The Red List of *Tovomita*

Lucas C. Marinho & Emily Beech

BOTANIC GARDENS CONSERVATION INTERNATIONAL
GTSG GLOBAL TREE SPECIALIST GROUP
IUCN SSC Species Survival Commission
GTA GLOBAL TREE ASSESSMENT
CNPq Conselho Nacional de Desenvolvimento Científico e Tecnológico
BOTÂNICA PROGRAMA DE PÓS GRADUAÇÃO
Franklinia FOUNDATION

Published by Botanic Gardens Conservation International Descanso House, 199 Kew Road, Richmond, Surrey, TW9 3BW, UK. redlist@bgci.org

ISBN-10: 1-905164-72-6
ISBN-13: 978-1-905164-72-1
EAN: 9781905164721

AUTHORS
Lucas C. Marinho is a PhD candidate at Feira de Santana State University, Bahia, Brazil.

Emily Beech is a Conservation Officer at Botanic Gardens Conservation International.

COVER PHOTOS
Front cover: *Tovomita fructipendula* (Marcelino Dias)
Back cover: Closed fruits of *Tovomita fructipendula* (Luis Torres-Montenegro)

DESIGN
Seascape. www.seascapedesign.co.uk

BOTANIC GARDENS CONSERVATION INTERNATIONAL

Botanic Gardens Conservation International (BGCI) is the world's largest plant conservation network, comprising more than 500 botanic gardens in over 100 countries, and provides the secretariat to the IUCN/SSC Global Tree Specialist Group. BGCI was established in 1987 and is a registered charity with offices in the UK, US, China and Kenya.

GTSG GLOBAL TREE SPECIALIST GROUP IUCN SSC Species Survival Commission

IUCN/SSC Global Tree Specialist Group (GTSG) forms part of the Species Survival Commission's network of over 7,000 volunteers working to stop the loss of plants, animals and their habitats. SSC is the largest of the six Commissions of IUCN – The International Union for Conservation of Nature. It serves as the main source of advice to the Union and its members on the technical aspects of species conservation. The aims of the IUCN/SSC Global Tree Specialist Group are to promote and implement global red listing for trees through the Global Tree Assessment and to act in an advisory capacity to the Global Trees Campaign.

The Red List of *Tovomita*

February 2019

Lucas C. Marinho & Emily Beech

BOTANIC GARDENS CONSERVATION INTERNATIONAL
GTSG GLOBAL TREE SPECIALIST GROUP
IUCN SSC Species Survival Commission
GTA GLOBAL TREE ASSESSMENT
CNPq Conselho Nacional de Desenvolvimento Científico e Tecnológico
BOTÂNICA PROGRAMA DE PÓS GRADUAÇÃO
Franklinia

Contents

Field expedition in Serra Bonita, Bahia (Atlantic Forest), occurrence of Tovomita guianensis *and* Tovomita mangle

Open fruit of Tovomita fructipendula *(Roberta Silva)*

Foreword

Staminate flower of Tovomita glazioviana

Staminate inflorescence of Tovomita acutiflora *(A.L. Correa)*

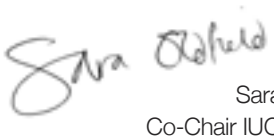
Progress towards the Global Tree Assessment (GTA), an initiative to assess the conservation status of all tree species, continues with efforts increasing to meet the 2020 deadline. The GTA is working with institutions and individuals across the world to compile data.

The majority of our recent Red List publications have focussed on groups of high horticultural importance including well-known groups such as ashes, maples, oaks and magnolias. However, with the Global Tree Assessment, all tree species, however poorly known, are considered.

Tovomita is a genus that many are not aware of, however, that does not make their conservation status less important to assess. A genus of 50 tree species found across Central and South America in moist forests, *Tovomita* is part of the Clusiaceae family. In this *Red List of* Tovomita, only four species or 8% of *Tovomita* are assessed as Threatened. However, 38% of *Tovomita* species (19 species) are categorised as Data Deficient, meaning that there is not enough data to say if these species are highly threatened or of little conservation concern. Many of the species are known from very few specimens separated by huge distances, suggesting that perhaps they are more widely spread in a landscape that has been undercollected or they are only found in specific habitat conditions and scattered across the landscape. Despite recent efforts to increase our knowledge taxonomically and with regards to their conservation status, little is still known about the population sizes, trends or threats to these species.

The *ex situ* survey revealed that there are no reported collections of *Tovomita* species in known *ex situ* collections. Recalcitrancy is likely to be high in the genus and *in situ* protections should be prioritised to ensure the survival of all the species in the genus.

The Red List of *Tovomita* represents a cross-country, cross-discipline collaboration, with input from colleagues from over 46 herbaria. Collaborations of this kind are necessary to draw the most comprehensive and up-to-date picture of the current conservation status of the world's tree flora.



Sara Olfield
Co-Chair IUCN SSC
Global Tree Specialist Group

Acknowledgements

This work is the result of the collaboration of several researchers and botanical colleagues. Photographs were collated into a database of around 4,500 specimens during visits to the following herbaria: A, ALCB, ASE, B, BAH, BHCB, CAS, CEPEC, CESJ, CVRD, GH, HB, HRB, HRJ, HST, HSTM, HUEFS, HURB, IAN, INPA, IPA, JPB, K, LPB, M, MAC, MBML, MG, NY, P, PEUFR, PMA, R, RB, SP, SPF, UC, UEC, UESC, UFP, UFRN, VIES and W., as well as images from LPB and PMA herbaria taken by Maria Cristina López Roberts and Juan Fernando Carrión, respectively. Each specimen in the database was examined and identified at the specific level, forming a reliable distribution map for each one of the species treated herein. The photographs were mostly taken by the first author, and all this work was facilitated by curators, staff and colleagues from the herbaria cited above. The beautiful illustration of the *Tovomita gazelii* fruit, was made by Natanael Nascimento.

To achieve conservation assessments for all species of *Tovomita*, many researchers have contributed their knowledge and shared their expertise, especially about the habitats in which this fascinating group occur. We would like to thank the reviewers of these assessments: Megan Barstow, Sean Carrington, Nidia Cuello, Eduardo Fernandez, Roosevelt García-Villacorta, Carol Kelloff, Lucas Costa Monteiro Lopes, Christina Lopez-Gallego, Lucas Moraes and Odile Poncy.

Lucas Marinho received funding from the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, PhD Fellowship # 141561 / 2015-7), from the Fundação Flora and the Instituto de Pesquisas Jardim Botânico do Rio de Janeiro (Brazil) throughout the REFLORA Project, and from Harvard University through the 2017 HUH Travel Grant. Lucas would also like to thank his PhD advisers, André Amorim and Pedro Fiaschi, for all support and direction during these six years.

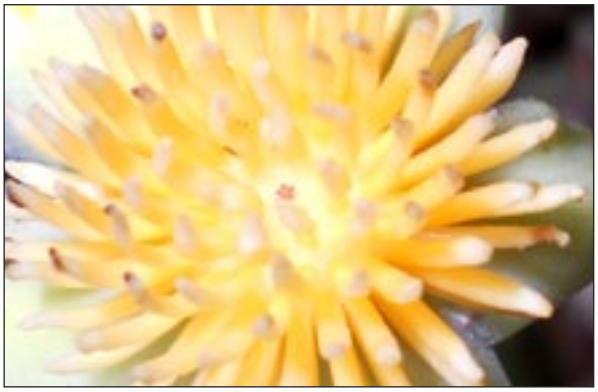
Fondation Franklinia has generously provided financial assistance for this work.

IUCN Red List Categories

EX	Extinct
EW	Extinct in the Wild
CR	Critically Endangered
EN	Endangered
VU	Vulnerable
NT	Near Threatened
LC	Least Concern
DD	Data Deficient
NE	Not Evaluated

List of acronyms

BGCI	Botanic Gardens Conservation International
GSPC	Global Strategy for Plant Conservation
GTA	Global Tree Assessment
GTC	Global Trees Campaign
GTSG	Global Tree Specialist Group
IUCN	International Union for Conservation of Nature
SSC	Species Survival Commission



Detail of the staminate flower of Tovomita megantha

Executive summary

Tovomita is a genus of 50 trees in the family Clusiaceae. They are found across the moist forests of Central and South America. Despite being the third largest genus in the Clusiaceae, the genus is relatively poorly known and there has never been a comprehensive taxonomic document produced about the genus.

The Red List of Tovomita presents IUCN Red List assessments of all 50 species in the genus. Only 8% of species (four species) are assessed as threatened, with 52% (26 species) assessed as Least Concern, and 38% assessed as Data Deficient. One species is assessed as Near Threatened (2%)

The threats to *Tovomita* are mostly threats to the habitat, with deforestation affecting the majority of species. Conversion of habitat into land for the "cabruca" plantation system is having a significant impact on the Atlantic forest habitat in which *Tovomita* is found. Hydroelectic dams, construction for tourism and transport link building all negatively impact the survival of *Tovomita*.

The Red List of Tovomita shows a large number of species assessed as Data Deficient (38%). It is not known if these species are of conservation concern. This is due to a lack of information about the full distribution of many species due to gaps in collection effort, population numbers and the quantitative impact of threats on the survival of the species.

Currently there are no reported *ex situ* collections of *Tovomita* and little is known about the seed storage behaviours or propagation methods needed to conserve this species in *ex situ*. As *Tovomita* species occur across many habitats it is recommended that *in situ* protection measures are put in place.

Open fruit of Tovomita acutiflora *in Ducke Reserve, Brazil* (Mário Terra)

White sand soil forest at Ducke Reserve, Amazonas, Brazil

Submerged leaves of Tovomita laurina (Gabriela Granghelli)

Introduction

Santa Lúcia Reserve, Espírito Santo, Brazil. Locality of Tovomita riedeliana

Family and genus background

Clusiaceae is a relatively small family with about 800 species in 15 genera distributed in both the Old and New World (Stevens, 2001). *Clusia* is the largest known genus of Clusiaceae. With its succulent leaves and attractive flowers, *Clusia* is widely cultivated around the world. For example, in Brazil, *C. fluminensis* is common in gardens and as a street tree. If *Clusia* is known for its flowers, the second largest genus, *Garcinia*, is widely known for its edible fruits as: Mangosteen (*G. mangostana*) and Bacuparí (*G. gardneriana*), (known also as "manggis") and their varieties, which are widely traded, especially in Southeast Asia. Unlike its more famous cousins, the third largest genus in the family, *Tovomita*, has no known ornamental or nutritional importance, and the genus is not cultivated. Although it has potentially commercially viable pharmacological properties, *Tovomita* is still unexplored in this sense.

Tovomita is found across the moist forests in South America and Mesoamerica. The first of the 50 known species of the genus was described in 1775 by the French botanist and pharmacist Jean Baptiste Aublet (1720-1778). *Tovomita* was first used to describe the species *T. guianensis* and its name was inspired by indigenous name *Votomite*, the vernacular name used for this plant by the *Galibis*, people from the northern coast of South America. During the following 250 years, several authors have contributed to the taxonomic knowledge of the group, however, there is still much more to be discovered.

Morphological characterisation

Tovomita are shrubs or trees that reach up to 30 m tall. In some species, the prop roots (see below) are so large that they can be mistaken for isolated individuals when viewed from the ground. Another important feature is the viscous exudate that seeps out from all parts of the plant when they are injured. This exudate is quite sticky and is often used by bees in building nests. The flowers of *Tovomita* are a small and somewhat showy and have a greenish to white colour. There are few species that have flowers with bright colours – red to purplish-red –, such as *Tovomita iaspidis* and *T. gazelli*, two little known species of the Atlantic Forest and Guiana Shield, respectively. Although not very flashy, the flowers of *Tovomita* have pleasurable and sweet floral scents that can reach long distances and attract the bees responsible for their pollination. Unlike the flowers, the fruits are eye-catching. The pulp (mesocarp) of the fruit have strong colours such as purplish-red or red, and the fleshy aril of the seeds can be red, orange or yellow, making a great contrast with the dark green leaves. Although it has aromatic flowers and showy fruits, *Tovomita* is not commercially exploited, possibly because of difficulties with propagation.

Distribution and habitat

Tovomita occurs from the moist forests of Costa Rica to Bolivia, Brazilian Atlantic Forest, and on the oceanic islands of Dominica, Martinique, St. Lucia and Trinidad in the Caribbean Sea. Some species have extensive ranges from the Amazon to the Atlantic Forest, while others are endemic to certain habitats. Although they are more common in extremely humid areas, some species occur in semi-deciduous seasonal forest areas, a drier environment linked to the Atlantic Forest biome. Typically, *Tovomita* species are associated with, and directly influenced by, watercourses, since they may even be submerged in times of river flooding in the Amazon region. However, it is possible to find *Tovomita* far from watercourses, generally in high forests with high humidity (Marinho, 2018). *Tovomita* species are often naturally found with few mature individuals simultaneously and it is rarely possible to find male and female individuals nearby.

Pharmalogical potential

Amazonian ethnic groups, especially from Peru, make use of *Tovomita* species to cure diseases such as low back pain (lumbago) and rheumatism (Sanz-Biset & Cañigueral, 2013). Unlike the majority of plant species that have their medicinal properties in the leaves, in *Tovomita*, the medicinal properties are found in the bark. For rheumatism relief, the *Tovomita* bark is prepared by macerating and mixing with ten other plants. Some academic studies have evaluated the chemical composition of *Tovomita* species and its actions as an antibacterial agent, with the organic extract obtained from the bark of some species of *Tovomita* showing a significant antibacterial activity (Nepomuceno *et al*., 2003). This information needs to be linked to taxonomic knowledge about the genus and the species with these properties should be identified.

Prop roots of Tovomita amazonica
(Alberto Vicentini)

Tovomita leucantha, *Tijuca Forest, Rio de Janeiro, Brazil*

Context of *Tovomita* within the Global Tree Assessment

South Bahia Atlantic Forest

Tovomita was described only 22 years after the publication of Linnaeus's *Species Plantarum* (1753), however, it has been little studied since its description. Therefore, the primary author decided to focus on *Tovomita*. Two important factors influenced the decision to work on this genus: 1) there is little published information and no comprehensive references about the genus, and 2) any information produced will be very important since little information is available. For six years, information on the taxonomy, morphology and distribution of *Tovomita* species was collected, creating a huge database that could be used to assess the conservation status of the species. This includes photography of specimens from 46 herbaria.

Tovomita may not be a well-studied genus, however the Global Tree Assessment will assess all tree species, however poorly known. The Global Tree Assessment is an initiative to assess the conservation status of the world's trees by 2020. In 2017, the first comprehensive list of the world's trees was published, revealing that there are 60,000 tree species globally (Beech *et al*., 2017). However, despite the importance of trees, many are threatened by over-exploitation and habitat destruction, as well as by pests, diseases, drought and their interaction with global climate change. In order to estimate the impact of such threats to trees there is an urgent need to conduct a complete assessment of the conservation status of the world's tree species – the Global Tree Assessment.

The Global Tree Assessment, led by BGCI and the IUCN SSC Global Tree Specialist Group, prioritises the tree species at greatest risk of extinction. The Global Tree Assessment provides information to ensure that conservation efforts are directed at the right species so that no tree species becomes extinct.

In order to achieve the Global Tree Assessment, it is necessary to work cross-collaboratively, bringing information from taxonomists and field researchers to create conservation assessments. *The Red List of* Tovomita exemplifies this approach and stemmed from the sharing of a poster of taxonomic work on ResearchGate. Open sharing of scientific publications and information on the internet has facilitated this collaboration and project and will continue to be a key element of the work of the Global Tree Assessment.

THE ASSESSMENT PROCESS AND OUR FINDINGS

All 50 currently validly published species in the genus *Tovomita* were assessed using the IUCN Red List Categories and Criteria[1]. The assessments will all be available on the IUCN Red List website (www.iucnredlist.org).

Species are assigned one of eight categories (Figure 1): Extinct (EX), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Least Concern (LC) and Data Deficient (DD). Critically Endangered, Endangered and Vulnerable are the three threatened categories. Taxa that do not qualify for a threatened category, but are close to qualifying for or are likely to qualify for a threatened category in the near future, can be assigned to the category Near Threatened. Least Concern is used for species that are assessed but are not considered threatened including widespread species and rare but stable species. The use of the category Data Deficient may be assigned to poorly known taxa. Species not yet evaluated are Not Evaluated (NE).

In order to assess whether a species belongs to a threatened category (CR, EN, VU) the species are evaluated in relation to five criteria: A) Population reduction; B) Geographic range; C) Small population size and decline; D) Very small or restricted population; and E) Quantitative analysis. The criteria are based on a set of thresholds and subcriteria. Extensive guidelines are available to facilitate the process for the conservation assessors (IUCN Standards and Petitions Subcommittee, 2017).

Globally four species (8%) of *Tovomita* are assessed as Threatened (Critically Endangered, Endangered, Vulnerable). Nineteen species or 38% of the genus are assessed as Data Deficient. Data Deficient species do not have enough data available to accurately determine their conservation status, these species could be either threatened or not threatened when full information becomes available. Due to this uncertainty, the percentage of threatened species lies between 8% and 46%. Twenty-six species (52%) are considered to be Least Concern – and not currently at risk of extinction. One species is listed as Near Threatened (Figure 2).

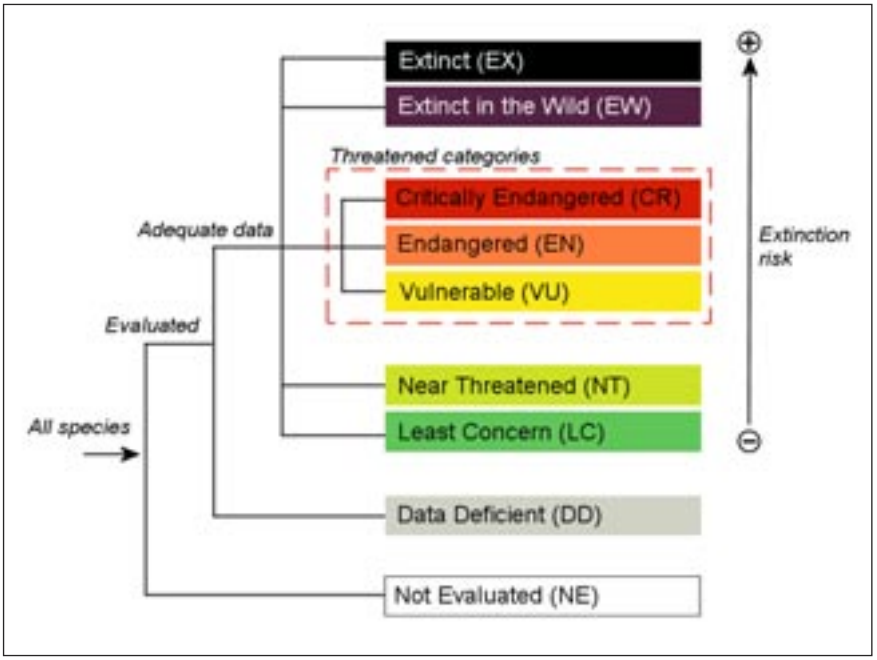


Figure 1. Structure of the IUCN Categories (version 3.1) (Credit: IUCN)

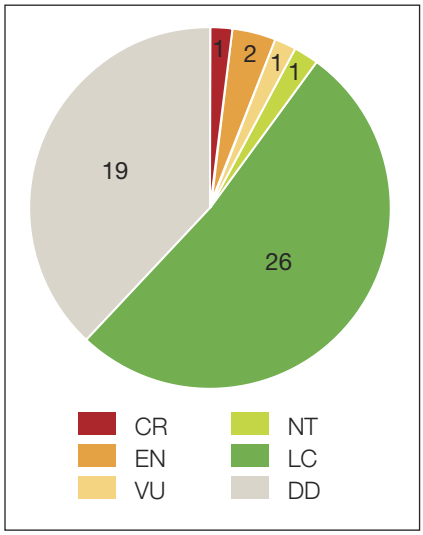


Figure 2. Summary of threat status of Tovomita

Santarém, Pará, Amazon Forest

[1]Some *Tovomita* species are not listed here, because taxonomic changes will be made in the near future such as recombination and synonymization.

Geographic analysis

Tovomita species occur in 15 neotropical countries, mostly in tropical South America (Bolivia, Brazil, Colombia, Ecuador, French Guiana, Guyana, Peru, Suriname and Venezuela), as well as Costa Rica and Panama, and on the Caribbean islands of Dominica, Martinique, Saint Lucia and Trinidad. The country with the highest number of specimens used in our analysis is Brazil, followed by Venezuela and Peru. This may be due to three factors: 1) a greater number of researchers/botanists working in Brazil; 2) easier access or collection in areas where *Tovomita* are found; and/or 3) almost 70% of the visited herbaria were in Brazil.

Staminate inflorescence of Tovomita mangle *(André Amorim)*

Number of species in Tovomita *per country*

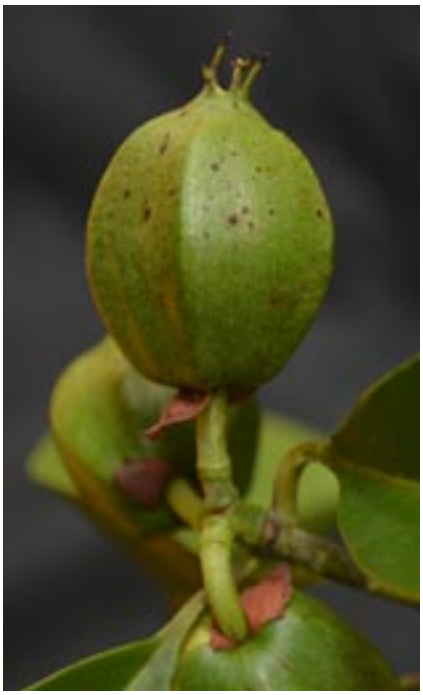
Most *Tovomita* species occur in the Amazon Forest, with a smaller number found in the Atlantic Forests (Marinho, 2018). Five species are found across both the Amazon and Atlantic Forests. *Tovomita fructipendula* is the species with the highest number of herbarium records (450 specimens) and *T. umbellata* is the most widespread species in the genus (eight countries). Thirteen of the 50 species (26%) are found in a single country and many species are endemic to small areas, some of them with only one record (e.g. *T. divaricata*). Brazil is the country with the most endemic species (10 spp.), six of them occurring only in the Atlantic Forest. Colombia, Guyana and Venezuela have one endemic species each: *T. colombiana*, *T. divaricata* and *T. clarkii*, respectively.

In contrast, Clusiaceae are found in 115 countries worldwide with 403 single country endemics, although the highest diversity in the rest of the family is also found in South America.

Threats

The main threat to *Tovomita* species is land use change in the region. For those species occurring in the Atlantic Forest, this takes the form of deforestation for the “cabruca” plantation system, which involves the cultivation of cocoa underneath the canopy. For the species in the Amazon, deforestation will also have an impact, with land cleared for agriculture, plantations and pasture. Road building, construction for tourism and hydroelectric dams have all been noted as threats to these species.

For those species assessed as Data Deficient, it is not known to what extent these threats affect the species directly, or the habitat they are found in. It has been noted that *Tovomita* species are not often found in forest border areas, perhaps due to lower humidity in these areas.



Closed fruit of Tovomita acutiflora
(Fernanda Cabral)

More research into the impact of these threats on the genus is needed to assess the conservation status of these species.

EX SITU SURVEY

Ex situ collections can act as a back-up to prevent extinction of species, accounting for stochastic events or severe threats. It is important to have genetically representative collections of all threatened species to allow these collections to be used for conservation purposes.

To conduct an *ex situ* survey, plant records are taken from the BGCI PlantSearch Database (see above). However, there is only a single record of a *Tovomita* in a botanic garden collection in the PlantSearch database. This species has been listed as *Tovomita* sp. so it is unclear which species this collection refers to.

PlantSearch

BGCI's Plantsearch database is the only global database of plants in cultivation in botanic gardens and related institutions. It is available online and is free to access. Data included in PlantSearch is provided by *ex situ* collection holders and this data provides the basis for broader *ex situ* assessments, such as this survey. By uploading a taxa list to PlantSearch, collection holders not only contribute data to the global botanical community, but they can also assess the conservation value of their own collections, including the threat status and number of other *ex situ* collections each taxon is known from. BGCI encourages collection holders to upload up-to-date taxa lists on an annual basis to ensure accuracy and enhance usability of the data provided through PlantSearch.

Target 8 of the Global Strategy for Plant Conservation calls for 75% of threatened plants to be held in *ex situ* collections (CBD, 2012). Clearly more effort is needed to ensure there are *ex situ* collections of all threatened *Tovomita*. The only study of *ex situ* collections of tree species found that worldwide only a quarter of threatened trees are found in *ex situ* collections (Rivers *et al*., 2015).

The seeds of *Tovomita* are hard, smooth and relatively large, slightly larger than beans, covered by a sweet and fleshy aril with bright colours. Although the morphological characterization is known, there is no information on seed storage behaviour and germination of *Tovomita* so it is unknown if it is possible to store the seeds in a seed bank or how to propagate them for *ex situ* collections. A predictive model of recalcitrance suggests that all species in *Tovomita* have a high probability of recalcitrant seed storage behaviour (over 80%) (Wyse & Dickie, 2018); thus, conventional seed banking may not be a viable *ex situ* conservation method.

Tijuca Forest, Rio de Janeiro

An additional difficulty is that *Tovomita* trees can be very large, which may account for the lack of *ex situ* collections of this genus. *Clusia*, the most cultivated genus, also has large trees, however, there are a great number of shrub species. Many of these are commercial hybrids that propagate easily through branches planted directly into the ground, which does not happen with *Tovomita*. Equally, many of *Tovomita* species have specific habitats which may not be easy to replicate in a botanic garden.

Data deficiency for *Tovomita*

As we can see from the results, there is a high proportion of species which are listed as Data Deficient. Many of the species are known from very few specimens separated by huge distances, suggesting that perhaps they are more widely spread in a landscape that has been undercollected or they are only found in specific habitat conditions and scattered across the landscape.

The most well collected area with *Tovomita* is the Ducke Forest Reserve in Amazonas, Brazil. This area has been exhaustively collected and most of the information on population sizes or structure presented here comes from this locality. However, the majority of areas where *Tovomita* have been found or are likely to occur have not been extensively collected from. Possibly, *Tovomita* is undercollected due to its arboreal habit in combination with the small flowers. The small flowers high in the canopy are often imperceptible to the eyes, and although they can be seen, it takes a lot of time to prepare climbing and cutting equipment to reach them. Researchers and collectors who are working on other groups usually do not have much time to collect fertile specimens of *Tovomita*.

Furthermore, *Tovomita* has specific habitat requirements and does not occur very close to the forest margins, with rare exceptions. Most of the specimens collected in the Amazon were made near roads, possibly when these roads were being opened (inferred from collection dates). This is very clear when we compare the number of Amazonian specimens with those of the Atlantic Forest. More collections of *Tovomita* are made in the Atlantic Forest, which has had more collection expeditions and access is relatively easier than in the Amazonian areas that have had fewer collection expeditions as they require more time and resources to access.

Capitão Reserve, Bahia, locality of occurrence of Tovomita fructipendula *and* Tovomita megantha

Little is known about the full distribution of many of the species of *Tovomita*, or the impact that threats such as extensive deforestation in the Amazon may have on the genus *Tovomita*. It, therefore, was not possible to list any *Tovomita* species under IUCN criterion A as there was little known about the declines in the species' ranges and habitats. It is likely *Tovomita* species have been affected by deforestation, land use change to agriculture, pasture and urbanisation but there is not enough information about original and current distribution of *Tovomita* to calculate percentage declines.

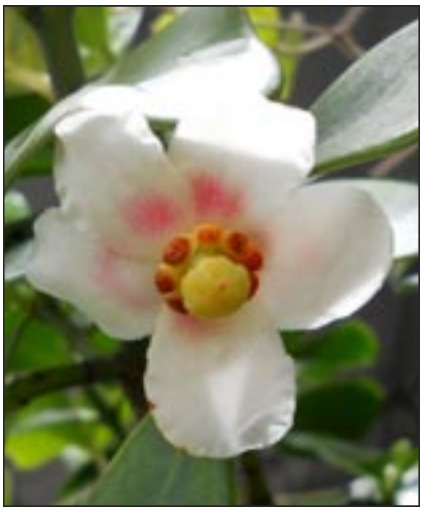
IUCN criterion B was used to assess three of *Tovomita* species, with small geographic ranges and declines. This criterion relies on a good knowledge of the full distribution of the species in question, which has not been possible for many of the species. Population size, trend and structure information is needed to list species under IUCN criterion C or D. For this reason, only two of the fifty species are listed using these criteria (*T. iaspidis* and *T. megantha*, see Annex 1), both listed under criterion D. Criterion E is not often used for IUCN Red List assessments, as it requires a quantitative analysis such as a Population Viability Analysis. Unsurprisingly, this information is not available for any of the *Tovomita* species.

For these reasons, it has not been possible to apply the IUCN criteria to many of the species of *Tovomita*.

Another complicating factor is that many of the species have been collected in few localities in multiple countries with each specimen separated by many miles. From the perspective of assessing the conservation status of a species, it is difficult to know if these species are in fact only found in distinct subpopulations or they are in fact just undercollected. As it is unknown whether these species could be highly threatened or extremely frequent between the few known localities, these species are listed as Data Deficient.

Until we know more, Data Deficient species should be considered as potential candidates for conservation actions, as many of these species are likely to be threatened when more extensive information is collected.

Comparison to other groups in the Clusiaceae



Clusia fluminensis

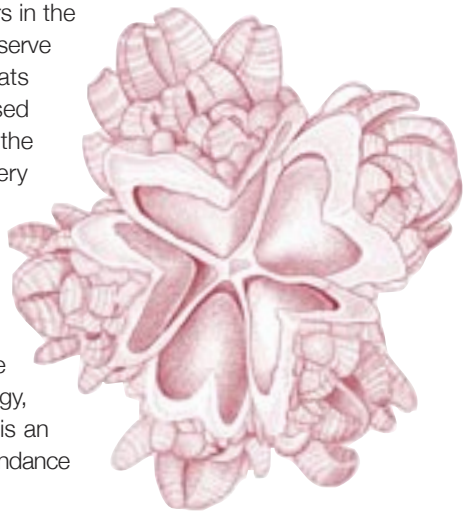
Tovomita is now one of the only genera in Clusiaceae comprehensively assessed. *Tovomitopsis*, a genus of two species, are both assessed as Data Deficient. The only other fully assessed genus in the family is *Agasthiyamalaia*, a monotypic genus, with the species *Agasthiyamalaia pauciflora* assessed as Critically Endangered. In summary 27% of trees in the family of Clusiaceae have been assessed, and of the largest genera, only *Tovomita* has been fully assessed. *Garcinia* and *Clusia* both have fewer than 30% of the tree species assessed. We would welcome further work on the tree species of Clusiaceae to be assessed as part of the Global Tree Assessment.

Species	Number of trees in genus	Percentage assessed
Agasthiyamalaia	1	100%
Tovomita	50	100%
Tovomitopsis	2	100%
Allanblackia	8	63%
Pentadesma	5	40%
Dystovomita	3	33%
Montrouziera	3	33%
Garcinia	323	29%
Moronobea	7	29%
Chrysochlamys	28	18%
Clusia	291	15%
Symphonia	15	7%
Lorostemon	5	0%
Platonia	1	0%
Thysanostemon	1	0%

Table 1. Percentage of tree species in each Clusiaceae genus assessed[2].

Unrepresentative species in collections – *Tovomita gazelii* (DD)

Tovomita gazelii is one of the strangest species of *Tovomita*. The species is the only one of the genus that has vivid colour petals, besides a fruit with very peculiar woody processes. *T. gazelii* was described in 2006 with its distribution restricted to French Guiana, in the central portion of the country. After extensive revision of herbarium collections, now the species is known from 15 specimens and its distribution extends to Guyana. The estimated extent of occurrence of this species is 75,000 km^2 and some of the specimens were collected near roads and disturbed areas. Although it occurs in the Montagnes de la Trinité Natural Reserve in French Guiana, and the threats are unknown, *T. gazelii* was assessed as Deficient Data (DD). Although the extent of occurrence is wide, very little is known about the species. It is possible the population size is very small, or that there are very few locations of the species but it is unknown. Despite the large amount of information on morphology, its biology is unknown, and there is an absence of appropriate data on abundance and distribution.



Garcinia gardneriana *(Cristiane Snak)*

[2]Numbers taken from GlobalTreeSearch and ThreatSearch (January 2019).
Future planned revisions in *Garcinia* may result in a change in the number of trees in the genus.

Conservation recommendations and conclusions

The conservation of a poorly known group such as *Tovomita* can be challenging. Here we make recommendations for the conservation of the group as well as continuing research to better understand the threat status of the genus.

In situ and *ex situ* protections

As many of the species of *Tovomita* are found in specific habitat types that would be difficult to recreate either artificially or through restoration, it is imperative that these habitats are protected in order to prevent the extinction of these species. Of course, habitat-level protection provides protection to the ecosystem, offering safeguards to many of the species within. It is of fundamental importance that large forest fragments are preserved, since *Tovomita* species are extremely sensitive to disturbed areas, possibly due to the reduction of humidity. This fact is evidenced by the absence of species in forest border areas. Most *Tovomita* species occur in forests that are frequently flooded or are close to watercourses, making the protection of these environments key to the preservation of the genus. Also as areas are explored further, we see several narrow range endemic species described from a certain locality (see Annex 1) which are experiencing some level of threat. The protection of areas that have not yet been inventoried becomes essential for both the knowledge of the genus and its protection.

As discussed above, there are many difficulties in incorporating *Tovomita* species into *ex situ* collections including their large growth habit, their specific habitat types and limited information about propagation techniques or seed storage behaviour.

Taking into account these difficulties, it is recommended that research is undertaken to better understand the viability of *ex situ* protections of *Tovomita*. Because of the time taken to do this research, it is clear that *in situ* protections are an invaluable method of conserving this genus.

Research

There is a large number of species in the genus that have been assessed as Data Deficient, reflecting a lack of collections across South America for these species. Further exploration of habitats containing *Tovomita* species should be prioritised, and more data about assemblages, ecology and population sizes collected. The taxonomic knowledge that has been produced during the last decade, together with the Red List assessments of *Tovomita* are the starting point for the expansion of the knowledge of the group in other areas of science. Studies on anatomy, physiology and, especially for ecology, should be employed in a common effort of knowledge about the species of *Tovomita.* We are hoping that by highlighting that 38% of *Tovomita* are DD, this study will generate further focus on filling in some of the data gaps of these species in the future. As new information becomes available, the conservations status of these plants could be determined as either Least Concern (not threatened) or a threatened category.

Conclusion

To conserve, we must first know. The best way to support conservation actions for groups of little-known plants, such as *Tovomita*, is to encourage research and field expeditions in rarely or never collected areas. *The Red List of* Tovomita provides, for the first time, a baseline for the conservation status of the genus. It is hoped this report will highlight the uncertainty of the conservation status of this group and also inspire more work on this genus to protect the threatened species and to learn more about those species assessed as Data Deficient.

Tijuca Forest, Rio de Janeiro, locality of Tovomita leucantha

Bibliography

Seedless fruit of Tovomita guianensis *(Christian Silva)*

Beech, E., Rivers, M., Oldfield, S., Smith, P.P., 2017. GlobalTreeSearch: The first complete global database of tree species and country distributions. J. Sustain. For. 36, 454–489. https://doi.org/10.1080/10549811.2017.1310049

CBD, 2012. Global Strategy for Plant Conservation: 2011-2020. BGCI, Int. Richmond, UK.

IUCN Standards and Petitions Subcommittee, 2017. Guidelines for Using the IUCN Red List Categories and Criteria. Version 13. Prepared by the Standards and Petitions Subcommittee.

Marinho, L.C., 2018. Two new species of *Tovomita* (Clusiaceae) from the Amazonian forest. Brittonia 70: 405–411.

Nepomuceno, D.C., Younes, R.N., Varella, A.D., Suffredini, I.B., 2003. Atividade antibacteriana e fracionamento direcionado do extrato orgânico obtido de *Tovomita* sp. Revista Brasileira de Farmacognosia 13: 3–4.

Rivers, M., Shaw, K., Beech, E., Jones, M., 2015. Conserving the World's Most Threatened Trees: A global survey of *ex situ* collections. BGCI, Richmond, UK.

Sanz-Biset, J. & Cañigueral, S., 2013. Plants as medicinal stressors, the case of depurative practices in Chazuta valley (Peruvian Amazonia). Journal of Ethnopharmacology 145: 67–76.

Stevens, P.F., 2001 onward. Angiosperm Phylogeny Website. http://www.mobot.org/ MOBOT/research/APweb/

Wyse, S.V., & Dickie, J.B., 2017. Taxonomic affinity, habitat and seed mass strongly predict seed desiccation response: a boosted regression trees analysis based on 17 539 species. Annals of Botany. 121(1): 71-83.

Annex 1

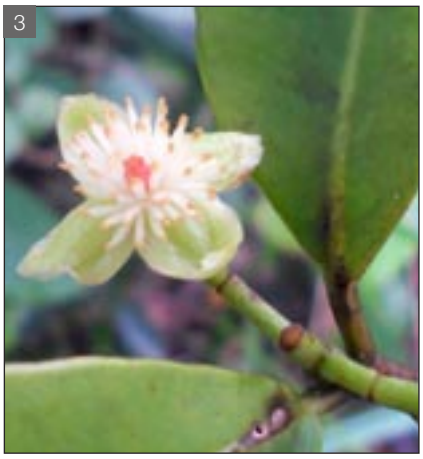
Globally threatened *Tovomita* species

Tovomita calophyllophylla García-Villacorta & Hammel
VU B2ab(iii)
Brazil, Colombia and Peru

Tovomita calophyllophylla is found in Brazil, Colombia and Peru. This species has a restricted area of occupancy (AOO) of less than 2,000 km^2 and occurs in fewer than 10 locations. Human pressures such as agricultural expansion and the building of hydroelectric dams on the white sand forests threaten this species with extinction as subpopulations of this species are likely very small. The species is found in protected areas but not in *ex situ* collections. It is assessed as Vulnerable.

AOO: less than 2,000 km^2
Locations: Fewer than 10
Habitat: White sand forest
Threats: Hydroelectric dam building, Agricultural expansion
Suggested conservation actions: Research into population size and trends

1 Tovomita calophyllophylla *(Mathias Engels)*
2 *Pistillate flower of* Tovomita calophyllophylla *(Mathias Engels)*
3 *Open fruit of* Tovomita calophyllophylla *(Mathias Engels)*



Tovomita iaspidis L. Marinho & Amorim
EN B1ab(iii); D
Brazil

Tovomita iaspidis is a tree known only from Bahia, Brazil. This species has a restricted extent of occurrence (EOO) of less than 500 km^2 and is found in only two locations. This species is threatened by the expansion of the "cabruca" plantation system. There are likely to be fewer than 250 mature individuals. One subpopulation of the species is found in a protected area but not within *ex situ* collections. It is assessed as Endangered.

EOO: less than 500 km^2
Population size: fewer than 250 mature individuals
Locations: 2
Threats: Deforestation for the expansion of the "cabruca" plantation system

1 *Corcovado Range, Bahia, locality of* Tovomita iaspidis
2 *Corcovado Range*
3 Tovomita iaspidis
4 *Inside the forest*

1 Tovomita megantha *prop roots*
2 Tovomita megantha *staminate flower*

Discovering New Species and their threats: *Tovomita iaspidis* (EN) & *T. megantha* (CR).

Tovomita iaspidis and *T. megantha* are new finds, described in 2015 and 2016 respectively. Both are endemic to the Atlantic Forest in Bahia state, Brazil, and little is known about their biology and population sizes. *Tovomita iaspidis* was discovered completely by chance on an expedition in search of another species sympatric to it, *T. glazioviana*. The new species was found directly beside to the older species, which is completely different morphologically. In contrast, the story of *T. megantha* involved a herbarium specimen collected in the 1990s which proved to be quite different from the others, leading us to an expedition to find a new species (*T. megantha*).

While *T. iaspidis* is a tree up to 10 m tall, which occurs in more open areas exposed to sunlight, *T. megantha* is a big tree (for the Atlantic Forest) that reaches up to 25 m tall in shady areas of the forest. These two species are examples of taxa that have been described recently that can already be assessed as threatened due to human direct actions in their habitat. The first and oldest problem faced by these species is the expansion of the "cabruca" plantation system, which removes the understory vegetation for cultivating cocoa. Currently, cocoa plantations are no longer as profitable as before, but still persist in this region. The most current problems faced by *T. iaspidis* and *T. megantha* are wood extraction, deforestation, and tourism-related civil construction, since the South of Bahia state is heavily targeted by hotel and resort companies. There are only two collections of *T. iaspidis*, of which only one occurs in a protected area. The case of *T. megantha* is even worse, since the species is only known from the type locality, which fortunately is a private protected area. Although recently described, the species were born into science as Endangered (EN) and Critically Endangered (CR).

Tovomita megantha L. Marinho & Amorim
CR B1ab(iii); D
Brazil

This species is a large tree found only in Bahia state. The species has a very restricted extent of occurrence (EOO) and is threatened by deforestation and tourism related expansion. The species is found in a single location and there are only eight known mature individuals. It is found in a protected area but not reported in an *ex situ* collection. It is here assessed as Critically Endangered.

EOO: 1 km^2
Population size: 8 mature individuals
Locations: 1
Threats: Deforestation for tourism construction, Wood extraction

Tovomita salimenae L. Marinho & Amorim
EN B1ab(iii)
Brazil

This species is a small tree endemic to Minas Gerais, Brazil. The tree has a restricted distribution and found in fewer than five locations. There is little information about population numbers. It is likely to be facing declines in habitat quality due to deforestation due to agricultural expansion in the region. The species is in at least one protected area but is not found in an *ex situ* collection. It is assessed as Endangered.

EOO: 1,666 km^2
Locations: 5
Threats: Deforestation due to agricultural expansion

Near threatened *Tovomita* species

Staminate inflorescence of Tovomita plumieri *(Roger Graveson)*

Closed fruits of Tovomita plumieri *(Roger Graveson)*

Tovomita plumieri Griseb.
Dominica, Martinique and Saint Lucia

Tovomita plumieri is a small tree which grows to about 9 m tall and very high prop roots. The species occurs at a higher altitude, moist forest on the Caribbean Islands of Dominica, Martinique and St. Lucia. Because it is endemic to the Caribbean Islands, its extent of occurrence (EOO) is relatively small (3,908 km^2). The species is represented by many specimens collected in Dominica and Martinique, but there are few records for St. Lucia, this is possibly due to the low number of collection expeditions in this area. In addition, most of the *T. plumieri* specimens collected on the Caribbean Islands date back to the pre-1980s. During the 21st century only a single specimen was collected in Martinique. The species has been collected in mountainous areas on all three islands, and they are not restricted to a certain habitat type. Recent hurricanes could potentially negatively affect the species. Due to all these facts, *T. plumieri* is evaluated as Near Threatened (NT).

EOO: 4,000 km^2
Locations: 8
Threats: No continuing decline

Data deficient *Tovomita* species

Closed fruit of Tovomita auriculata *(Luis Torres-Montenegro)*

Tovomita albiflora A.C. Sm.
Guyana and Venezuela

Tovomita atropurpurea Steyerm.
Venezuela

Tovomita auriculata Cuello
Peru and Venezuela

Tovomita calodictyos Sandwith
Brazil, French Guiana and Guyana

Tovomita clarkii Pipoly ex L. Marinho & Gahagen
Venezuela

Tovomita clusiiflora (Ducke) L. Marinho
Brazil, Colombia and Peru

Tovomita colombiana L. Marinho
Colombia

Tovomita divaricata Maguire
Guyana

Tovomita duckei Huber
Brazil and Bolivia

Tovomita fanshawei Maguire
Brazil, French Guiana, Guyana, Suriname and Venezuela

Tovomita gazelii Poncy & Offroy
French Guiana and Guyana

Tovomita hopkinsii Bittrich & L. Marinho
Brazil

Tovomita longirostrata L. Marinho
Brazil

Tovomita morii Maguire
Colombia, Ecuador and Panama

Tovomita rubella Spruce ex Planch. & Triana
Brazil

Tovomita tenuiflora Benth. ex Planch. & Triana
Brazil, Ecuador, Peru and Venezuela

Tovomita trojitana Cuatrec.
Colombia and Ecuador

Tovomita turbinata Planch. & Triana
Colombia

Tovomita vismiifolia L. Marinho
Brazil

Open fruit of Tovomita longirostrata *(Narcísio Bigio)*

Least concern *Tovomita* species

1 Tovomita acutiflora *(Mário Terra)*
2 Tovomita choisyana *(Rafael Barbosa-Silva)*
3 Tovomita laurina *(Mathias Engels)*
4 Tovomita fructipendula
5 Tovomita guianensis
6 Tovomita leucantha *(Leandro Cardoso)*

Tovomita acutiflora M.S.Barros & G.Mariz
Brazil, Colombia and Venezuela

Tovomita amazonica (Poepp.) Walp.
Brazil, Guyana, Peru and Suriname

Tovomita brevistaminea Engl.
Brazil

Tovomita caloneura A.C. Sm.
Brazil, French Guiana, Guyana and Peru

Tovomita carinata Eyma
Bolivia, Brazil, French Guiana, Guyana and Suriname

Tovomita choisyana Planch. & Triana
Brazil, French Guiana and Suriname

Tovomita foldatsii Cuello
Brazil and Venezuela

Tovomita fructipendula (Ruiz & Pav.) Cambess.
Bolivia, Brazil, Colombia, French Guyana, Guyana, Peru and Venezuela

Tovomita glazioviana Engl.
Brazil

Tovomita gracilipes Planch. & Triana
Brazil, Peru and Venezuela

Tovomita grata Sandwith
Brazil, French Guiana, Guyana, Suriname and Venezuela

Tovomita guianensis Aubl.
Bolivia, Brazil, French Guiana, Guyana, Suriname and Venezuela

Tovomita laurina Planch. & Triana
Bolivia, Brazil, Colombia and Peru

Tovomita leucantha (Schltdl.) Planch. & Triana
Brazil


1


2


3


4


5


6

1 Tovomita mangle *(Jomar Jardim)*
2 Tovomita macrophylla *(Gustavo Shimizu)*
3 Tovomita longifolia *(André Amorim)*
4 Tovomita stylosa *(Barry Hammel)*
5 Tovomita umbellata *(Narcísio Bigio)*

1


2


3


4


5


Tovomita longifolia (Rich.) Hochr.
Brazil, Costa Rica, French Guiana, Guyana and Panama

Tovomita macrophylla (Poepp.) Walp
Brazil, Peru and Venezuela

Tovomita mangle G. Mariz
Brazil and French Guiana

Tovomita riedeliana Engl.
Brazil

Tovomita schomburgkii Planch. & Triana
Brazil, Guyana, Suriname and Venezuela

Tovomita secunda Poepp. ex Planch. & Triana
Bolivia, Brazil, Colombia, Ecuador. French Guiana, Peru and Suriname

Tovomita speciosa Ducke
Brazil, Ecuador, French Guiana and Guyana

Tovomita spruceana Planch. & Triana
Brazil, Colombia, Guyana and Venezuela

Tovomita stergiosii Cuello
Brazil, Colombia. Peru and Venezuela

Tovomita stylosa Hemsl.
Colombia, Costa Rica and Panama

Tovomita umbellata Benth.
Bolivia, Brazil, Colombia, French Guiana, Guyana, Peru, Suriname and Venezuela

Tovomita volkeri L. Marinho
Brazil, Colombia, Peru and Venezuela

Annex 2

Summary table

Taxon name	Author	Red List Category	Red List Criteria
Tovomita acutiflora	M.S. Barros & G. Mariz	LC	
Tovomita albiflora	A.C. Sm.	DD	
Tovomita amazonica	(Poepp.) Walp.	LC	
Tovomita atropurpurea	Steyerm.	DD	
Tovomita auriculata	Cuello	DD	
Tovomita brevistaminea	Engl.	LC	
Tovomita calodictyos	Sandwith	DD	
Tovomita caloneura	A.C. Sm.	LC	
Tovomita calophyllophylla	García-Villacorta & Hammel	VU	B2ab(iii)
Tovomita carinata	Eyma	LC	
Tovomita choisyana	Planch. & Triana	LC	
Tovomita clarkii	Pipoly ex L. Marinho & Gahagen	DD	
Tovomita clusiiflora	(Ducke) L. Marinho	DD	
Tovomita colombiana	L. Marinho	DD	
Tovomita divaricata	Maguire	DD	
Tovomita duckei	Huber	DD	
Tovomita fanshawei	Maguire	DD	
Tovomita foldatsii	Cuello	LC	
Tovomita fructipendula	(Ruiz & Pav.) Cambess.	LC	
Tovomita gazelii	Poncy & Offroy	DD	
Tovomita glazioviana	Engl.	LC	
Tovomita gracilipes	Planch. & Triana	LC	
Tovomita grata	Sandwith	LC	
Tovomita guianensis	Aubl.	LC	
Tovomita hopkinsii	Bittrich & L. Marinho	DD	
Tovomita iaspidis	L. Marinho & Amorim	EN	B1ab(iii); D
Tovomita laurina	Planch. & Triana	LC	
Tovomita leucantha	(Schltdl.) Planch. & Triana	LC	
Tovomita longifolia	(Rich.) Hochr.	LC	
Tovomita longirostrata	L. Marinho	DD	
Tovomita macrophylla	(Poepp.) Walp	LC	
Tovomita mangle	G. Mariz	LC	
Tovomita megantha	L. Marinho & Amorim	CR	B1ab(iii); D
Tovomita morii	Maguire	DD	
Tovomita plumieri	Griseb.	NT	
Tovomita riedeliana	Engl.	LC	
Tovomita rubella	Spruce ex Planch. & Triana	DD	
Tovomita salimenae	L. Marinho & Amorim	EN	B1ab(iii)
Tovomita schomburgkii	Planch. & Triana	LC	
Tovomita secunda	Poepp. ex Planch. & Triana	LC	
Tovomita speciosa	Ducke	LC	
Tovomita spruceana	Planch. & Triana	LC	
Tovomita stergiosii	Cuello	LC	
Tovomita stylosa	Hemsl.	LC	
Tovomita tenuiflora	Benth. ex Planch. & Triana	DD	
Tovomita trojitana	Cuatrec.	DD	
Tovomita turbinata	Planch. & Triana	DD	
Tovomita umbellata	Benth.	LC	
Tovomita vismiifolia	L. Marinho	DD	
Tovomita volkeri	L. Marinho	LC	

Annex 3

IUCN Red List Categories and Criteria

EXTINCT (EX)
A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time-frame appropriate to the taxon's life cycle and life form.

EXTINCT IN THE WILD (EW)
A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time-frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN)
A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU)
A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT)
A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC)
A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)
A taxon is Not Evaluated when it is has not yet been evaluated against the criteria.

The criteria for Critically Endangered, Endangered and Vulnerable

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing an extremely high risk of extinction in the wild:

A. Reduction in population size based on any of the following:
   1. An observed, estimated, inferred or suspected population size reduction of ≥90% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
      (a) direct observation
      (b) an index of abundance appropriate to the taxon
      (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
      (d) actual or potential levels of exploitation
      (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

   2 An observed, estimated, inferred or suspected population size reduction of ≥80% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may

not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of ≥80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:
   1. Extent of occurrence estimated to be less than 100 km^2, and estimates indicating at least two of a-c:
      a. Severely fragmented or known to exist at only a single location.
      b. Continuing decline, observed, inferred or projected, in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) area, extent and/or quality of habitat
         (iv) number of locations or subpopulations
         (v) number of mature individuals.
      c. Extreme fluctuations in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) number of locations or subpopulations
         (iv) number of mature individuals.

   2. Area of occupancy estimated to be less than 10 km^2, and estimates indicating at least two of a-c:
      a. Severely fragmented or known to exist at only a single location.
      b. Continuing decline, observed, inferred or projected, in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) area, extent and/or quality of habitat
         (iv) number of locations or subpopulations
         (v) number of mature individuals.
      c. Extreme fluctuations in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) number of locations or subpopulations
         (iv) number of mature individuals.

C. Population size estimated to number fewer than 250 mature individuals and either:
   1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, (up to a maximum of 100 years in the future) OR

   2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):
      (a) Population structure in the form of one of the following:
         (i) no subpopulation estimated to contain more than 50 mature individuals, OR
         (ii) at least 90% of mature individuals in one subpopulation.
      (b) Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a very high risk of extinction in the wild:

A. Reduction in population size based on any of the following:
   1. An observed, estimated, inferred or suspected population size reduction of ≥70% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
      (a) direct observation
      (b) an index of abundance appropriate to the taxon
      (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
      (d) actual or potential levels of exploitation
      (e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of ≥50% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of ≥50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥50% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, AND where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:
   1. Extent of occurrence estimated to be less than 5000 km^2, and estimates indicating at least two of a-c:
      a. Severely fragmented or known to exist at no more than five locations.
      b. Continuing decline, observed, inferred or projected, in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) area, extent and/or quality of habitat
         (iv) number of locations or subpopulations
         (v) number of mature individuals.
      c. Extreme fluctuations in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) number of locations or subpopulations
         (iv) number of mature individuals.

   2. Area of occupancy estimated to be less than 500 km^2, and estimates indicating at least two of a-c:

      a. Severely fragmented or known to exist at no more than five locations.
      b. Continuing decline, observed, inferred or projected, in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) area, extent and/or quality of habitat
         (iv) number of locations or subpopulations
         (v) number of mature individuals.
      c. Extreme fluctuations in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) number of locations or subpopulations
         (iv) number of mature individuals.

C. Population size estimated to number fewer than 2500 mature individuals and either:
   1. An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, (up to a maximum of 100 years in the future) OR

   2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):
      (a) Population structure in the form of one of the following:
         (i) no subpopulation estimated to contain more than 250 mature individuals, OR
         (ii) at least 95% of mature individuals in one subpopulation.
      (b) Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 250 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a high risk of extinction in the wild:

A. Reduction in population size based on any of the following:
   1. An observed, estimated, inferred or suspected population size reduction of ≥50% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are: clearly reversible AND understood AND ceased, based on (and specifying) any of the following:
      (a) direct observation
      (b) an index of abundance appropriate to the taxon
      (c) a decline in area of occupancy, extent of occurrence and/or quality of habitat

(d) actual or potential levels of exploitation
(e) the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of ≥30% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

3. A population size reduction of ≥30%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of (b) to (e) under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of ≥30% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, AND where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of (a) to (e) under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:
   1. Extent of occurrence estimated to be less than 20,000 km^2, and estimates indicating at least two of a-c:
      a. Severely fragmented or known to exist at no more than 10 locations.
      b. Continuing decline, observed, inferred or projected, in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) area, extent and/or quality of habitat
         (iv) number of locations or subpopulations
         (v) number of mature individuals.
      c. Extreme fluctuations in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) number of locations or subpopulations
         (iv) number of mature individuals.

   2. Area of occupancy estimated to be less than 2000 km^2, and estimates indicating at least two of a-c:
      a. Severely fragmented or known to exist at no more than 10 locations.
      b. Continuing decline, observed, inferred or projected, in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) area, extent and/or quality of habitat
         (iv) number of locations or subpopulations
         (v) number of mature individuals.
      c. Extreme fluctuations in any of the following:
         (i) extent of occurrence
         (ii) area of occupancy
         (iii) number of locations or subpopulations
         (iv) number of mature individuals.

C. Population size estimated to number fewer than 10,000 mature individuals and either:
   1. An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, (up to a maximum of 100 years in the future) OR

   2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):
      (a) Population structure in the form of one of the following:
         (i) no subpopulation estimated to contain more than 1000 mature individuals, OR
         (ii) all mature individuals are in one subpopulation.
      (b) Extreme fluctuations in number of mature individuals.

D. Population very small or restricted in the form of either of the following:
   1. Population size estimated to number fewer than 1000 mature individuals.

   2. Population with a very restricted area of occupancy (typically less than 20 km^2) or number of locations (typically five or fewer) such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and is thus capable of becoming Critically Endangered or even Extinct in a very short time period.

E. Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

Source: IUCN (2012)

The Red List of *Tovomita*

For further information please contact:

BGCI
Descanso House
199 Kew Road, Richmond
Surrey, TW9 3BW
United Kingdom
Tel: +44 (0)20 8332 5953
Fax: +44 (0)20 8332 5956
E-mail: info@bgci.org
Web: www.bgci.org

www.globaltrees.org
www.globaltreeassessment.org