



Opinion

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Seasonally Dry Tropical Forests of Peru: Current Status and Conservation with Social Responsibility



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Abstract

Seasonally dry tropical forests (SDTF) constitute one of the most threatened terrestrial ecosystems in Peru. That is the important of carrying out studies on their spatio-temporal distribution patterns and floristic composition. The aim of this study is to highlight the effort made by many researchers in the knowledge of the SDTF. However, it is important to complement such studies with still few others about germplasm conservation, seed germination physiology, in vitro conservation protocols, chemistry of natural products and the biological activity of secondary metabolites, reforest devastated areas and carbon sequestration to mitigate the dramatic consequences of climate change.

Keywords: Endemisms, Equatorial SDTF, Floristic composition, Germplasm bank, in vitro plant conservation

Introduction

The seasonally dry tropical forests (SDTF) of Peru constitute a very fragile ecosystem, with high biodiversity and endemism. SDTF are widely dispersed in various regions of Peru. For this reason several classifications have been proposed since the first phytogeographic studies carried out by Weberbauer *et al.*, [1,2]. The Linares-Palomino *et al.*, [3,4] classification divides Dry Forests into subunits such as Equatorial, Inter-Andean and Eastern Seasonally Dry Forests subunits, this división is the most accepted.

The Equatorial SDF subunit includes the regions from the south of Ecuador to Tumbes, Piura, Lambayeque (Figure 1 a,b) and part of Cajamarca and La Libertad. The Equatorial SDF cover more than three million hectares and is probably the most studied subunit. The predominant plant species are *Prosopis limensis* (Fabaceae/'algarrobo'), *Colicodendron scabridum* (ex *Capparis angulata*) (Capparaceae/'sapote') and *Vachellia macracantha* (ex *Acacia macracantha*) (Fabaceae/'faique'). Other important species, although strongly deforested are *Handroanthus chrysanta* (ex *Tabebuia chrysanta*) (Bignoniaceae/'guayaacán

amarillo'), *Erythrina smithiana* (Fabaceae/'frejolillo') (Figure 1b) y *Loxopterygium huasango* (Anacardiaceae/'hualtaco'). Two endemic animal species stand out in Equatorial SDF ecosystem, the 'white-winged guan' (*Penelope albipennis*/Cracidae) and the 'spectacled bear' (*Tremarctos ornatus*/Urcidae, both critically endangered (UCN 3.1). The Inter-Andean SDF subunit includes the Huancabamba, Marañón, Mantaro and Apurímac river systems, although minor remnants have also been identified in the Cuzco and Puno regions, specifically the formations in Quillabamba and Machupicchu, near the Urubamba river. There are numerous species of forestry importance in this subunit such as *Bursera graveolens* (Burseraceae), *Sapindus saponaria* (Sapindaceae), *Chorisia insignis* (Malvaceae), *Guazuma ulmifolia* (Malvaceae), *Ochroma pyramidale* (Malvaceae), *Muntingia calabura* (Muntingiaceae), *Hura crepitans* (Euphorbiaceae), *Eriotheca ruizii* (Malvaceae), *Curatella americana* (Dilleniaceae), *Piptadenia colubrina* (Fabaceae), and others. The Eastern SDF subunit covers fragments on the eastern flanks of the Andes of the San Martín region, specifically in the surroundings of

Tarapoto, integrating several endemic species such as *Schinopsis peruviana* (Anacardiaceae), *Triplaris peruviana* (Polygonaceae), *Platymiscium gracile* (Fabaceae) and *Inga tenuicalyx* (Fabaceae).

The aim of this study is to highlight the efforts of various researchers in the SDTF study and to present some research guidelines for its conservation and rational use.



Figure 1: Equatorial Seasonally Dry Tropical Forest (SDTF) in the Lambayeque region. a. SDTF area heavily devastated, b. *Erythrina smithiana*, a frequent Fabaceae in the SDTF, c. Seed germplasm bank-UNPRG, d. Fruits and seeds of some representative species of the SDTF, e. In vitro germplasm bank-UNPRG, f. Forest species production greenhouse, and g. *Psittacanthus linearis* (Loranthaceae)

Table 1: Tree and shrub species of the Equatorial SDF (Lambayeque) priority for a short-term reforestation program with social responsibility.

| Select Species | Family | Propagation Form | | |
|---|------------------|------------------|--------|----------|
| | | Seeds | Stakes | In vitro |
| Scientific name and popular name | Family | Seeds | Stakes | In vitro |
| 1. <i>Prosopis pallida</i> (algarrobo) | Fabaceae | X | | |
| 2. <i>Coloicodendron scabridum</i> (sapote) | Capparaceae | X | | |
| 3. <i>Vachellia macracantha</i> (faique) | Fabaceae | X | | |
| 4. <i>Loxopterygium huasango</i> (hualtaco) | Anacardiaceae | | | X |
| 5. <i>Handroanthus chrysantha</i> (guayacán amarillo) | Bignoniaceae | X | | X |
| 6. <i>Celtis iguanaea</i> (palo blanco) | Ulmaceae | X | X | |
| 7. <i>Cochlospermum vitifolium</i> (polo polo) | Cochlospermaceae | X | | |
| 8. <i>Bursera graveolens</i> (palo santo) | Burseraceae | | X | |
| 9. <i>Eriotheca ruizii</i> (Pasallo) | Malvaceae | X | | |
| 10. <i>Caesalpinia glabrata</i> (charán) | Fabaceae | X | | |
| 11. <i>Ficus obtusifolia</i> (higuerón) | Moraceae | | X | X |
| 12. <i>Bielschmiedia sulcata</i> (palto de monte) | Lauraceae | X | X | |
| 13. <i>Piper tuberculatum</i> (matico) | Piperaceae | | | X |
| 14. <i>Pithecellobium multiflorum</i> (angolo) | Fabaceae | X | | |
| 15. <i>Terminalia valverdae</i> (almendro) | Combretaceae | X | | |

| | | | | |
|---|-------------|---|--|---|
| 16. <i>Beautempsia avicennifolia</i> (vichayo)-shrub | Capparaceae | X | | |
| 17. <i>Grabowskia boerhaaviaefolia</i> (palo negro)-shrub | Solanaceae | X | | X |

Relevant studies on the SDTF

Studies about the SDTF are scarce, however a greater number have been executed in the Equatorial SDF. A study of some aspects of the structural and floristic patterns of the Reserva Ecologica Chaparri registered 1255 individuals, this represented 24 species, where the most abundant was *Cordia lutea* (Boraginaceae) in the Lambayeque region [5]. A phenology study revealed that until six of 17 species were available for *P. albipennis* (White-winged guan) as food throughout the year, the remaining 11 species were seasonal in the ecological reserve introduced above [6]. Likewise, floristic composition of trees and shrubs are important studies to determinate significant alteration and depredation of valuable genotypes of patches of SDTF ecosystems [7].

Studies in structural and diversity patterns of trees are relevant for determining status conservation, thus an investigation determined that tree density varied from 31 to 458 individuals per hectare and until 45 woody species in two conservation areas of the Northwestern Biosphere Reserve (Cerros de Amotape National Park and Tumbes Reserved Area) located in the Tumbes region [8]. Studies of edaphic characteristics and floristic composition are important to determine the relationship between soils composition and forest structure. Thus, A research registered 18 and 23 species, where *Loxopterygium huasango* and *Erythrina smithiana* showed the largest basal area in the Equatorial SDF of La Menta and Timbes (Sullana, Piura) respectively; the study also corroborated the forest structure based on kind of soils such as Entisols and Orthents properly of SDF [9]. A research conducted to determine woody vegetation, endemism and conservation status reported 151 species, 103 genera and 40 families of woody plants. The investigation also revealed a high number of endemic species was seriously threatened in a type of seasonally dry forests of Jaen (Cajamarca region) [10].

Germplasm conservation ex situ and reforestation program with social responsibility

One of the major omissions in the study of the SDTF of Peru is the lack of *ex situ* germplasm conservation and reforestation programs. Germplasm conservation *ex situ* can be carried out in several ways: as sexual seed and through *in vitro* cultures, especially in species with recalcitrant seeds. That is why a Germplasm Bank of Seeds of the SDTF species has been established in the General Laboratory of Biotechnology (LGB) of the Pedro Ruiz Gallo National University (UNPRG) of Lambayeque (Figure 1c,d). This germplasm bank has seeds of ca. 120 species, which are preserved under environmental conditions with a temperature of 24-26°C and a 12-12 h photoperiod with moderate natural light. As it is unknown if the seeds are orthodox, recalcitrant or intermediate,

most of the species are found as seedlings and culture of shoot tips and nodal segments in *in vitro* condition (Figure 1e). This germplasm bank of SDTF species is the first to be established in a public university in Peru. The lack of reforestation programs is another of the great omissions in the study of the SDTF species. Given this, a broad program of plant production has been started from three strategies: seeds germinated in the greenhouse, rooted cuttings and through *in vitro* cultures (Table 1). Currently, we distributed more than 10,000 plants free of charge among the rural residents of the SDTF and we hope this quantity will increase exponentially in the next three years (Figure 1f).

Future Research

Future research on SDTF species should address the following aspects:

- a) To use standard evaluation models whenever possible since each researcher chooses particular models and methods that make it difficult to make comparisons between one forest and another, even from the same subunit. For example, some authors evaluate the diameter at breast height (dhh) ≥ 1.0 cm and others ≥ 10.0 cm.
- b) To establish relationships between vegetation structure and edaphic and climatic conditions to determine the SDTF dynamics over time.
- c) To investigate the germination physiology of seeds to establish reliable protocols for short- and medium-term conservation, such as sexual seed or *in vitro* cultures.
- d) To encourage the phytochemical study of SDTF species with the possibility of finding secondary metabolites of pharmacological importance. This is the case of the 'suelda con suelda' (*Psittacanthus linearis*) (Figure 1g), a semi-parasitic species of the Loranthaceae family, with antimicrobial potential [11], related phylogenetically to *Viscum album* ('mistletoe'), with potential powerful inhibitory activity against coronavirus (SARS-CoV) due to the presence of ML II lectin [12,13].
- e) To carry out studies about carbon sequestration in order to suggest appropriated programs that could contribute with the mitigation of the effects of climate change.

Conclusions

Although studies in the spatio-temporal distribution and floristic composition of the SDTF have been carried out in various regions of Peru, studies related to germplasm conservation and the implementation of reforestation programs are still scarce and almost non-existent. Remembering that plant species are

depositories of innumerable secondary metabolites with wide biological activity, for that reason their study and rational exploitation is important. Likewise, the ravages of climate change and the protection of forests and biodiversity is another global concern.

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Conflict of Interest

The authors declare that there is no conflict of interest.

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