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Research Article

The population and habitat of *Saurauia bontocensis* Merr (degway) in Tadian, Mountain Province, Philippines

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Abstract

Any conservation initiative to protect endemic and threatened species must consider their population and habitat. *Saurauia bontocensis* Merr is an endemic species in the Philippines currently classified as vulnerable and needs conservation. Hence, this study sought information about its population and habitat preference in Tadian, Mountain Province. Results revealed the presence of 36 *S. bontocensis* plants in the 17 quadrats that were established; 33 are in the tree phase, while three are poles. Most trees are old and need to be rejuvenated and propagated to increase their population, mainly because no wildlings/seedlings are growing in the area. Morisitas index and chi-square results showed that the plants are randomly distributed in the moist areas of the forest with an elevation ranging from 1273–1651 masl, a temperature of 19.9 ^{o}C to 26.2 ^{o}C, a humidity of 65.2%-97.9%, a light intensity of 75fc–5295 fc, a soil moisture of 1%-8%, and a soil pH of 3-6.2. They thrive on acidic and loamy soil and survive under varied light intensities. In general, they are adapted to the environmental conditions of the broad-leafed portions of montane forest. With the current population of S. bontocensis, off-site conservation initiatives, with due consideration to the environmental factors of its habitat, should be conducted to increase its population and prevent local extinction. With the right conservation efforts, there is hope for rejuvenating and propagating this species.
Keywords: broad-leafed trees, conservation, endemic species, environmental condition

Introduction

Saurauia bontocensis Merr, locally known as *degway* in Mountain Province, is a medium-sized fruit-bearing tree that forms part of the forest in mountainous areas. It is one of the *Saurauia* species endemic to the Philippines, and it is recorded only in the Cordillera Administrative Region, particularly in Mountain Province, Benguet, Abra, Kalinga, and Ifugao (Daipan et al.,

2022; Pelser et al., 2023). It is classified as vulnerable, which means that adverse factors threaten it throughout its range, and it is likely to move to the endangered category in the future if there are no conservation efforts for this species (DAO No. 2017-11). Adverse factors include climate change and habitat change affecting many native trees in the Philippines (Tacloy et al., 2021).

Pelser et al. (2011) described this species as pioneer trees, meaning they are part of the original vegetation forming an ecosystem, mainly a forest. As a pioneer species, it helps establish conditions that will favor the survival of other species. With their fruits, they supported faunal species that fed on them. A study conducted by Angel et al. (2018), as cited by Tacloy et al. (2021), also shows that *S. bontocensis* is important in the mitigation of the impacts of climate change through its role in carbon sequestration, in which a tree can sequester an average of 0.439 kg of carbon dioxide per year. The plant also has economic value as the fruits are processed into jam, jelly, and whole fruit preserved in sugar, resembling raisins.

In Mountain Province, *S. bontocensis* plants can be considered indicator species since their absence from their habitat indicates disturbance. Their habitats are now being converted into vegetable gardens and invaded by pine trees, which make the area unsuitable for this species. Because of this, the remaining population is believed to have declined through the years, though no studies have been conducted on this matter. If the threats persist in the coming years, it will be possible for the species to suffer a severe population decline. With these facts, Daipan et al. (2022) recommended that *S. bontocensis* and other *Saurauia* species, found only in specific ranges and well-defined habitats, be conserved. Considering that a species' habitat is an essential factor in a successful conservation project, this study aimed to determine the habitat preference, distribution pattern, and population structure of the *S. bontocensis* in the forest of Duagan Tadian, Mountain Province. Currently, there is no information about its population or environmental requirements for growth and survival. We hope that the results of this study will serve as the basis for designing a conservation project to increase its number in the area and prevent its local extinction.

Material and Methods

Research Site

This study was conducted in the montane forest of Duagan, Tadian, Mountain Province. The forest is a combination of pine and broad-leafed, but the specific locations of sampling points are within the broad-leafed portion. Samples were taken from two sites, Sitio Nabitic and Duagan proper. The study sites (Fig. 1) are part of the municipality's protected forest and watershed area. Data gathering started from the lowest elevation, where the *S. bontocensis* was first observed, up to the topmost elevation, where the *S. bontocensis* was last observed. The

data were gathered during the dry season, the period when survival of plants was greatly affected by the absence of rainfall.

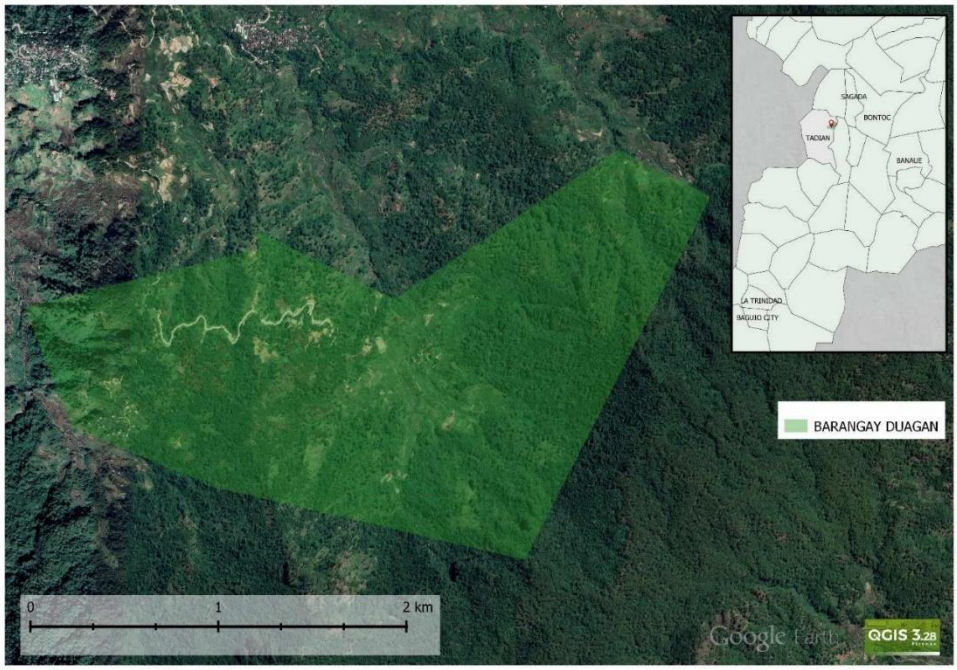

Figure 1. The study area at Tadian, Mountain Province

Sampling

The Quadrat method was used in the study, in which a total of 17 plots with a dimension of 25 m x 25 m per plot were established within the study area based on the existence of an S. ontogenesis. The first plot was established on the lowest elevation where *S. bontocensis* was first sighted, and the rest were established thereafter up to the topmost elevation where the last individual of the said plant was observed. The plots were established with the help of a guide from the community.

All *S. bontocensis* plants within each plot were counted and recorded. The environmental parameters of its habitat were gathered and recorded on-site. Elevations were recorded with the use of GPS (eTrex, Garmin, Taiwan), temperature and humidity through a mini-temperature and humidity meter (UT333, UNI-T, China), soil moisture and soil pH were determined through a soil tester (DM 15 Takemura, Japan), and light intensity through a mini-light meter (UT383, UNI-T, China). The population structure was based on the growth phases of plants, which were determined according to their diameter at breast height (dbh), and tree height. These were measured through a diameter tape and calibrated meter stick, respectively. The growth phases were adopted from the study of Helmanto et al. (2019) based on Mueller-Dombois and Ellenberg (1974), in which the seedling phase has a height of <1.5 meters, the sapling phase has a height of >1.5m and a dbh of <10 cm, the pole phase has a height of >1.5m and a dbh between 10-20 cm, while tree phase has a height of >1.5m and a dbh of >20 cm.

Analysis of Data

The data on environmental factors were analyzed using descriptive statistics, particularly mean, while Morisita's Index of Dispersion and Chi-square were used to analyze the pattern of distribution. Below are the formulae for Morisita's index of dispersion (I_d)and Chi-square (χ^2).

$$I_d = n\left(\frac{\Sigma x^2 - N}{N(N-)1}\right)$$

Where: n= total number of plots (quadrats)

X= number of individuals of one species in a single plot (quadrat)

$\sum X^2$= sum of all values of X^2

N= total number of individuals in all plots

Where: $I_d = 1$ indicates a random dispersion

$I_d < 1$ indicates a uniform dispersion

$I_d > 1$ indicates a clumped dispersion

To examine whether the index value is significantly different from 1.0 using a statistical test to reach a correct conclusion, significant deviations from 1.0 (random) are assessed by calculating the value of Chi-square through the following formula:

$$x^2 = \left(\frac{n * \Sigma x^2}{N}\right) - N$$

Results

Population structure and dispersion pattern

Table 1 shows the population structure based on the growth phases of *S. bontocensis* in the forest of Duagan, Tadian. The population is low, mostly composed of trees. Close observation showed that the old trees support epiphytes, lichens, and moss. Though the trunk and branches of the plants are small compared to other trees, more epiphytes hang on them, indicating that these are decades-old trees. This observation is corroborated by the guide who said that some of the sample trees were the same trees from which they had been collecting fruits as children. Another critical observation is the absence of wildlings, seedlings, and saplings around the mature plants. A single fruit of *S. bontocensis* contains hundreds of seeds that could germinate and grow into wildlings, yet no seedlings were observed in all the plots.

Table 1. Population distribution of *S. bontocensis* as to growth phases

Classification	Population
Seedling	0
Sapling	0
Pole	3
Tree	33
TOTAL	**36**

The distribution or dispersion pattern of a population describes the arrangement of its individuals within an area at a particular time. The dispersion pattern of *S. bontocensis* in the montane forest of Duagan, Tadian is random (Table 2). The 36 *S. bontocensis* plants were randomly distributed in the 17 sampling plots, equivalent to 10,625 m^2.

Table 2. Dispersion pattern of *S. bontocensis* in the montane forest of Tadian, Mountain Province

Parameter	Computed value	Critical value	Dispersion Pattern
Chi-square(X^2)	6.5	26.3	Random
t-value	1.6794	2.12	Random

Habitat of *S. bontocensis*

The population of *S. bontocensis* is part of the broad-leafed portions of the montane forest. The plants are located in sloping to steep portions with an elevation ranging from 1273 to 1651 meters above sea level (masl) (Table 3). No *S. bontocensis* was found below 1000masl altitude.

Table 3. Habitat of *S. bontocensis* as to elevation and environmental conditions

Parameter	Min	Max	Mean
Elevation (masl)	1273	1651	1422.353
Temperature (°C)	19.9	26.2	22.856
Humidity (%)	65.2	97.9	83.61
Light Intensity (fc)	75	5295	1030.353
Soil Moisture (%)	1	8	5.352
Soil pH	3	6.2	5.008

Results revealed that the species live in areas with low to moderate daytime temperatures, a moderate to high humidity, varying light intensities, an acidic and loamy soil, and can tolerate very low soil surface moisture during the dry season. In particular, the upland environmental conditions which favor the survival of the species include daytime temperatures ranging from 19.9 °C to 26.2 °C although they can survive at much lower temperatures during cold months. The species prefer moist areas with a relative humidity ranging from 65.2% to 97.9%. They can survive both in shaded and open areas with light intensity of 75 to 5295 foot-candles (fc). They prefer soil with a pH of 3 to 6.2, and can tolerate soil surface moisture of as low as 1% during the dry season.

Discussion

The current population structure of the *S. bontocensis* in the study area implies that it may undergo extirpation in the coming years if there are no interventions to regenerate the old trees or produce planting materials to replace them. If the disturbance of their habitat will not be

controlled, it may lead to the demise of the old trees. If this happens, it would have a corresponding negative impact on the forest ecosystem, such as less habitat for epiphytes and faunal organisms, a lesser food source for fruit-feeding faunal species, decreased carbon dioxide sequestration, and a decline in other ecosystem services that are derived from *S. bontocensis* population.

The very limited poles and the absence of seedlings and saplings in the study area indicate that the seeds could hardly germinate on their own, which confirms the claim of Tacloy et al. (2022) that it has a low natural regeneration capacity. Although fallen fruits are gathered on the ground, the seeds hardly germinate. The viability of the seeds could have been affected by the fruit's sweet, mucilaginous substances that could alter germination. Furthermore, the fruit's rotting may have impacted the seeds' viability, as the seeds remain within the fruit until it rots. Their viability may be preserved if gathered immediately from ripened fruits since, according to FAO (n.d.), delayed extraction can cause heat and fermentation within the fruits, affecting seed viability. The random dispersion or distribution of *S. bontocensis* plants in the 17 quadrats indicates a relatively uniform environmental condition and a random distribution of resources within the forest (Walker, 2011). The findings imply that the study area has the resources needed to support the growth of *S. bontocensis;* thus, it has a better chance of survival when propagated and planted within the area. This finding could be used as a consideration in designing a *S. bontocensis* conservation project in the future.

Saurauia in the Philippines is generally found at higher elevations, from 1,000masl to as high as 2000masl in thickets and forests (La Frankie, 2010; Jacobs, 2015; CDFP, 2022). This contradicts the claim of Sosef and van der Maesen (n.d.) that *Saurauia* is most common between 500 and 1200 meters. The absence of *S. bontocensis* in elevations below 1000masl may be attributed to the effects of climate change and fragmentation of the broad-leafed portion of the forest due to farming and invasion by pine trees. When the broad-leafed forest is converted into farms or pine forest, the environmental condition is altered and is no longer suitable for the survival of *S. bontocensis*. If this will persist, it may cause local extinction by depletion of its suitable habitat which is the case of endemic species with specialized or unique habitat (Mendoza-Fernandez et al., 2022; Sottosanti, 2023).

The environmental conditions which favor the growth and survival of *S. bontocensis* is similar with the environmental requirements of other *Saurauia* species such as *S. microphylla*. The study of Helmanto et al. (2020) found that the environmental factors in *S. microphylla* habitats include daytime temperatures of 16ºC to 27.6ºC, humidity range of 49.3% to 90%, and a soil pH of 5.8 to 7. However, it varies in terms of soil moisture, as the findings of Helmanto et al. showed that *Saurauia* species grow in habitats with soil moisture between 15% and 70%. The

variation could be attributed to the time we conducted the research, which happened to be during the dry season in the Philippines. Although *S. bontocensis* can grow in open areas, these areas are near creeks or springs, which may indicate that the plant needs a substantial amount of water to survive. Given these environmental conditions, the species is vulnerable to the impacts of climate change. In general, climate changes alter the growth, mortality, and reproduction of trees while causing significant effects on species distribution (Gebeyehu & Hirpo (2019). The changing precipitation patterns in our locality, where the rainy season is becoming shorter, threaten the remaining population. A prolonged dry season and increasing temperature also make the forest vulnerable to fire, which could affect the existing population and, worse, the mortality of individual trees depending on the severity of forest fires (Gebeyehu & Hirpo, 2019). Laface et al. (2022) mention that the quality or condition of a plant's habitat is reflected in the population dynamics over time.

Like any other plant, *S. botocensis* requires sunlight to grow. It can survive under different intensities and grow in partly shaded and open areas. Most plants grow in partly shaded areas where they receive enough sunlight to survive and bear flowers. Those found in open areas have fewer flowers and have darker leaves. They bear flowers during the dry season; the earliest is March, and the end of the fruiting period is October, though it varies from year to year.

Conclusion

The micro-population of *S. bontocensis* has low natural regeneration ability, one of the extinction-prone species' characteristics. The surviving population is at risk due to climate change and habitat alterations. Collaborative implementation and monitoring of the Municipal Forest Land Use Plan would minimize further threats to the plant's habitat, particularly its conversion into vegetable gardens. Meanwhile, the environmental conditions of the plant's habitat should always be considered in any off-site conservation effort. Propagation studies through seeds and cuttings may help determine the most viable method to increase its population. Studies on the mode of seed dispersal and its germination may be conducted to shed light on the absence of wildlings in the area.

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