

All hands on deck: An innovative approach to sustained and sustainable conservation funding for endangered plants and ecosystems

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When the world was ending the first time, Noah took all the animals, two by two, and loaded them aboard his escape craft for evacuations. But it's a funny thing: He left the plants to die. He failed to take the one thing he needed to rebuild life on land, and concentrated on saving the freeloaders! (Powers, 2018, p. 451).

Despite the proliferation of environmental non-governmental organizations (NGOs) in recent years, plant conservation remains drastically underfunded, receiving only a fraction of the philanthropy currently directed at animal conservation, particularly for "charismatic megafauna." By way of illustration, at least six NGOs are dedicated solely to preventing the extinction of the five extant rhinoceros species. The largest of these, International Rhino Foundation, reported a total revenue of US \$3,681,483 in 2019. In contrast, current estimates of global plant richness exceed 391,000 vascular plant species, of which roughly 40% (>150,000 species)—are threatened with extinction (Antonelli et al., 2020). The only global organization focused solely on plant conservation, Botanic Gardens Conservation International, reported US \$4,233,338 in total revenue

in 2019. Given these metrics, relative funding translates to less than US \$30 per threatened plant taxon versus US \$736,297 per rhinoceros species per annum from *just one* of the five rhino NGOs. Even taking into account smaller, regional plant conservation organizations, the stark reality is that current conservation funding is woefully inadequate given the magnitude of the plant biodiversity crisis.

The Red List Project (TRLP) was founded in 2018 as an NGO (501(c)(3)) dedicated to preventing the extinction of the world's most endangered plants and to protecting biodiversity hotspots (Mittermeier et al., 2004). TRLP was launched to enhance plant conservation funding through diversified funding streams. To this end, TRLP engages with global industries that rely on plants and plant derivatives and pairs for-profit entities with community organizations, universities, botanic gardens, and local conservation NGOs around the world. For example, TRLP has established partnerships with several fragrance manufacturers to develop consumer products based upon the scents of imperiled plants and their habitats. Proceeds from these products are directed to allied conservation efforts in countries of origin. Since fragrance is ubiquitous in consumer products—from fine perfumes to household cleaners—this avenue provides

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an array of products with the potential to generate conservation funding. TRLP fragranced products are developed through synthetic chemistry and headspace capture technology, and/or published volatile organic compound (VOC) profiles, so do not rely on extractive practices for production (Figure 1).

Statistica, a marketing and consumer data research firm, reported the 2020 value of the flavor and fragrance market in North America at US \$4.5 billion and predicted that the global fragrance market will be US \$52.4 billion by 2025 (Statistica, 2021). Even a minute fraction of fragranced product sales would revolutionize philanthropy for plant biodiversity conservation. Additionally, the direct-to-consumer educational value is incalculable, with daily use of a fragranced product a routine reminder of the importance of environmental conservation and the critical role of plants in everyday life.

This approach is highlighted by an ongoing partnership between TRLP, independent fragrance house Baruti Perfumes, and the University of Palermo, to prevent the extinction of the critically endangered Palermo violet (*Viola ucriana* Erben and Raimondo). This violet is restricted to the slopes of Mt Pizzuta in the Serre della

Pizzuta Nature Reserve in Sicily (Italy), between 950 and 1300 m s.l.m., where it grows in xeric prairies on steep slopes (Gianguzzi et al., 2018). *Viola ucriana* is an herbaceous perennial with lightly fragrant, yellow flowers, and is threatened by factors partly related to human disturbance (e.g., fires, grazing, etc.). Its leaf morphology suggests some adaptation to mountain habitats of the Mediterranean Region, and is, in fact, a close relative of two other violets endemic to other Sicilian reliefs, that is, *Viola tineorum* Raimondo and Erben (with purple to violet-bluish flowers) restricted to the summit of Rocca Busambra (Sicani Mountains) between 1500 and 1600 m a.s.l., and *Viola nebrodensis* C. Presl (with deep violet flowers), which occurs on the Madonie Mountains between 1600 and 2000 m a.s.l. (Gianguzzi et al., 2017). In 2019, an expedition was organized with the Baruti perfumer and researchers from the University of Palermo to smell and study the plant while in bloom. The collaboration documented a delicate floral scent dominated by salicylates, eugenol (clove), and ionones. Baruti's perfumer (Drosopoulos) subsequently developed a commercial scent based on available data and his own observations.

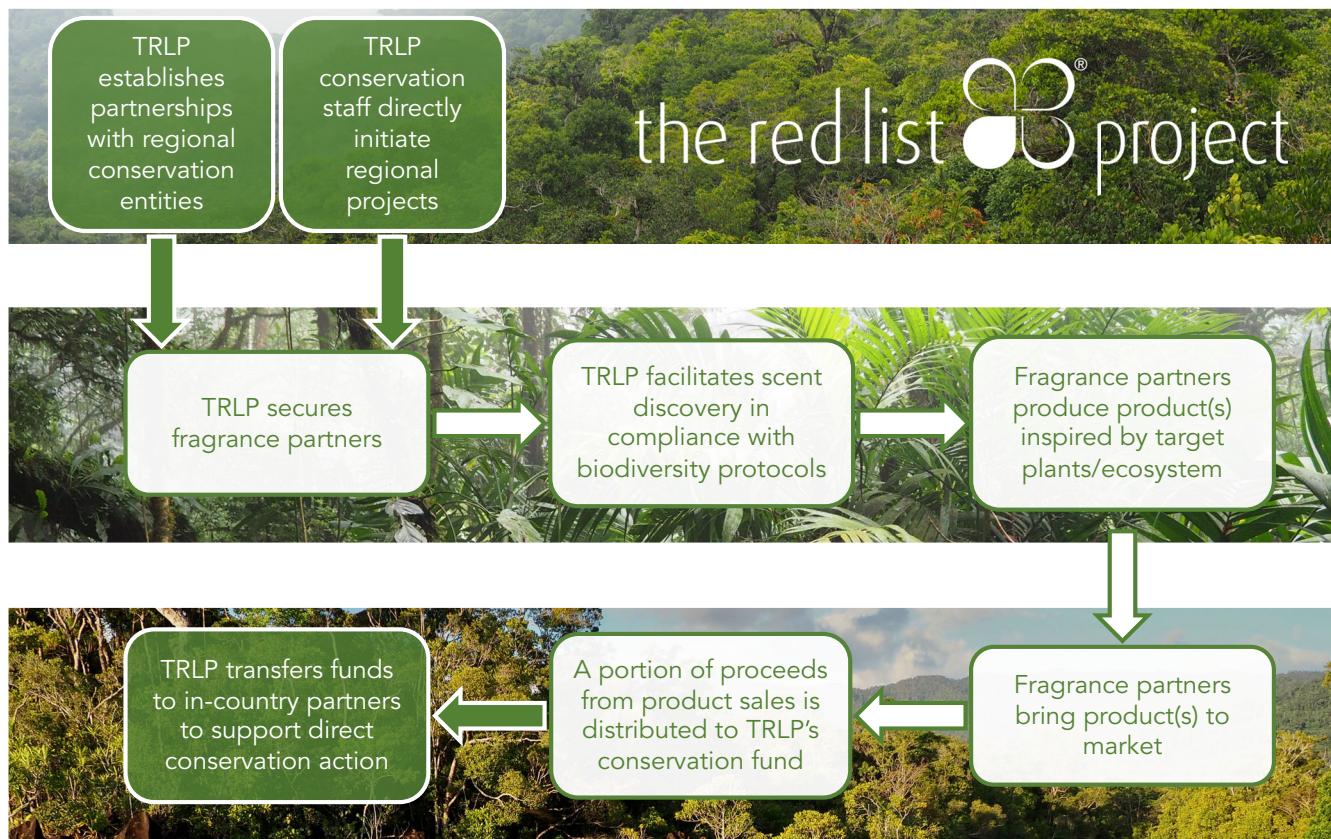


FIGURE 1 Generalized flow chart of the primary activities for innovative engagement in conservation and business sectors that can lead to novel funding streams for global plant conservation conducted by The Red List Project

Baruti has developed a second product based upon the critically endangered shrub, *Portlandia platantha* Hook.f. (Rubiaceae), restricted to Jamaica's eastern end at low elevations. For this conservation project, TRLP is teaming with the Botany Department of the Natural History Museum of Jamaica. Drosopoulos was able to study the floral scent during several visits to the Huntington Botanical Gardens (Los Angeles, California), where the species is in ex situ cultivation. Scent of the flowers is reminiscent of *Gardenia* but lacks the sharp green top note and bears a more pronounced vanillic/coconut facet overall. The synthesized scent is a very close proxy for the actual scent of the flower in full bloom.

Results of both studies are now offered by Baruti as ambient sprays and will soon be developed into reed sticks and candles. Fifty percent of the proceeds from product sales are dedicated to research and habitat restoration conducted by scientists at both institutions, with the aim of preventing the extinction of the two imperiled species. Both aforementioned species are single-site endemics, which Knapp et al. (2020) have identified as species most likely to go extinct.

Novel partnerships that engage across disciplines, livelihoods, and political boundaries may be the best way to raise significant, impactful philanthropic dollars to curb the loss of our botanical heritage in this current sixth mass extinction. We encourage others to think differently about how best to address the massive loss of biodiversity and call “all hands on deck”—from trusted allies to the most unlikely of collaborators, because innovative ways to fund conservation work and educate the world simultaneously may be our best bet to leave a positive conservation legacy.

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CONFLICT OF INTEREST

The authors declare no potential source of conflict of interest, financial or otherwise.

AUTHORS CONTRIBUTION

Lorenzo Gianguzzi conceived of the paper. Peggy Fiedler led the writing, editing, and review of the manuscript, and

all authors (Lorenzo Gianguzzi, Peggy L. Fiedler, Vanessa Handley, and Spyros Drosopoulos) contributed to the writing and editing. Vanessa Handley prepared the figure.

DATA AVAILABILITY STATEMENT

Data that support the findings of this study are openly available at the IUCN Red List of Threatened Species website and at <http://top50.iucn-mpsg.org/species/15,top50.iucn-mpsg.org>.

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