had darkened leaves, with a burnt, dry appearance, possibly due to freezing and necrosis of plant tissues. The damage was easily observed in gallery forest vegetation, cerrado *sensu stricto*, *campo sujo* and *vereda* near the meeting of the Roncador and Taquara streams (Fig. 3).

Fig. 3. General appearance of the *vereda*, approximately 2 months after an atypical cold event. IBGE Ecological Reserve, Brasília - Federal District, Brazil. Photo: Leonardo Bergamini, 07/14/2022.

Seeking to evaluate the effects of this atypical low temperature episode on the population of *L. brasiliensis*, a field survey was carried out in a *vereda* area, along the Taquara stream (Fig. 2). The first survey was carried out on 07/14/22, about two months after the climatic event. For one hour, three people walked about 1,300 m along the area, covering approximately 1 ha. In addition, three individuals located near the road were also evaluated. A second survey was carried out on 09/06/2022. Since the individuals were not marked, not all were revisted on the second survey.

A total of 84 individuals of *L. brasiliensis* were located in the field, ranging from single rosettes with about 20 cm in diameter to individuals with multiple rosettes forming patches of approximately 2 meters in diameter. So far, no measurement of individuals has been carried out. At that first moment, only an initial observation was made on the behavior of this species in a rare weather event. It is intended to implement, soon, a project for the characterization and demographic monitoring of this population in the Reserve. All individuals had dry leaves and stems, and only the basal portion of the stem of some individuals still had living tissue (Fig. 4A). Even though the tissue damage was not assessed anatomically to acertain that damage was indeed caused by the frost, the visual characteristics of the observed damage as well as the remarkable sincronicity on all surrounding vegetation give enough evidence that it was in fact the case. The stems of the inflorescences were broken and dry, although it was not possible to determine if this damage was the result of the cold or if they are stems from previous reproductive events. However, all individuals, regardless of their size, were already in an advanced stage of resprout, with several new leaves (Fig. 4B). Thus, although the low temperature event affected individuals, including delaying the reproductive event, there is still no evidence of permanent damage to the population. A second survey was carried out on 09/06/2022, and it was observed that the individuals continued to show resprout growth. (Fig. 4C). The photos of the observed individu-

Fig. 4. *Lobelia brasiliensis* A. O. S. Vieira & G. J. Shepherd (Campanulaceae) after frost damage. IBGE Ecological Reserve, Brasília - Federal District, Brazil. A. Only the basal portion of the stem has living tissue. Young leaves sprouting from the base. B. All branches dead and intense basal regrowth. C. Continued regrowth observed in one of the large individuals, 54 days after the first survey and aproximately 100 days after the frost. Photos A and B: Leonardo Bergamini, 07/14/2022. Photo C: Angelita Coelho, 09/06/2022.

als are available on the iNaturalist platform (https://www.inaturalist.org/projects/impacto-de-uma-geada-sobre-individuos-de-lobelia-brasiliensis).

Considering that *L. brasiliensis* is a rare species, with a very restricted distribution, its populations must be monitored and analyzed frequently, allowing the identification of possible negative impacts in time intervals that still allow their mitigation. The population located in the Reserve will continue to be monitored to provide subsidies for the conservation of the species. The continued monitoring will be valuable to describe the interaction between specific impacts, such as the rare climatic event described here, in addition to other threats to the species, such as the presence of species with invasive behavior that occur in the same environments, such as *Melinis minutiflora* P.Beauv. and *Pteridium arachnoideum* (Kaulf.) Maxon, and the lowering of the water table and the densification of the shrub cover, mainly due to the spread of the species *Trembleya parviflora* (D.Don) Cogn. The latter has spread through some conservation units in the DF, forming closed canopies in wetland areas and causing a reduction in species diversity locally (Meireles et al., 2002; 2004; Santos & Munhoz, 2012), and is very abundant in the study area.

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