Contribuţii Botanice – 2021, LVI: 45-52 DOI: 10.24193/Contrib.Bot.56.4
Grădina Botanică "Alexandru Borza"
Cluj-Napoca

EVALUATING CONSERVATION STATUS, THREATS AND POPULATION TRENDS OF *LEUCADENDRON*, A PLANT GENUS ENDEMIC TO THE CAPE REGION IN SOUTH AFRICA

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Abstract: Declines in endemic species have significant impact on global biodiversity loss. More efforts need to be harnessed to further protect endemic species from the current global extinction crisis. This study evaluated the current conservation status, factors responsible for risk of extinction and the trends in populations of *Leucadendron*, a plant genus endemic to the Cape region in South Africa. The SANBI (South African National Biodiversity Institute) Red List was employed in this study. The results revealed that over 50% of taxa in this genus are threatened and most of the species are exposed to habitat destruction and the presence of invasive species. It was also discovered that two species of this genus are currently extinct, which implies this genus is facing a high risk of extinction. More efforts, such as designing effective methods of controlling forces responsible for the risk of extinction of taxa in this genus, should be put in place to prevent their complete extirpation in future.

Keywords: Conservation, endemism, extinction risk, population decline, threatened species

Introduction

Species extinction is currently a global problem and it is translating into loss of ecosystem services [1]. The current decline in species populations puts Earth's biodiversity at future risk [2], which makes continuous review of species that are at risk of extinction extremely important. Threatened species need continuous evaluation, at intervals of at least a decade, to keep track of changes in their conservation status and to determine whether efforts made in conservation of threatened species are generating the results required [3]. One of the steps to evaluate extinction risk of taxa is to determine the factors that are responsible for that risk and recommend how the effect of these ecological forces can be mitigated [4].

Endemic species occur exclusively within certain geographical areas [5]. They are highly vulnerable to extinction due to anthropogenic threats, small population sizes, specific habitat conditions, short reproduction capacity and population decline [6]. Consistent evaluation of the conservation status of endemic species is important in order to keep track of increase in their extinction risk and also to determine their response to conservation actions put in place to reduce that risk [7].

The genus *Leucadendron* belongs to the family Proteaceae [8]. Endemic to the Cape region of South Africa [9], this genus consists of short and tall evergreen shrubs [10]. Some of the species are widespread while others are rare. Their flowers possess distinct coloured petal-like bracts [11] and the majority of them are used as cut flowers [12].

This study evaluated the conservation status, threats and population trends of

Leucadendron using the SANBI Red List. This is to show the current degree of extinction risk in the genus and indicate factors that should be controlled to reduce the risk of extinction of this genus.

Methodology

The South African National Biodiversity Institute (SANBI) is the national conservation body in South Africa charged with the responsibility of assessing plant and animal species in South Africa for conservation purposes. The SANBI Red List contains the conservation status of South African plant taxa. It also includes information such as threats, uses, trends in population and other relevant information that reveals the state of conservation of taxa listed on the Red List. IUCN guideline are strictly adhered to by SANBI in evaluating the conservation status of South African flora and fauna and this has made the SANBI Red List a globally accepted platform for determining the status of plant and animal taxa that occur in South Africa. The 2020 version of the Red List [13] was employed in this study to evaluate the current conservation status of the genus *Leucadendron*. The following were determined from the Red List: Conservation status, threats and population trends of *Leucadendron* species. Percentages of taxa under different SANBI Red List categories for *Leucadendron* were calculated and the percentages of taxa under different categories of population trend (increasing, decreasing, stable, fluctuating) were determined. The percentages of taxa in this genus facing different categories of threats were calculated.

Results

A total of 96 recognized species and subspecies of *Leucadendron* were found on the SANBI Red List. The following are the percentages of taxa in *Leucadendron* that fall under different SANBI Red List Categories: 2% are already Extinct (EX), 18.8% are Critically Endangered (CE), 18.8% are Endangered (EN), 13.5% are Vulnerable (VU), 17.7% are Near Threatened (NT), 2% are Rare, 1% are Data Deficient Taxonomically Problematic (DDT) and 26% are of the Least Concern (LC); 51.1% are threatened (Critically Endangered + Endangered + Vulnerable) and 71.8% are of conservation concern (Critically Endangered + Endangered + Vulnerable + Near Threatened + Rare + Data Deficient Taxonomically Problematic). The percentages of taxa in *Leucadendron* threatened by different kinds of ecological forces are as follows: 66.7% are threatened by habitat destruction, 60.4% are threatened by the presence of invasive species, 23% are threatened by fire occurrence, 17.7% are threatened by pollution, 16.7% are threatened by harvesting, 4.1% are threatened by grazing, 2% threatened by drought, 1% threatened by pest control, 1% threatened by reproductive failure, 10.4% are not threatened and the factors threatening 9.4% that are of conservation concern are unknown. The percentage of taxa experiencing population decrease in this genus is 62.5% and the populations of 27% of taxa are stable. Those that are fluctuating between decreasing and stable are 5.2%, and the population trends of 3% are unknown.

Discussion

Conservation status changes over time, with species becoming either more threatened or less threatened due to conservation interventions [3]. Thus it is important to determine current conservation status of threatened plant groups regularly. Because *Leucadendron* has two species that are currently extinct (Figure1; Table 1), 51.1% currently threatened (Figure 1; Table 1) and

71.8% of conservation concern (Table 1), it can be concluded that this genus is facing a high risk of extinction.

Table 1: Listing of the species in the genus *Leucadendron*, their SANBI Red List Status and the threats each is facing

Species	SANBI Red List Status	Population trend	Threats
Leucadendron album (Thunb.) Fourc.	LC	Stable	Fire occurrences, invasive species presence
Leucadendron arcuatum (Lam.) I.Williams	LC	Stable	Habitat destruction
Leucadendron argenteum (L.) R.Br.	EN	Decreasing	Habitat destruction, invasive species presence
Leucadendron barkerae I.Williams	LC	Stable	Fire occurrences
Leucadendron bonum I.Williams	CE	Decreasing	Fire occurrences, reproductive failure
Leucadendron brunioides Meisn. var. brunioides	LC	Stable	No threats
Leucadendron brunioides Meisn. var. *flumenlupinum* I.Williams	CE	Decreasing	Pollution, invasive species presence, habitat destruction
Leucadendron burchellii I.Williams	NT	Stable	Invasive species presence, habitat destruction
Leucadendron cadens I.Williams	Rare	Stable	No threat
Leucadendron chamelaea (Lam.) I.Williams	CE	Decreasing	Invasive species presence, habitat destruction, pest control
Leucadendron cinereum (Sol. ex Aiton) R.Br.	VU	Decreasing	Invasive species presence, habitat destruction, pollution,
Leucadendron comosum (Thunb.) R.Br. subsp. *comosum*	LC	Stable	No threat
Leucadendron comosum (Thunb.) R.Br. subsp. *homaeophyllum* (Meisn.) I.Williams	CE	Decreasing	Harvesting, fire occurrences, invasive species presence
Leucadendron concavum I.Williams	EN	Unknown	Fire occurrences
Leucadendron conicum (Lam.) I.Williams	NT	Decreasing	Unknown
Leucadendron coniferum (L.) Meisn.	VU	Decreasing	Harvesting, invasive presence, habitat destruction, pollution
Leucadendron cordatum E.Phillips	Rare	Stable	Habitat destruction, fire occurrences
Leucadendron coriaceum E.Phillips & Hutch.	EN	Decreasing	Habitat destruction, invasive species presence, pollution
Leucadendron corymbosum P.J.Bergius	VU	Decreasing	Pollution, invasive species presence, habitat destruction
Leucadendron crassulaefolium (Salisb. ex Knight) I.Williams	DDT	Stable	Unknown
Leucadendron cryptocephalum Guthrie	EN	Decreasing	Habitat destruction, invasive species presence, overgrazing
Leucadendron daphnoides (Thunb.) Meisn.	EN	Decreasing	Habitat destruction, invasive species presence
Leucadendron diemontianum I.Williams	NT	Stable	No threat
Leucadendron discolor E.Phillips & Hutch.	EN	Decreasing	Habitat destruction, harvesting
Leucadendron dregei E.Mey. ex Meisn.	EN	Decreasing	Fire occurrence
Leucadendron dubium (H.Buek ex Meisn.) E.Phillips & Hutch.	NT	Decreasing	Habitat destruction
Leucadendron elimense E.Phillips subsp. *elimense*	EN	Decreasing	Invasive species presence, harvesting, habitat destruction

Leucadendron elimense E.Phillips subsp. *salteri* I.Williams	CE	Decreasing	Habitat destruction, invasive species occurrence, harvesting
Leucadendron elimense E.Phillips subsp. *vyeboomense* I.Williams	CE	Decreasing	Habitat destruction, invasive species presence, fire occurrences,
Leucadendron ericifolium R.Br.	LC	Stable	Habitat destruction, invasive species occurrence, fire occurrences
Leucadendron eucalyptifolium H.Buek ex Meisn.	LC	Decreasing	Habitat destruction, invasive species occurrence
Leucadendron flexuosum I.Williams	CE	Decreasing	Habitat destruction, invasive species occurrence
Leucadendron floridum R.Br.	CE	Decreasing	Habitat destruction, harvesting, invasive species presence
Leucadendron foedum I.Williams	VU	Decreasing	Habitat destruction, invasive species presence, pollution
Leucadendron galpinii E.Phillips & Hutch.	VU	Decreasing	Invasive species presence, harvesting, habitat destruction
Leucadendron gandogeri Schinz ex Gand.	LC	Stable	Invasive species presence, harvesting, fire occurrences
Leucadendron glaberrimum (Schltr.) Compton subsp. erubescens I.Williams	LC	Stable	No threats
Leucadendron glaberrimum (Schltr.) *compton* subsp. glaberrimum	LC	Stable	No threats
Leucadendron globosum (Kenn. ex Andrews) I.Williams	CE	Decreasing	Invasive species presence, Habitat destruction
Leucadendron grandiflorum (Salisb.) R.Br.	EX	Not Applicable	Unknown
Leucadendron gydoense I.Williams	EN	Decreasing	Habitat destruction
Leucadendron immoderatum Rourke	CE	Fluctuating	Habitat destruction, invasive species presence
Leucadendron lanigerum H.Buek ex Meisn. var. laevigatum Meisn.	CE	Fluctuating	Habitat destruction, invasive species presence, pollution
Leucadendron lanigerum H.Buek ex Meisn. var. lanigerum	EN	Decreasing	Habitat destruction, invasive species presence, pollution, harvesting
Leucadendron laureolum (Lam.) Fourc.	LC	Unknown	Habitat destruction, invasive species presence
Leucadendron laxum I.Williams	EN	Decreasing	Pollution, invasive species presence, harvesting, habitat destruction
Leucadendron levisanus (L.) P.J.Bergius	CE	Decreasing	Habitat destruction, pollution, invasive species presence,
Leucadendron linifolium (Jacq.) R.Br.	VU	Decreasing	Invasive species presence, habitat destruction, pollution, harvesting
Leucadendron loeriense I.Williams	LC	Stable	Habitat destruction, fire occurrence, invasive species presence,
Leucadendron loranthifolium (Salisb. ex Knight) I.Williams	NT	Decreasing	Habitat destruction
Leucadendron macowanii E.Phillips	CE	Fluctuating	Habitat destruction, harvesting, invasive species presence
Leucadendron meridianum I.Williams	NT	Decreasing	Habitat destruction, invasive species presence
Leucadendron meyerianum H.Buek ex E.Phillips & Hutch.	EN	Decreasing	Fire occurrences
Leucadendron microcephalum (Gand.) Gand. & Schinz	LC	Unknown	Habitat destruction, invasive species presence

Leucadendron modestum I.Williams	EN	Decreasing	Invasive species presence, habitat destruction, pollution
Leucadendron muirii E.Phillips	NT	Decreasing	Habitat destruction, invasive species presence, fire occurrences
Leucadendron nervosum E.Phillips & Hutch.	NT	Decreasing	Unknown
Leucadendron nitidum H.Buek ex Meisn.	LC	Stable	No threat
Leucadendron nobile I.Williams	LC	Stable	No threat
Leucadendron olens I.Williams	NT	Stable	Unknown
Leucadendron orientale I.Williams	EN	Decreasing	Invasive species presence, habitat destruction
Leucadendron osbornei Rourke	LC	Stable	No threat
Leucadendron platyspermum R.Br.	VU	Decreasing	Harvesting, invasive species presence, fire occurrences
Leucadendron pondoense A.E.van Wyk	VU	Decreasing	Fire occurrences, habitat destruction
Leucadendron procerum (Salisb. ex Knight) I.Williams	VU	Decreasing	Invasive species presence, habitat destruction
Leucadendron pubescens R.Br.	LC	Decreasing	Habitat destruction, fire occurrences
Leucadendron pubibracteolatum I.Williams	NT	Fluctuating	Invasive species presence, habitat destruction
Leucadendron radiatum E.Phillips & Hutch.	EN	Decreasing	Fire occurrences
Leucadendron remotum I.Williams	EN	Decreasing	Fire occurrences, climate change
Leucadendron roodii E.Phillips	EN	Decreasing	Habitat destruction, fire occurrences, drought
Leucadendron rourkei I.Williams	LC	Stable	No threat
Leucadendron rubrum Burm.f.	LC	Stable	Habitat destruction, invasive species presence
Leucadendron salicifolium (Salisb.) I.Williams	LC	Decreasing	Habitat destruction, invasive presence, drought
Leucadendron salignum P.J.Bergius	LC	Decreasing	Habitat destruction, grazing, invasive species presence
Leucadendron sericeum (Thunb.) R.Br.	CE	Decreasing	Habitat destruction, fire occurrences
Leucadendron sessile R.Br.	NT	Decreasing	Unknown
Leucadendron sheilae I.Williams	VU	Decreasing	Invasive species presence, habitat destruction, pollution
Leucadendron singulare I.Williams	VU	Decreasing	Habitat destruction, pollution, invasive species presence
Leucadendron sorocephalodes E.Phillips & Hutch.	NT	Decreasing	Unknown
Leucadendron spirale (Salisb. ex Knight) I.Williams	EX	Not Applicable	Habitat destruction, invasive species presence
Leucadendron spissifolium (Salisb. ex Knight) I.Williams subsp. fragrans I.Williams	LC	Stable	Habitat destruction, grazing
Leucadendron spissifolium (Salisb. ex Knight) I.Williams subsp. natalense (Thode & Gilg) I.Williams	NT	Decreasing	Unknown
Leucadendron spissifolium (Salisb. ex Knight) I.Williams subsp. oribinum I.Williams	VU	Decreasing	Habitat destruction, invasive species presence
Leucadendron spissifolium (Salisb. ex Knight) I.Williams subsp. phillipsii (Hutch.) I.Williams	LC	Stable	Habitat destruction, invasive species presence

Leucadendron spissifolium (Salisb. ex Knight) I.Williams subsp. spissifolium	LC	Stable	Fire occurrences, invasive species presence
Leucadendron stellare (Sims) Sweet	EN	Decreasing	Habitat destruction, grazing, invasive species presence, fire occurrences
Leucadendron stelligerum I.Williams	CE	Decreasing	Habitat destruction, invasive species presence, pollution, harvesting
Leucadendron strobilinum (L.) Druce	VU	Stable	Fire occurrences
Leucadendron teretifolium (Andrews) I.Williams	NT	Decreasing	Habitat destruction, invasive species occurrence
Leucadendron thymifolium (Salisb. ex Knight) I.Williams	CE	Decreasing	Invasive species presence, habitat destruction, pollution
Leucadendron tinctum I.Williams	NT	Decreasing	Unknown
Leucadendron tradouwense I.Williams	CE	Decreasing	Invasive species presence, harvesting, habitat destruction
Leucadendron uliginosum R.Br. subsp. *glabratum* I.Williams	NT	Decreasing	Habitat destruction, invasive species presence
Leucadendron uliginosum R.Br. subsp. *uliginosum*	NT	Decreasing	Habitat destruction, invasive species presence
Leucadendron verticillatum (Thunb.) Meisn.	CE	Fluctuating	Habitat destruction, invasive species presence, harvesting
Leucadendron xanthoconus (Kuntze) K.Schum.	LC	Stable	Habitat destruction, invasive species presence

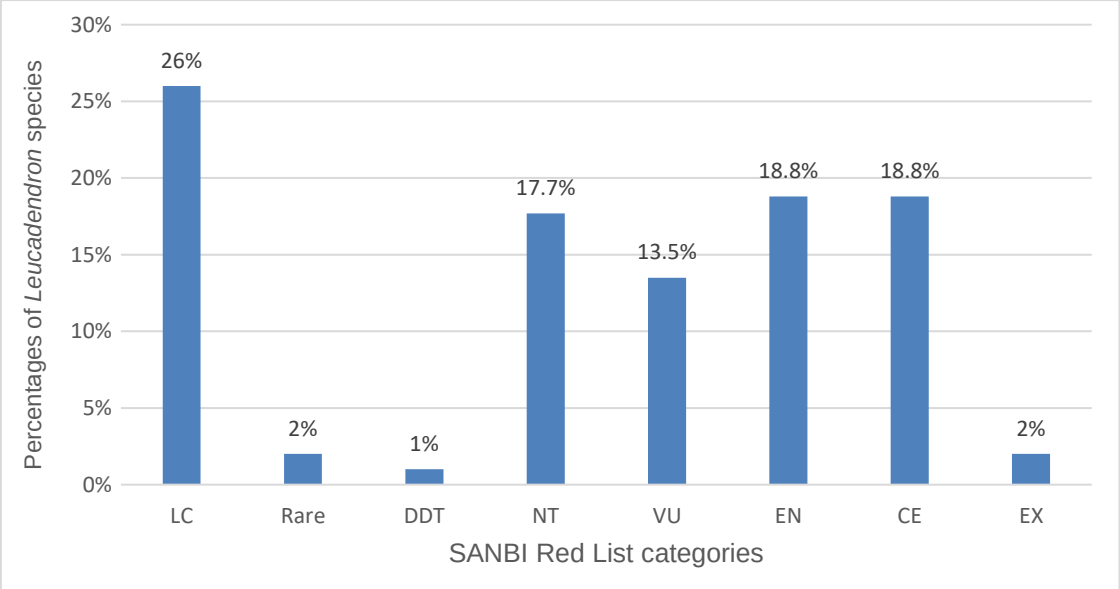

Fig. 1: Percentages of *Leucadendron* taxa that fall into different SANBI Red List categories

Certain factors are responsible for risk of extinction of threatened species [14] and these ecological forces need to be controlled to prevent further species decline and increase in biodiversity loss. This study recommends re-evaluation of *Leucadendron* species where their threats are listed as unknown (Table 1; Figure 2) to determine factors responsible for their risk of extinction.

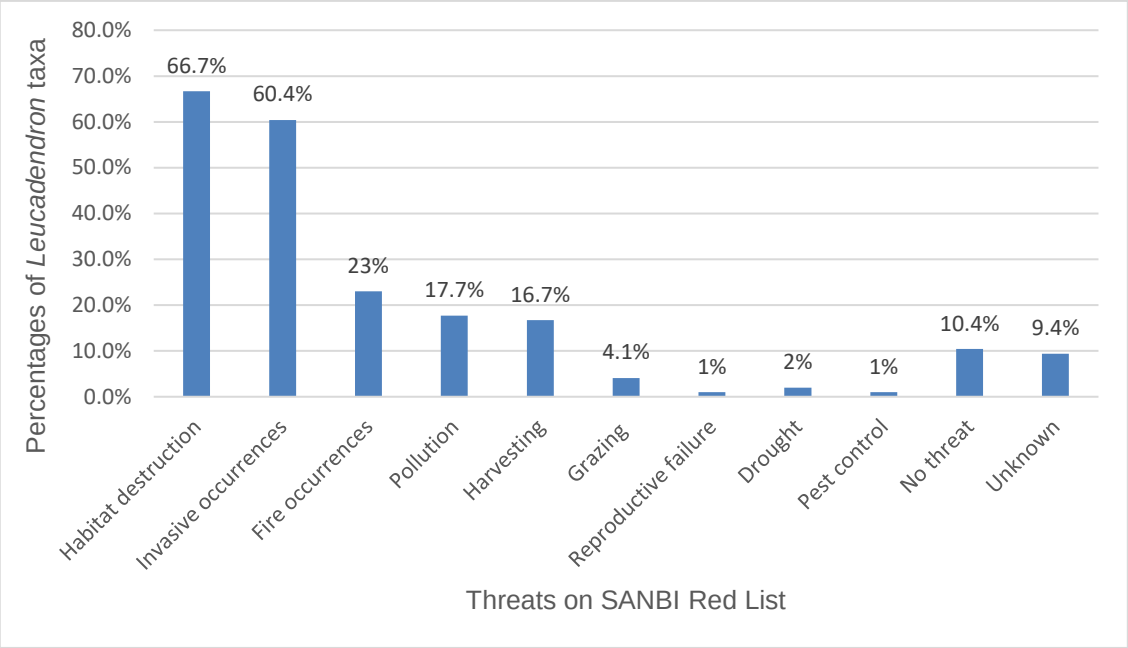

Fig. 2: Percentages of *Leucadendron* taxa that face different threats on the SANBI Red List

The trends in population size of species is one of the factors that determine risk of extinction of species [15]. Whether the population of threatened taxa is decreasing, increasing or stable will determine whether or not they will become more threatened in future [3]. The present study recommends re-evaluation of taxa whose population trends are unknown (Table 1) to determine which category of population trends they fall into. With a larger percentage of the taxa in the genus experiencing population decline (Table 1), it can be concluded that this genus is tending towards a higher extinction risk in the future. This implies that more proactive measures are needed to curtail the risk of extinction of this genus.

Conclusion

This study has shown that the genus *Leucadendron,* endemic to the Cape region of South Africa, is highly threatened and the factors responsible for the risk of extinction are revealed (Table 1). The study contributes to the body of literature that promotes advocacy for high level protection of endemic species because they the genus *Leucadendron* should be protected. Regeneration of these species should be encouraged to increase the number of populations.

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EVALUAREA STATUSULUI CONSERVATIV, A AMENINȚĂRILOR ȘI TRENDULUI POPULAȚIONAL AL GENULUI *LEUCADENDRON*, ENDEMIC PENTRU REGIUNEA CAPULUI DIN AFRICA DE SUD

(Rezumat)

Scăderea numărului de specii endemice are un impact semnificativ asupra pierderii biodiversității globale. Trebuie depuse eforturi suplimentare pentru a proteja în continuare speciile endemice de actuala criză globală a dispariției. Acest studiu a evaluat starea actuală de conservare, factorii responsabili pentru riscul de extincție și tendințele populațiilor de *Leucadendron*, un gen de plante endemic pentru Regiunea Capului din Sudul Africii. Pentru acest studiu s-a folosit Lista Roșie a ISABN (Institutul Sud African de Biodiersitate Națională). Rezultatele au arătat că peste 50% dintre taxonii acestui gen sunt amenințați, iar majoritatea speciilor sunt expuse la distrugerea habitatului și prezența speciilor invazive. De asemenea, s-a descoperit că două specii ale genului sunt actualmente extincte, ceea ce presupune că genul de plante este supus unui risc ridicat de extincție. Ar trebui depuse mai multe eforturi, cum ar fi proiectarea unor metode de a controla forțele responsabile pentru riscul de extincție a taxonilor acestui gen, pentru a preveni eliminarea completă a acestora în viitor.

Received: 4.05.2021; Accepted: 15.07.2021