How Tall is the World's Tallest Flowering Tree?

Centurion Height Determination Field Notes & Report
2018-11-30
Tasmania, Australia

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CENTURION

Summary

We used a ground-based high-quality portable laser rangefinder to measure the height of Centurion, a Tasmanian *Eucalyptus regnans*.. Our best determination from the observations in this field work is that the Centurion tree is 100.5 ± 0.4 m on 30 November 2018. To the best of our knowledge, Centurion is the tallest tree outside of California, the tallest tree in the Southern Hemisphere, and the tallest non-redwood tree, and the tallest flowering plant on Earth. Furthermore, we believe this is the first-ever laser measurement of any flowering plant over 100 m, and the first laser measurement of any Southern Hemisphere tree over 100 m.

Online Resources

Field data, photographs, and any future calculations are available at
https://giant-trees.com/how-tall-is-the-tallest-flowering-tree/

Introduction

Purpose

The tallest known flowering plant on Earth is a *Eucalyptus regnans* growing in Southern Tasmania known as Centurion (Tng *et al* 2012). It was discovered and measured at 99.6 m in height in 2008 by an aerial laser scanning LIDAR flight, and measured by tape drop at 99.82 in 2014 (Sillett et al 2015).

As ten years had elapsed since that first measurement, and almost five since the second, we visited Centurion on 30 November 2018 to remeasure it as part of a volunteer community effort to observe Australia's giant trees (Mifsud 2003, McIntosh 2018). We were unsure if it had grown or shrunk in recent years, and were also aware of the difficulty in comparing numbers across three different techniques.

Knowing that old-growth *Eucalyptus* trees often have several live branches at their summit (Bar-Ness *et al* 2012), and that old-growth *Eucalyptus* continue to grow throughout their life cycle (Sillett *et al* 2010), we considered it quite likely that the tree had continued growing to the numerically significant threshold of 100 m. We tested the hypothesis that the tree had grown 0.18 cm over four years to a height of over 100 m.

We selected minimal-impact, portable, ground-based laser techniques that can be reliably repeated throughout the year. We were fortunate to have access to a high-quality survey laser, a Laser Technologies TruPulse 360, provided by Walsh Optics of Hobart, Tasmania.

Past measurements of the tallest flowering tree

Within the period of European presence in Australia, it is very possible that the tallest *E. regnans* grew on the mainland in the state of Victoria (Mifsud 2003). However, tree height measurement data from the 19th and 20th centuries are very scarce, and much of the forest has now been felled (or burnt). Newspaper articles dating as far back as 1886 (Euroa Advertiser 1886) and well into the 1930s (The Southern Mail 1940) discussed the possibility that the tallest tree on Earth was one of the Victorian *E. regnans.* There is an 1872 report of a Victorian tree 133 m tall, but its veracity is disputed (Hickey *et al* 2000, Mifsud 2003). Mifsud (2003) nominates a 114m tall tree cut in 1880 as the most credible high value.

In 1964, the tallest known flowering tree height was Mount's (1964) survey theodolite measurements of 320 feet, or 97.54 m, for the Trident Tree, later known as the Mount Tree in his honour.

By the 21st century, available information indicated that the world's tallest flowering plants were Tasmanian *E. regnans*. Hickey *et al* (2000) conducted a survey of all known contenders for Tasmania's tallest tree and report a value of 92 m as the tallest known flowering plant. In 2005, a new contender, named Icarus Dream was found just nearby and measured at 97 m (The Age, 2005).

When Centurion was first measured by aerial laser survey, it was reported as being 101 m in height (Sydney Morning Herald, 2008). The number was soon revised to 99.6 m height ESRI (2010) with no mention again of the 101 m value. Mifsud (personal communication 2018) reports on a tape drop conducted in 2016 at 99.6 m.

Centurion has been structurally measured in great detail in early 2015, and Sillett *et al* (2015) report a 99.82 m height via tape measure drop (presumably combined with laser measurements within the tree crown). They used tree-ring and structural analysis of several old-growth *E. regnans* to present an estimate of Centurion as 320±60 years old. They additionally report on several physical measures for the tree, including 122.45 ± 3.07 thousand kg of biomass, and containing 1.56 ± 0.16 million leaves.

Working from that 99.82 m height from four years ago, Wardlaw (personal communication 2018) proposed the value of a re-measurement field excursion to this tree to test the hypothesis that the tree was taller than 100 m in height.

Outlining the natural heritage values in the Tasmanian World Heritage Area, Rudman & Balmer 2018 report the existence of 96 known Tasmanian *Eucalyptus* trees taller than 85 m of which 24 individuals are over 90 m in height. While aerial laser survey data is considered of very high quality, repeat measurements are rare. Similarly, tape drops are only rarely performed and are difficult to repeat.

To contribute to the ongoing refinement of measurement technique for these trees, we present here our methods, raw data, photographic evidence and a discussion on our calculations. We discuss a number of stages at which our measurements may be incorrect, and invite technical feedback and future discussion.

Methods

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• ## 1) Establishment of a fixed Reference Point

Methods

1 We found an unmistakable feature at an easily accessible point at the base of the tree and nominated it as a "Reference point"
2 We marked this with a blue pencil and several blue cable test as a visible survey point, and photographed it from several angles

DETAIL OF REFERENCE POINT AT BASE OF TREE, AT BOTTOM OF VERTICAL COLOURED PENCIL

Results

1. This Reference point is intended to be relocatable for future measurements.
2. Over time the tree may put on some additional bark mass at this point. Photographic records could be used to assist in determining how much variation this may bring to future measurements.

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REFERENCE POINT AT BASE OF TREE, AT BOTTOM OF VERTICAL COLOURED PENCIL

• 2) Determination of ground level as midway between upslope and downslope

Methods

1. We looked for a visible unmistakable interface of the study tree surface at the contact with ground soil on the upper and lower slopes.

2. We did not extrapolate any extra height by imagining where the tree continued into the ground out of sight, despite there being a slight accumulation at its base. While there was a recognisable ledge/ring of other tree roots at the base of Centurion, we viewed the upper part of that ledge as the tree's base.

3. After circumnavigating the tree, we selected the best candidate points for the tree's base at upslope, and then downslope. These were marked with coloured pencils and photographed from several angles.

FIRST AND SECOND DOWNSLOPE CANDIDATES

4. We then set up a laser survey station A, point "Araucaria", at the point where we could see the reference point & the two lower slope candidate points.

5. We then used the laser rangefinder to calculate several vertical distance (VD) values in relation to the reference point. We additionally collected horizontal distances (HD) and compass azimuth (AZ) to fix our stations in 3-dimensional space.

6. We then performed a similar technique to determine the VD between the reference point and the three upslope candidates.

Results

► **STATION A "Araucaria" DATA**

► **STATION A** Results: The reference point is 0.1 m higher than Araucaria. The averaged result of two downslope points is 1.3m below Araucaria. Therefore, the reference point is 1.4 m above our best determination of the downslope point.

► **STATION B "Bunya'" DATA**

► **STATION B** Results: The reference point is 1.2 m lower than Bunya. The averaged result from three upslope points is 1.33m below Bunya. Therefore, the reference point is 0.13 m above the best determination of our upslope point.

FIRST UPSLOPE CANDIDATE

1. From A Results and B Results we have calculated that the reference point is 1.4 m above the downslope point and that the reference point is 0.13 m above the upslope.
2. The reference point height above midslope ground level is calculated to be at the average of these two values.
3. We have therefore determined that the height of the reference point is 0.765 m above the ground.

SECOND AND THIRD UPSLOPE CANDIDATES

• 3) Establishing Height of "Strong Fork

Method

1. We identified a very distinctive branching fork in a low epicormic branch that we had confirmed was visible from both our ground stations near the reference point and also from up the hillside with a much more open view of the tree crown.
2. We photographed this "Strong Fork" from several angles and together viewed the photographs on the camera screen to confirm we were looking at the same feature.
3. Strong Fork is a branching point on the second-lowest branch on Centurion. It is near a very distinctive "bird's nest" of collected bark ribbons. It is orientated in such a way that we could see the true junction point from the base of the tree and up the hillside.
4. Over time, the branch may fall off the tree, or the thickening of the tree branch may shift the location of the branching point. However, the way the branch is orientated it will affect the HD more than the VD. Photographs could be used on future re-measurements to assess whether there has been any observable change in the shape of position of this branch.

Results

► STATION C "Cedar'" DATA

► STATION C Results: We established this survey point but quickly abandoned it as the almost completely vertical angle to Strong Fork made looking through the rangefinder impossible.

► STATION D "Dipterocarp'" DATA

► STATION D Results: Dipterocarp is 0.3 m lower than the reference point. Dipterocarp is 27.66 m lower than Strong Fork. Therefore the reference point is 27.36m below Strong Fork.

1. The height of the reference point is 0.765 m.
2. Strong Fork is 27.36 m above the reference point.
3. Strong Fork is therefore at a height of 28.125 m.

DETAIL OF STRONG FORK

• 4) Establishing Height of the "White Shield"

Methods

WHITE SHIELD TARGET DETAIL

1. We moved uphill to a viewpoint where we could clearly see Strong Fork and a higher, conspicuous feature we named the "White Shield".
2. White Shield is a section of the mid-stem where a large branch appears to have broken off or where some event has wounded the tree. It appears to be exposed dead wood.There is a visible rim of live bark growing over onto the White Shield. There is a distinctive section of dark coloured live bark on the right hand side which comes down to a distinctive bend in the rim of bark. This was our survey target within the White Shield.
3. While bark peeling and the continued growth of live wood over the White Shield could make this point harder to pinpoint in the future, it was still the most distinct point available to us. Of the two markers - the dark bark and the shape of the shield rim, the shape of the shield rim should stay consistent over the 2018-19 growing season or longer.
4. We photographed this feature and viewed it together to confirm we were looking at the same feature.

Results

WHITE SHIELD TARGET DETAIL

► STATION E "Elm'" DATA
► STATION E Results: Our best determination from ten averaged observations is that Elm is 15.59 m below Strong Fork. Our best determination from 29 averaged observations is that Elm is 47.24 m below White Shield. Therefore, we have calculated White Shield is 31.65 m above Strong Fork.

1. Strong Fork is at a height of 28.125 m
2. White Shield is 31.65 m above Strong Fork.
3. Strong Fork is therefore 59.775 m high.

• 5) Establishing Height of "Treetop-Lowest View"

Methods

1. We moved uphill to a viewpoint where we could see White Shield and what appeared to be the very top of the tree.
2. We could see several healthy epicormic branches contending to be the very treetop.The main stem was clearly broken just below these branches, indicating that at one point the tree must have been taller. The lower branches on the trunk, including Strong Fork, was completely obscured by the vegetation of the rainforest.
3. It was difficult to determine visually which of several branch foliage clusters was actually the highest point.
4. At this point of our fieldwork we were unsure of whether we would be able to find any other viewpoints higher on the hill that would provide a clearer view of the actual summit.
5. Our method for measuring the top of the tree consisted of taking several laser shots of the candidate clusters to see which cluster showed the highest VD value.
6. The cluster that gave us the highest VD was actually not the visibly highest cluster, indicating that our station was less than optimal for viewing the top of the tree.
7. Once we had found a cluster that gave us a consistently higher VD, we recorded several VD values to find a maximum value that we could repeat five times. We waited for any wind gusts to settle between shots.
8. At this stage and the two subsequent stations Elm & Dipterocarp we had not precalculated a "number to beat" to indicate 100 m height for the tree. We were therefore wilfully blind to what number would cross that threshold.
9. Since there was only clear skies behind Centurion, we decided that a maximal value recorded at least five times was acceptable, as there was no object behind for the laser to erroneously measure.We therefore recorded several numbers until we thought we had the true maximum value, and then continued shooting until we had observed that number five times.
10. We named this survey target "Treetop-LowestView" when writing up our field notes as it was the treetop viewing survey point at the lowest altitude of the three we visited.

WHITE SHIELD VISIBLE ON STEM

Results

► STATION F "Ficus'" DATA

► STATION F Results: Our best determination from 21 averaged observations is that Ficus is 26.414 m below White Shield. Ficus is 66.3 m below the Treetop-LowestView. Therefore, Treetop-LowestView is 39.886 m above White Shield.

1. 1We were aware that we did not have a clear view to the top of the tree. This station "Ficus" was both lower in altitude and closer to Centurion and therefore at a more acute angle of view. We observed that by gaining elevation and distance would reveal the true position of the highest branches more clearly.

HIGHEST VIEW OF TREETOP FROM STATION GINGKO

• 6) Establishing Height of "Treetop-Highest View"

Methods

1. We continued up the hillside to a vantage point where we could see much more clearly the actual position of the candidate foliage clusters for the actual treetop, and still have a clear view of White Shield.
2. As we were almost on the nearby ridge top, we made efforts to traverse along the slope contour and thereby add more angles on the tree,
3. Having climbed about 13 m higher on the slope from Station Ficus, we had a substantially better view of the very summit of the tree.
4. The lower crown, including Strong Fork, was completely obscured by the vegetation of the rainforest. Centurion was still notably the tallest tree in the vicinity.

DETAIL OF TREETOP FROM STATION GINGKO

Results

► STATION G "Gingko'" DATA
► STATION G Results: Our best determination from 19 averaged observations is that Gingko is 12.63 m below White Shield. Gingko is 53.8 m below Treetop-HighestView. Therefore, Treetop-HighestView is 41.17 m above White Shield.

1. The scanning process went much more efficiently at this station as the cluster of foliage that was visibly the highest also resulted in the highest Vertical Distance values.

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• 7) Establishing Height of "Treetop-MidView"

Methods

1. We continued up the slope looking for viewpoints but could not find one. We therefore traversed and descended until we found a point with a clear view, ultimately about 3 m lower in altitude that Station Gingko.

Results

► STATION H "Hakea'" DATA
► STATION H Results: Our best determination from 25 averaged observations is that Hakea is 15.196 m below White Shield. Hakea is 56.3 m below Treetop-MidView. Therefore, Treetop-MidView is 41.104 above White Shield.

1. Again, the scanning process went much more efficiently at this station as the cluster of foliage that was visibly the highest also resulted in the highest Vertical Distance values.

RECORDING AND CALCULATING FIGURES IN THE FIELD

8) Determining whether Station Ficus should be included in the calculations

Method

LASER AND TRIPOD IN USE

1. We considered removing Treetop-LowestView data due to quantitatively and qualitative evidence that we were not seeing the actual treetop.
2. When we observed the treetop from Station Ficus, the actual highest cluster as indicated by VD was not visibly the highest point on the tree. This indicates that we did not have an optimal angle to identify the actual treetop at Station Ficus, and possibly were shooting at the bottom of a foliage cluster. We realised that had we come to Ficus after Gingko or Hakea, we would have decided not to take observations there.
3. When comparing the three TreeTop View data, Stations Gingko and Hakea were less than 0.07 m apart in calculated height, whereas Ficus was about 1.2 lower. This is evidence that the measurements from Ficus were not of the actual treetop.

Results

1. We have included the data from Station Ficus, Treetop-LowestView in our best determination but have also included ain our reporting a value without Ficus.
2. We calculated these three determinations of height of the tree by adding the calculated height of White Shield with the measured height above White Shield for each of Treetop-LowestView, Treetop-HighestView, and Treetop-MidView.

- Height of Centurion tree as per observations of Treetop-LowestView (Station Ficus) = 39.886 m + 59.775 m = 99.661 m
- Height of Centurion tree as per observations of Treetop-HighestView (Station Gingko) = 41.17 m + 59.775 m = 100.945 m
- Height of Centurion tree as per observations of Treetop-MidView (Station Hakea) = 41.104 m + 59.775 m = 100.879 m

• 9) Determination of Centurion tree height

Method

1. We averaged our three height determinations: Treetop-LowestView at 99.661, Treetop-HighestView at 100.945 m, and Treetop-MidView at 100.879 m.

2. We also calculated an average without Treetop-LowestView (Station Ficus) at 99.661 m.

Result

1. Our best determination of the height of Centurion is 100.495 m on 30 November 2018, integrating the two clear-view Treetop-Views.

2. Including the Station F, where the view of the treetop was not visually direct, our best determination of height of Centurion is 100.912 m on 30 November 2018.

FIELD CREW AT OVERLOOK OF TREE

• 10) Height Summary and a simple method for estimating error

Methods

1. We were aware that we were using a piece of equipment with a reported error of +/- 0.2 m. Our calculations consist of 311 observed VD values, with most of them repetitions of some sort.

2. We contacted Dr. David Caprette, Teaching Professor at Rice University (USA), to assist us with estimating a survey error.

3. Following his assistance with the calculations, we will report a final value as containing an estimated survey error +/-0.4 m.

Results

A compilation of determined heights above ground for named observations along Centurion on 2018-11-30.	Height	Calculation	Document Section
Reference Point	**0.765 m**	*1.4 m above the downslope point and 0.13 m above the upslope.*	Section 2
Strong Fork	**28.125 m**	*27.36 m above Reference Point*	Section 3
White Shield	**59.775 m**	*31.65 m above Strong Fork*	Section 4
Treetop-LowestView	***99.661 m***	*39.886 m above White Shield*	Section 5
Treetop-HighestView	***100.945 m***	*41.17 m above White Shield*	Section 6
Treetop-MidView	***100.879 m***	*41.104 m above White Shield*	Section 7
Treetop - Best Determination excluding Station Ficus.	***100.912 m***	*Average of (100.945, 100.879)*	Section 8,9
Treetop - Best Determination including Station Ficus	***100.495 m***	*Average of (99.661, 100.945, 100.879)*	Section 8,9

• 11) DBH - Standard Forestry Measurement of Diameter at Breast Height

Methods

1. We used the upslope, downslope, and reference points as calibrations for our circumference tape wrap of Centurion at a height of 1.37 m.
2. We placed coloured pencils as markers at
   - 0.575 m above the reference
   - 1.975 m above the downslope candidates
   - 0.698 m above the upslope candidates
3. We wrapped a tape around the tree stem and pulled it tight after checking it was level. There were no epiphytes, burls, or contiguous plants to complicate measurement.

Result

1. The circumference of Centurion at 1.34 m height was measured as 13.38 m on 30 November 2018.
2. Our determination of diameter at breast height (1.34 m) is 4.26 m on 30 November 2018.

AT THE BASE OF THE WORLD'S TALLEST KNOWN FLOWERING PLANT

Conclusions and Discussion

• Significance of findings

Our fieldwork reports the first measurements of Centurion as taller than the numerically significant threshold of 100 m to 100.495 m as per our best determination.

Including our estimate of survey error, this number is best considered as 100.5 m +/- 0.4 m.

To the best of our knowledge, Centurion is the tallest tree outside of California, the tallest tree in the Southern Hemisphere, and the tallest non-redwood tree, and the tallest flowering plant on Earth. Furthermore, we believe this is the first-ever laser measurement of any flowering plant over 100 m, and the first laser measurement of any Southern Hemisphere tree over 100 m.

At some point the tree could have been substantially taller. A visible break in the stem indicates that it once reached much higher. All of the contending foliage cluster branches are much younger epicormic resprouts that will struggle to reach the same height as the previous stem due to the weaker attachment point to the main stem and their competition with each other.

• Potential improvements

We utilised a modern portable laser rangefinder with a high quality tripod on a day with excellent weather conditions. We were able to conduct multiple shots for each vector we surveyed, and additional extra shots for vertical distances.

We endeavoured to repeat and average whatever component measurements we could. For example, it was very easy to measure and record VD values again and again, but we were not able to conduct repeat stations for observation of the distance between Strong Fork and White Shield, or between Strong Fork and the reference point. Creating those repeat stations would be easier than repeating the uphill stations, but we were at that stage unsure of what amount of visibility we would be able to obtain later in the day. As it was, we filled a complete field day with very little time not conducting measurements or searching for viewpoints.

The laser rangefinder was in brand new condition and passed our basic calibration tests after field work (testing at 30, 2, and 1 metres alongside a tape measure, and testing angles level to zenith). We performed calculations to values using centimetres or occasionally millimetres, however, the actual reported values of the device only included a single decimal point (10 cm). We therefore rounded our calculated height determination to the nearest 0.1 m.

Mifsud (personal communication, 2018) hypothesises that handheld lasers used for mapping ultra-tall *Eucalyptus* tree overestimate heights by 15-25 cm per each 100m. Our maximum straight-line distances was 121.8. This potential overestimate could be a systematic source of error.

We are aware that future calculations from this same data may determine a potentially much higher error values for this field visit. However, even if the range was much higher (for example, +/ 8.0 m), the most probable value from our observation remains 100.5 m in height, and correspondingly, on balance the current data would support the hypothesis that the tree is greater than 100 m in height.

We could have misidentified features on the tree stem, but did our best to control for this by using camera screens to help identify them. A gust of wind could have shifted branches, but we controlled for this by waiting for still moments.

The tripod we used was not gimballed, and the tilting ball-head plus distance from the laser's tripod mount to the axis of measurement could have caused a small measurement error as it was tilted up and down. Using a tape measure we measured a maximum variation of 0.05 cm VD in the sensor height. A future measurement campaign could accommodate this variation in their field techniques.

• Comparison with other measurements and techniques

Centurion was first discovered in aerial scanning "LIDAR" laser data in 2008 and measured within the 3-dimensional "point cloud" data as 99.6 m. In early 2014, it was measured via tape measure drop as 99.82 meters tall by Sillett *et al*. (2015). This is a height growth of 0.22 m over six years. Our results, almost five years later, indicate a growth of 1.092 m. There are a number of inherent confounds in comparing the numbers. Because all three measurements were taken by different techniques, it is impossible to conclusively say whether it has grown faster, whether the environment has changed, or whether one of the numbers is incorrect.

These three height measurements were performed by different teams and completely different methods. The 2008 aerial scanning LIDAR data can draw upon detailed topographic contour information of the landscape to determine a derived ground level. Presumably, the 2014 tape drop and 2018 ground laser measurements used the same upslope and downslope levels to get an identical ground level. However, this ground level could have shifted with environmental changes such as soil accumulation (e.g. bark ribbons, rotting leaves), soil compaction/erosion (visitor impacts, landslip, decomposition), or soil moisture changes.

Tape measures are considered the most precise of these three methods. Mifsud (personal communication, 2018) provides examples of five trees over 90 m for which two tape drops by different teams within a single calendar year yielded identical values within 0.1 m of each other. Hickey et al (2000) reports on a comparison within a single tree of tape drop, laser rangefinder, and surveyor theodolite. They found that all values were within 0.5 m of each other.

Our ground-based methods offer a repeatable method of measurement that, unlike tree-climbing methods, are able to be conducted in a wide range of weather conditions and with substantial repetitions of component measurements. Following extensive experience measuring *Eucalyptus* trees with tape measures while on-ropes (Bar-Ness *et al* 2012), we are aware of some strengths and weaknesses of these methods (Table 2). For example, we aren't aware of tape measurements in which measurers completely retracted and redeployed a tape measure to make sure that it was falling straight without interference from stem and branches.

We hypothesise that ground-based lasers are less precise that aerial LIDAR or tape drops, but have the potential to be conducted with drastically lower costs, constraints, and risk.

Ground based laser measurements are also able to be conducted year-round by a single person, and include less potential impact to the tree itself. By posting photographs and video of our reference points as well as our raw laser data, we will make future measurements more directly comparable.

Comparison of three tree height measurement methods	Ground laser	Tape Drop	Scanning Laser
Cost	$	$$$	$$$$$
Safety	High	Low	Highest
Ease of repetition	Easy	Hard	Very hard
Most likely error	Misidentification of stem landmarks, compounded errors over many linked measures	Tape not straight down, topmost height measure	Data processing error
Weather considerations	All-weather	Restricted by high winds and inclement weather	Fine weather days selected for very expensive flights
People required	Single	Two at very minimum	Airplane personnel, airfield personnel data processing personnel
Impact on tree	Minimal	Low	Nil
Ability to revisit to check mistaken numbers	Easy	Difficult	Very difficult

OVERLOOK OF CENTURION

·Conclusion

We will endeavour to revisit this tree for regular re-measurements using the same equipment which will allow for a finer resolution time sequence of tree height and to cross-check our measurements to the best ability. We will additionally endeavour to climb the tree again to conduct a tape drop to allow for a direct comparison of the two methods.

While we are conscious that we could continue to mathematically refine our error estimate of +/- 0.4 m, we have observed that no other reporting of height value for any of the other tree measurements referenced to in this document include a reporting of any error values. We propose that all laser rangefinder height measurements be reported with an effort at estimation of an error range. Optimally, reporting would include the manufacturer's specifications of instrument accuracy.

Similarly, tree heights for notable trees are routinely presented across various media without any reference to the date of observation. As trees grow and change over their lifetimes, the measurements are best reported with specific reference to a particular time.

By publicly posting our raw data, methods, photographic recordings (with video soon to be made available in the future) we have created a pathway for interested parties to reanalyse our findings. Additionally, by providing an error value we contribute an element to best-practice reporting of tree heights. Following our height determination of 100.5 ± 0.4 m, our fieldwork indicates that this tree has grown taller than 100m. To the best of our knowledge, this tallest known flowering tree on Earth and the tallest tree in the Southern Hemisphere is also the only known flowering plant alive taller than 100m, and the the only tree known in the Southern Hemisphere taller than 100 m.

Equipment List

- * Rangefinder - Laser Technology TruPulse 360
    - Calibrated as accurate for distance measurement with tape measure on 2018-12-02
    - Specifications as per manufacturer:
        - *Distance Accuracy to Typical Targets: ± 0.2 m (8 in)*
        - *Distance Accuracy to Very Distant & Weak Targets:± 1 m (3 ft)*
        - *Inclination Accuracy: +/- 0.25° Typical*
        - *Azimuth Accuracy: +/- <0.5° RMS; typical*
        - *Max Range to Reflective Targets: 2000 m (6,560 ft)*
        - *Max Range to Non-Reflective Targets: 1000 m (3,280 ft)*
- * Manfrotto 0x55 carbon fibre tripod
- * Sony A7R3 professional digital camera - for stills and video
- * Coloured pencils and bright cable ties as markers
- * Tape measure - 30m
- * Clipboard, data sheets, pencils, calculator

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Online Resources

Field data, photographs, and any future calculations are available at
https://giant-trees.com/how-tall-is-the-tallest-flowering-tree/