



STATE SECRETARIAT FOR INFRASTRUCTURE AND ENVIRONMENT

ANNEX IX – METHOD FOR ASSESSING FLORA INTEGRITY

STATE SECRETARIAT FOR INFRASTRUCTURE AND ENVIRONMENT

This ANNEX describes the procedure to be employed with the method for assessing and qualifying the physical integrity of Live Collections at the BOTANIC GARDEN, known as the Qualitative and Quantitative Assessment of Flora Injury.

The proper management of plants kept within a controlled environment, which is the case of the BOTANIC GARDEN's live collections, is the best way to ensure ideal conditions. If they are improperly managed, the plants will respond with visible physical signs, construed as injuries within the scope of this CONCESSION.

Injuries can appear on sections of plants (trunks, stems, stalks, branches and leaves), in the form of necrosis, mechanical wounds, rot, fire damage, vandalism damage, chlorosis, leaf drop and mortality, among others. Signs of damage that are external to the plant may also qualify as injuries, such as the presence of weeds (especially in the vases of orchids and bromeliads), parasites and potentially noxious organisms, such as pests, pathogens and invasive exotic species.

The method applies to woodland and shrub flora (including palm trees) and plants with different growth patterns, such as weeds (terrestrial, aquatic, epiphytes and hemiepiphytes), ferns and lianas.

Individuals shall be sorted into five categories (phytosanitary state), according to the result of the phytosanitary assessment: 1) excellent; 2) good; 3) average; 4) poor; and 5) very bad, considering the following factors:

- State of the trunk (score of 1 to 5);
- Recent growth rate (score of 1 to 3);
- Tree vitality (score of 1 to 5);
- Diseases, pests and parasites (score of 1 to 3);
- Treetop vigor (score of 1 to 5); and
- Residual longevity (score of 1 to 3).

The assessment of the integrity of the flora, considering each of the factors described above, shall adhere to the following criteria:

STATE SECRETARIAT FOR INFRASTRUCTURE AND ENVIRONMENT

Factor	Factor Variation
State of Trunk (ST)	Solid and healthy (5) Sections of missing bark (3) Extensive rotting and hollows (1)
Recent Growth Rate (GR)	Average or above average for the species (3) Below average for the species (2) Negligible growth (1)
Tree Vitality (TV)	No signs of dieback (5) Intermediate stage of dieback (3) Two or more of the main branches dead, advanced stage of dieback (1)
Diseases, Pests and Parasites (DP)	No infestation or disfiguring injuries present (3) Chronic infestation or disfiguring injuries (2) Advanced infestation, which is usually fatal (1)
Treetop Vigor (TTV)	Summer: Leaves of normal size and color (5) Leaves of smaller size or somewhat discolored (3) Small, yellowed leaves, showing severe signs of burning or precocious autumnal coloring (1) Winter: Buds of normal size, swelling (5) Buds of smaller size (3) Small buds, several dead buds (1)
Residual Longevity (RL)	More than 20 years (3) Between 5 and 20 years (2) Less than 5 years (1)

ST – State of Trunk

The tree trunk is examined to determine its integrity and to identify physical imperfections such as extensive rotting and hollows, or sections of missing bark. The score ranges between 1 and 5. The top score (5) is attributed to a solid, healthy trunk; an intermediate score (3) is attributed when sections of missing bark are identified; and the lowest score (1) is attributed in case of extensive rotting and hollows. Physical damages caused to the bark as a result of poorly executed pruning shall also be considered. Insect attacks, diseases or the presence of parasites on the trunk, however, shall not be considered in this category, even if oozing or other signs are visible.

GR – Recent Growth Rate

The recent growth is assessed based on the sprouts or growth segments seen at the ends of stems or branches. This growth varies from one species to the other. The examiner's experience is crucial, being acquired and consolidated with every new assessment performed. In the majority of species, sprouts can be identified by scarring on the dormant bud preceding each new sprout during the growing season. The top score ranges between (3), in case of average or above-average growth for species; (2), for a growth rate below the average for the species; and the lowest score (1), for negligible growth.

TV – Tree Vitality

Vitality is assessed according to signs of dieback. Dieback is described as the progressive death of twigs and branches, from the end (extremity) of the branch toward its base. It can be caused by several factors, such as fungus, bacteria, low temperatures, drought, defective aeration and drainage, chemical toxicity and insect attacks. The score ranges between 1 and 5. The top score (5) is attributed when no signs of dieback exist. An intermediate score (3) can be attributed when signs indicate an intermediate stage of dieback, and the lowest score (1) is attributed when two or more of the main branches have died, signaling an advanced stage of dieback.

DP – Diseases, Pests and Parasites

The score ranges between 1 and 3. The top score (3) is attributed when the tree shows no sign of infestation or disfiguring injuries. The score (2) is attributed when the tree shows signs of chronic or disfiguring infestation. The lowest score (1), in turn, is attributed when the tree shows signs of advanced infestation, which is usually fatal. The presence of mistletoe should be considered in the determination of this factor. Please note that the presence of epiphytes (a plant that grows on the surface of other plants without extracting nutrients, but merely resting on them) on the tree is not to be confused with a parasitic infestation, which is the case with mistletoe. Diseases and pests that are visible on the trunk or treetop should be disregarded in this category.

TTV – Treetop Vigor

Vigor is assessed on the basis of the size and coloring of the leaves. On trees that are leafless during certain seasons of the year, the assessment can be performed based on the buds found on the tree's branches. The buds or sprouts are tissues that produce sprouting or flowers. The assessment of the buds or sprouts requires training and familiarity with the characteristics of the species under observation. Most often, the treetop vigor can be assessed according to the leaves. The score ranges between 1 and 5. The top score (5) is attributed when the leaves are of normal size and color. An intermediate score (3) may be attributed when the leaves appear smaller or somewhat discolored, while the lowest score (1) is attributed when the leaves are small, yellowed, and show signs of severe burning or precocious autumnal coloring. When the assessment is based on buds or sprouts, the top score shall be attributed when the buds are of normal size and swelling. The intermediate score (3) may be attributed when the buds appear smaller, and the lowest score (1) when the buds are small, amid several dead buds.

RL – Residual Longevity

The residual longevity consists of an estimate of the number of years that the tree is likely to live. The natural longevity varies from one species to another, and it is a material fact. The assessment of the residual longevity, however, shall determine the life expectancy for the individual under examination. The score ranges between 1 and 3. The top score (3) is attributed when it is estimated that the tree might live for more than 20 years. An intermediate score is attributed when the life expectancy ranges between 5 and 20 years, and the lowest score when the life expectancy is less than 5 years.

TS – Total Score

The total score is reached by adding up the scores attributed to the six categories: $TS = ST + GR + TV + DP + TTV + RL$

The qualification into one of the five categories is based on the sum of the scores obtained in the assessment of all the above factors, as follows:

- I. Score of 24 to 22 points – “excellent” state;
- II. Score of 21 to 18 points – “good” state;
- III. Score of 17 to 13 points – “average” state;
- IV. Score of 12 to 9 points - “poor” state; and
- V. Score of 8 to 6 points – “very bad” state.

For non-woodland and shrub individuals, with the exception of ferns and lianas, the state of trunk factor shall be excluded, and the following gradation shall be applied:

- I. Score of 19 to 18 points – “excellent” state;

STATE SECRETARIAT FOR INFRASTRUCTURE AND ENVIRONMENT

- II. Score of 17 to 15 points – “good” state;
- III. Score of 14 to 12 points – “average” state;
- IV. Score of 11 to 9 points – “poor” state; e
- V. Score of 8 to 5 points – “very bad” state.

Sampling and assessment shall be done separately for each Live Collection at the BOTANIC GARDEN. The Inventory data and data on the integrity assessment and qualification of the Orchid Collections found in the “Dr. Frederico Carlos Hoehne Orchid Garden” and the Bromeliad Collections of the Ornamental Plants Research Nucleus are not to be included in the assessment for purposes of determining the PERFORMANCE INDICATORS.

For the Qualitative and Quantitative Assessment of Flora Injury, all individuals assessed shall have their geographic coordinates captured with the use of GPS and image recordings, which shall be stored in a database operated by the CONCESSIONAIRE throughout the entire CONCESSION TERM.

To calculate the **PRi** parameter (ANNEX XXI), the CONCESSIONAIRE shall have photographic records of the state of integrity of the individuals in the Flora’s BIOLOGICAL ASSETS’ live collection. The images shall be registered before the authorization is granted to allow the operation of the Flora’s BIOLOGICAL ASSETS.

To calculate the **PI** parameter (ANNEX XXI), the CONCESSIONAIRE shall have updated photographic records of the state of integrity of the individuals in the Flora’s BIOLOGICAL ASSETS’ live collection. The images shall be registered annually after the authorization is granted to allow the operation of the Flora’s BIOLOGICAL ASSETS.

Ranking of individuals in the live collection, in view of the calculation of the **PRi** and **PI** parameters, shall be documented in a Report on the Individuals’ Integrity, to be made available for access or consultation by the GRANTING AUTHORITY and the IBT, whereas the CONCESSIONAIRE shall be fully responsible for the methodology employed and the results thereof. The Report shall be signed by the Collections’ Technical Director, as required under item 3.1.11.

The adoption of new, more efficient, accurate technologies is desirable as they become available. The introduction of new techniques must be accepted and authorized by the GRANTING AUTHORITY during ordinary CONTRACT reviews.

REFERENCE MATERIALS

Araujo, M.N; Araujo, A.J. (2011). “Arborização Urbana. Série de Cadernos Técnicos.” Regional Board of Engineering, Architecture and Agronomy of the State of Paraná – CREA-PR. Available at: <https://www.crea-pr.org.br/ws/wp-content/uploads/2016/12/arborizacao-urbana.pdf>