Arboriculture & Urban Forestry 2025
https://doi.org/10.48044/jauf.2025.006

Identifying Essential Selection Criteria and Program Components to Improve Hawai‘i’s Exceptional Tree Program Based on Expert Consensus

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Abstract. Background: Hawai‘i’s exceptional trees are currently identified based on 7 selection criteria established in 1975. These criteria and their corresponding program components have remained stagnant with minimal improvements since the program’s inception. This study builds upon previous exceptional (aka “heritage,” “significant,” “champion,” “monumental,” “notable,” etc.) tree research conducted in other geographic locations in an attempt to discover if consensus exists regarding how these trees of importance should be identified, managed, and protected. Methods: A panel of 13 experts from around the state were presented 45 exceptional tree selection criteria and several program components using a 3-iteration Delphi method to determine if consensus exists on which selection criteria and program components should be used by Hawai‘i’s Exceptional Tree Program. Results: The results identified 33 exceptional tree selection criteria and 5 program components (i.e., protection mechanisms, private property exceptional tree maintenance costs, funding, public education and outreach, and program management best practices) recommended by the expert panel, as well as examples of how each should be implemented to improve the efficacy of this conservation program. Conclusions: These findings add to a growing body of exceptional tree research designed to identify, recognize, and protect a region’s most valued trees, while also having applicability to urban forestry programs more broadly.

Keywords. Delphi Method; Exceptional Trees; Heritage Trees; Tree Protection; Urban Forest Policy; Urban Forest Governance; Urban Forestry Conservation.

INTRODUCTION

There has been a plethora of names used to denote trees of importance, including 60 identified by Jim (2017). While these terms include “exceptional,” “heritage,” “significant,” “champion,” and “monumental” trees (Ritchie 2019), the specific name used is often based on where the respective program is located, even though these terms may represent similar selection criteria (Ritchie et al. 2021). As such, for the purposes of this study, the term “exceptional trees” will be used.

Exceptional trees around the world have been identified by at least 40 unique selection criteria (Ritchie 2019) such as historical value, cultural value, aesthetics, size (Clark et al. 2020), botanical value, and ecological value (Britton et al. 2015; Lau et al. 2017). Exceptional tree programs can be found at local (The Village of Glenview [date unknown]) to national scales (National Parks Board 2024) and on public and private land (City of San Diego, California 2005; Britton et al. 2015). These programs often have an educational focus (Nebraska Forest Service 2022), with some also including legal protections (Legislature of the State of Hawai‘i 1975; Portland Parks & Recreation Urban Forestry 2019). Legal protections can exist at various levels including municipal (City of Melbourne 2019), state/provincial (Legislature of the State of Hawai‘i 1975), and national scales (Jim 2004), although even with these protections, high mortality rates can still occur (Jim 2005; Chen 2015). For example, one notable loss of exceptional trees took place between 1986 and 1995 in Guangzhou, China, when 21.5% of their exceptional trees died (Jim 2004). Instances such as these are largely the result of anthropogenic factors such as roadwork and construction (Jim 2004; Jim 2005). The loss of these iconic trees (Lau et al. 2017) is often one of the

motivating factors in beginning (City and County of Honolulu 2024) or restarting (McNamara and Carter 2006) an exceptional tree program, as these programs are designed to conserve these unique tree specimens (Britton et al. 2015), the largest of which act as keystone structures in urban forests (Stagoll et al. 2012).

Hawai‘i’s Exceptional Tree Program

Hawai‘i’s Exceptional Tree Program began in 1975 when legislation was passed to “safeguard exceptional trees from destruction due to improper land development,” which by that time had resulted in the loss of “many of the State’s exceptional trees” (Legislature of the State of Hawai‘i 1975; DLNR Division of Forestry and Wildlife 2019). This legislation mandates each of the state’s 4 counties to enact legal protections for trees and/or groves of trees that comprise one or more of the 7 following selection criteria: “historic or cultural value,” “age,” “rarity,” “location,” “size,” “esthetic quality,” or “endemic status” (Legislature of the State of Hawai‘i 1975). Trees of exceptional status in each county are evaluated by their respective Arborist Advisory Committee (AAC), and nominees deemed worthy are submitted to the City/County Council for approval through an ordinance process (County of Hawai‘i 2016; Rezents 2016; American Legal Publishing 2021; County of Kaua’i 2024).

Hawai‘i’s exceptional tree protection mechanisms utilize a tax incentive and regulations. The incentive is seen in the form of a state tax deduction of up to $3,000 per exceptional tree every 3 years for maintenance purposes (State of Hawai‘i Department of Taxation 2004). Additionally, state regulations administered by each county through ordinances prohibit the removal of designated exceptional trees (Legislature of the State of Hawai‘i 1975). While all 4 counties administer the same $1,000 fine for damaging or illegally removing an exceptional tree (County of Hawai‘i 2016; Rezents 2016; American Legal Publishing 2021; County of Kaua’i 2024), each county implements slight variations regarding the strict process to remove exceptional trees. For the City and County of Honolulu, these trees can only be removed if approval is first obtained from the City Council, or in emergency situations where “there is imminent danger to life or property” (American Legal Publishing 2021). Similarly for Maui County, most exceptional trees can only be removed if they are “dead, diseased, irretrievably damaged, or [are] a hazard to public safety or welfare” (Rezents 2016). Additionally, the owner of an exceptional tree can request that the Director of Parks and Recreation and AAC consider removing their exceptional tree, although approvals rarely occur (Rezents 2016). Kaua‘i County requires that the County Council approve any removals of exceptional trees (County of Kaua’i 2024), while Hawai‘i County has the most substantial protections as “it shall be unlawful for any person, corporation, public agency or other entity to substantially damage, remove or destroy an exceptional tree in the County” (County of Hawai‘i 2016).

The intent of this research is to determine if the exceptional tree selection criteria used in Hawai‘i are reflective of current values, which is imperative in light of recent findings by Ritchie (2019) highlighting a potential discrepancy between exceptional tree selection criteria currently used by these conservation programs and those recommended by experts. This study also builds upon previous exceptional tree research examining if expert consensus exists on a core set of exceptional tree selection criteria that should be used to denote these trees of importance regardless of geographic location. Furthermore, this research explores the essential program components that should be included in Hawai‘i’s Exceptional Tree Program to improve its overall efficacy. These results add to a growing body of exceptional tree research designed to identify, recognize, and protect a region’s most valued trees (Jim 2004; Jim 2005; Jim and Zhang 2013; Britton et al. 2015; Chen 2015; Jim 2017; Lau et al. 2017; Ritchie 2019; Ritchie et al. 2021). Furthermore, many of the solutions identified in this study could be applicable to other urban forestry conservation programs that experience similar issues, specifically program components such as protection mechanisms, private property tree maintenance costs, funding, public education and outreach, and program management best practices.

MATERIALS AND METHODS

The Delphi Method

The foundation for this modified Delphi study was 45 of the “heritage tree” selection criteria identified by Ritchie et al. (2021)(Table 1) in addition to several open-ended questions. The Delphi method is ideal for instances where there is inadequate and/or incomplete knowledge about a topic (Skulmoski et al. 2007) and relies upon the use of expert opinions (Okoli and Pawlowski 2004). The process is dependent on

Table 1. Definitions for the 45 exceptional tree selection criteria introduced in round 1.

Category	Criterion	Definition
Aesthetics	Aesthetics	A visually impressive tree that stands out from others in the area. Exceptional trees with this characteristic often add an awe-inspiring component to the landscape. For example, this could be due to its representation of special size or age and form features in addition to others such as captivating flowers, seeds, leaves, and/or other aspects.
Age	Nonspecific age	Age is used for the designation of an exceptional tree without listing a specific minimum threshold value.
Age	Program-specific age	A specific minimum age threshold is assigned to an entire exceptional tree program regardless of species. For example, all trees must be greater than 100 years old.
Age	Oldest specimen of species in region	The oldest specimen of each species within a program's geographic area will be awarded exceptional tree status.
Age	Species-specific age	This reflects the different longevities that species have to more accurately show what is considered old. For example, at an age of 75, one species may be considered young, while another may have surpassed what is often considered its expected lifespan. Each species within an exceptional tree program will be assigned an age threshold. If a tree meets or exceeds this requirement, it will be awarded exceptional tree status.
Benefits	Ecological/habitat value	A tree that provides benefits to organisms in the surrounding environment. An example would be a specimen that has large and/or old characteristics which can facilitate or support a large amount of life forms such as birds, bats, mammals, and even aquatic organisms should water collect in a crevasse.
Benefits	Significant environmental value	A tree that provides significant environmental benefits, usually in the form of ecosystem services such as carbon sequestration, stormwater runoff avoidance, reduced erosion, shading, reduction in the urban heat island effect, and pollutant removal.
Benefits	Economic benefits	A tree that provides economic benefits to a given geographic region, usually through ecotourism. An example could be an iconic tree that attracts visitors due to its historical, cultural, size, age, aesthetic, or other impressive traits.
Botanical/horticultural/arboricultural/biological value	Endangered	A tree that is valued based on its endangered status worldwide. The International Union for Conservation of Nature's "Red List of Threatened Species" could be one resource for determining this.
Botanical/horticultural/arboricultural/biological value	Rarity	A tree that is rare due to its infrequent occurrence worldwide.
Botanical/horticultural/arboricultural/biological value	Botanical/horticultural/arboricultural/biological value	A tree that has unique or exceptional botanical, horticultural, arboricultural, or biological value. These trees are often a valuable source for future propagation efforts based on their genetic components.
Botanical/horticultural/arboricultural/biological value	Specific species/species significance	A specific species of tree that is deemed to be of importance for a given program's area (e.g., ʻŌhiʻa lehua [*Metrosideros polymorpha*] in Hawaiʻi).
Botanical/horticultural/arboricultural/biological value	Seed source/propagation stock	A tree that is an important source of seed or propagation stock.
Botanical/horticultural/arboricultural/biological value	Resistant to disease/climate conditions	A tree that is valued due to its ability to resist disease and/or exposure to climatic conditions over time.
Botanical/horticultural/arboricultural/biological value	Biological heritage	A tree that is the progeny of a known exceptional tree or other tree of value. An example of this can be seen with the decedents of the "Lone Pine" in Australia. These trees can be replacements for former exceptional trees as long as the genetic source can be verified.

Table 1 continued on next page

Table 1. Continued

Category	Criterion	Definition
Botanical/horticultural/arboricultural/biological value	Endemic	A tree that is valued in a given geographic area due to its endemic status.
Cultural value	Indigenous cultural associations	A tree of importance to indigenous cultures and/or associated with various indigenous events.
Cultural value	Local significance	A tree that is locally known as a key fixture within the community. The removal of such a tree can negatively impact the community through a change in aesthetics and/or loss of an iconic natural structure.
Cultural value	Cultural value	A tree that represents a wide range of cultural aspects and values which benefit a community or specific culture. This can include an association with past and current groups, such as a plant that was and remains a part of a specific group’s culture. This tree can provide a sense of place for those in the local community, act as a fundamental component of a community’s identity, etc.
Cultural value	Social/community value	A well-known tree that is prominent in the community and provides a connection for those who interact with it (e.g., memories associated with a tree or those that occurred in its vicinity).
Cultural value	National interest	A tree with a characteristic(s) so important that it is considered a vital component of a country’s stated cultural/conservation goals. These trees can also be recognized and included in exceptional tree programs at lower geographic scales such as states/provinces, counties, and municipalities.
Cultural value	Religious/spiritual value	A tree that is associated with religious and spiritual practices.
Cultural value	Legends and oral histories	A tree that is specifically mentioned as being associated with legends, mythical stories, and/or folklore.
Cultural value	Productive trees	A tree that was planted and/or preserved due to its use as a culturally important resource (e.g., food source, medicinal purposes, useful materials, etc.).
Form/structure/morphology	Form/structure/morphology	A tree that displays an interesting morphology due to ideal physical traits, unusual physical growths, or other characteristics that set it apart from other trees (both of the same and alternative species).
Form/structure/morphology	Unusual/curious growth form	A tree that has a unique physical form. Examples include fused limbs, trees growing along the ground/at an unusual angle, odd growths, or something else out of the ordinary.
Form/structure/morphology	Outstanding example of species	An exemplary tree that represents a species optimal form/structure.
Historical value	Remnant	A tree that represents the characteristics of a previously significant era (e.g., one that predates colonization), the work of a master artist, and/or possesses high artistic values. This includes, but is not limited to, tree lined avenues and areas where historically unique landscaping designs/styles are still visible.
Historical value	Historical value	A tree that is associated with a historical place, event, and/or date that had a lasting and important contribution to a given area (e.g., place, events, dates, etc.).
Historical value	Historic person/memorial planting	A tree that was planted for, by, or in association with a historically significant person. A tree can also receive this distinction if it was planted to commemorate an event, group, or institution of importance.
Historical value	Represented in historical documents	A tree that is mentioned or visually depicted in historical documents (e.g., sketches, journals, photos, etc.).
Historical value	Historical witness	A tree that has “witnessed” an important historical and/or cultural event. This can occur if a tree is located at the site of a notable event and/or was somehow a part of the acts that transpired.

Table 1. Continued

Category	Criterion	Definition
Landmark/location/ landscape	Landmark/location/ landscape	A tree that is visually dominant in the landscape and often contributes aesthetically to the local area. This type of tree can also be associated with various historical events that it continues to represent. The removal of such a tree would drastically alter the local area in a negative way.
Landmark/location/ landscape	Relic specimen	A tree that is a relic of a former ecosystem. For example, a species of tree that may have once been common in an area but now only a few individuals remain.
Landmark/location/ landscape	Collection/grove/ avenue	A grove or avenue (including an allée) of trees that are grouped together in close proximity to provide an exceptional example of the species.
Landmark/location/ landscape	Edge of natural range	A tree that represents the edge of its natural range for a specific area.
Landmark/location/ landscape	Unusual species for area/outside natural range	A species of tree that is outside of its natural ecological range and represents an unusual type of specimen for a specific area.
Landmark/location/ landscape	Unique location/ context	A tree found at an unusual location. An example of this would be a tree that is growing on a grave site.
Other quality	Other unique quality	A tree that possesses unique qualities or traits that creates value which is not already covered by the other criteria listed in the study above.
Size	Champion size—cumulative points	A tree that has the greatest point total for its species in a program's geographic region based on girth (diameter/circumference), height, and crown spread. This criterion is used to determine "champion" status by adding various metrics to achieve a cumulative point score for a specific species. For example, one common method used by the nonprofit *American Forests* is: "Trunk Circumference [inches] + Height [feet] + ¼ Average Crown Spread [feet] = Total Points", but this method can vary based on geographic region. If 2 or more trees of the same species have totals within 10 points of each other, "co-champion" status will be awarded.
Size	Champion size—category	A tree that represents the largest physical metric(s) for a species in a program's geographic region. This criterion is based solely on physical measurements such as height, diameter/circumference, and canopy spread. The "champion" title is awarded to the largest tree of each species in each of these 3 categories. A single tree can be the "champion" of multiple categories.
Size	Species-specific size	Size is used to compare physical metrics (height, diameter, canopy spread, etc.) only amongst trees of the same species to determine what is large. This helps to contrast the different physical metrics that various species can exhibit to more accurately show what is considered to be large. For example, a height of 100 feet or a diameter of 10 meters may be considered small for one species while very large for another.
Size	Nonspecific size	Size is used for the designation of an exceptional tree without listing a specific minimum threshold value.
Size	Program-specific/ nonchampion size	A specific size threshold is assigned to an entire exceptional tree program. It is not species-specific and applies to all trees being nominated. For example, all trees with a diameter greater than 5 meters would qualify.
Size	Growth conditions	A tree that has achieved sizable growth for its species in poor conditions. These conditions could be the result of climate or soil factors.

anonymity, survey iterations, and controlled feedback (Rowe and Wright 1999) to allow opinions to converge towards consensus through multiple iterations (Dalkey and Helmer 1963). Three survey iterations are commonly used in Delphi studies (Jones et al. 1992; Skulmoski et al. 2007). There are no minimum or maximum numbers of experts (Evans 1997), although 10 to 15 participants are generally considered to be ideal (Adler and Ziglio 1996; Skulmoski et al. 2007), and the selection of the expert panel uses a nonprobability snowball sampling technique (Keeney et al. 2006). Likert scales are used to obtain quantitative responses (Shah and Kalaian 2009; von der Gracht 2012) to produce a percentage of agreement value, which some have derived by combining the number of responses for the 2 upper Likert categories (Mcleod 2012; von der Gracht 2012; Stewart et al. 2017). Once a criterion reaches consensus, it can be removed from further discussion in the study (Stewart et al. 2017; Ritchie et al. 2021), and verification of the previous iteration’s findings takes place with the expert panel between survey rounds (Mcleod 2012; Ritchie et al. 2021). There is no set value for consensus in the literature (Keeney et al. 2006). This value is topic-dependent with medical decisions sometimes requiring 100% agreement (Keeney et al. 2006), while studies pertaining to environmental topics such as vulnerability and adaptation assessments might only require 70% (Mcleod 2012).

The Delphi method has been used to investigate exceptional trees (Lau et al. 2017; Ritchie et al. 2021) as well as urban forestry topics more broadly. For example, Wolf and Kruger (2010) conducted a Delphi study to investigate urban forestry research and technology transfer needs; Östberg et al. (2013) used this method to evaluate different tree parameters that have been utilized during tree inventories; while Barron et al. (2016) implemented the Delphi method to produce a list of identifiers that could be used to indicate urban forest health and resiliency.

Exceptional Tree Delphi Research Method

This research follows the 3-iteration Delphi methodology used by Ritchie et al. (2021). The initial survey was comprised of 45 exceptional tree selection criteria and 4 program components (protection mechanisms; public education and outreach; program funding; and best management practices) that were evaluated through the use of closed and open-ended questions. A 5-point Likert scale (1 = not at all important, 2 = slightly important, 3 = moderately important, 4 = significantly important, 5 = critically important) was used to evaluate the presented criteria. The combined Likert scale ratings for categories 4 and 5 were used to produce level of agreement values, which were then grouped into “percentage of importance” categories for each criterion, with $\geq$ 75% representing high importance, $\geq$ 50% to $<$ 75% medium importance, $\geq$ 25% to $<$ 50% low importance, and $<$ 25% very low importance (e.g., if a criterion received 50% for the significantly important category and 30% for the critically important category, its percentage of importance value would be 80%). Positive expert consensus was defined as any criterion achieving a percentage of importance value of $\geq$ 75%, while negative consensus was any criterion with a percentage of importance value of $<$ 25%. Criteria that achieved consensus (positive or negative) were omitted from future survey iterations, with positive consensus criteria being recommended for use in Hawai‘i’s Exceptional Tree Program, while negative consensus criteria should not. A confirmation of findings verification phase preceded each subsequent survey round to ensure the panel did not have any objections with the findings from the previous survey round and to provide an opportunity to suggest additional criteria, definition modifications, and content that should be included in the upcoming survey round.

Each survey iteration was designed to take approximately 45 to 60 minutes to complete. Thirteen exceptional tree experts were selected to participate in the study and were identified using a snowball sampling method to ensure that participants represented government agencies, nonprofits, private corporations, and community experts, all of which are important contributors to exceptional tree programs (Ritchie 2019). These experts were all from Hawai‘i and had at some point been a member of an AAC for 1 of the 4 counties.

The criteria used to select each expert was based on the following 4 components produced by Adler and Ziglio (1996): (1) knowledge and practical engagement with the issues under investigation; (2) the capacity and willingness to contribute to the exploration of a particular problem; (3) assurance from the experts that sufficient time will be dedicated to the Delphi exercise; (4) skills in written communication and in expressing priorities through voting procedures.

The study defined an exceptional tree expert as:

…an individual who has extensive knowledge about an exceptional tree program and its collective components. Examples of these experts may include exceptional tree committee members (Arborist Advisory Committee), academics, urban forestry department managers, directors of nonprofits and professional associations, etc.

RESULTS

Selection Criteria

The first survey saw a response rate of 100% with an average submission time of 17.9 days. The panel were presented 96 closed and 24 open-ended questions (survey questions for each iteration can be found in the supplementary materials repository: https://drive.google.com/drive/folders/1GkGWz-6Oy3FIIUmtHsKHTa60fpds8brZ). Of the 45 criteria examined, there were 21 high, 14 medium, 4 low, and 6 very low percentage of importance values (Table 2), amounting to 27 criteria reaching consensus, with 21 being positive consensus and 6 representing negative consensus. There were no objections to these results by the expert panel during the confirmation of findings stage.

The second survey once again had a 100% response rate with an average submission time of 21.6 days. The panel were presented 55 closed and 21

Table 2. Exceptional tree selection criteria percentage of importance values throughout 3 rounds. ≥ 75 = high importance, ≥ 50 – < 75 = medium importance, ≥ 25 – < 50 = low importance, < 25 = very low importance.

Criterion	Percentage of importance Round 1	Percentage of importance Round 2	Percentage of importance Round 3	Percentage of importance Final Values
Endangered	100.0	N/A	N/A	**100.0**
Rarity	100.0	N/A	N/A	**100.0**
Botanical/horticultural/arboricultural/ biological value	100.0	N/A	N/A	**100.0**
Indigenous cultural associations	100.0	N/A	N/A	**100.0**
Local significance	100.0	N/A	N/A	**100.0**
Landmark/location/landscape	100.0	N/A	N/A	**100.0**
Champion size—cumulative points	61.5	100.0	N/A	**100.0**
Specific species/species significance	92.3	N/A	N/A	**92.3**
Cultural value	92.3	N/A	N/A	**92.3**
Species-specific size	69.2	92.3	N/A	**92.3**
Social/community value	92.3	N/A	N/A	**92.3**
Ecological/habitat value	84.6	N/A	N/A	**84.6**
Significant environmental value	84.6	N/A	N/A	**84.6**
Remnant	69.2	84.6	N/A	**84.6**
Relic specimen	84.6	N/A	N/A	**84.6**
Aesthetics	84.6	N/A	N/A	**84.6**
Seed source/propagation stock	69.2	84.6	N/A	**84.6**
National interest	84.6	N/A	N/A	**84.6**
Religious/spiritual value	84.6	N/A	N/A	**84.6**
Legends and oral histories*	61.5	84.6	N/A	**84.6**
Historical value	84.6	N/A	N/A	**84.6**
Socio-cultural benefits	Introduced in R3	Introduced in R3	83.3	**83.3**
Resistant to disease/climate conditions	53.9	69.2	83.3	**83.3**
Economic benefits	53.9	76.9	N/A	**76.9**

Table 2 continued on next page

Table 2. Continued

Criterion	Percentage of importance Round 1	Percentage of importance Round 2	Percentage of importance Round 3	Percentage of importance Final Values
Productive trees	38.5	76.9	N/A	**76.9**
Outstanding example of species	76.9	N/A	N/A	**76.9**
Historic person/memorial planting	69.2	76.9	N/A	**76.9**
Represented in historical documents	76.9	N/A	N/A	**76.9**
Historical witness	69.2	76.9	N/A	**76.9**
Collection/grove/avenue	76.9	N/A	N/A	**76.9**
Champion size—category	76.9	N/A	N/A	**76.9**
Nonspecific size	76.9	N/A	N/A	**76.9**
Form/structure/morphology	53.9	46.2	75.0	**75.0**
Endemic	69.2	69.2	N/A	**69.2**
Biological heritage	69.2	61.5	66.7	**66.7**
Survivor tree	Introduced in R3	Introduced in R3	66.7	**66.7**
Other unique qualities	46.2	61.5	66.0	**66.0**
Oldest specimen of species in region	46.2	61.5	50.0	**50.0**
Growth conditions	38.5	69.2	41.7	**50.0**
Species-specific age	53.9	46.2	50.0	**41.7**
Nonspecific age	61.5	38.5	N/A	**38.5**
Unusual/curious growth form	23.1	N/A	N/A	**23.1**
Unusual species for area/outside natural range	23.1	N/A	N/A	**23.1**
Edge of natural range/localized distribution	23.1	N/A	N/A	**23.1**
Unique location/context	23.1	N/A	N/A	**23.1**
Program-specific age	15.4	N/A	N/A	**15.4**
Program-specific/Nonchampion size	7.7	N/A	N/A	**7.7**

* Originally titled “Legends/mythical/folklore value.” Modified to reflect expert consensus at the conclusion of the study.

open-ended questions. The 18 remaining criteria examined saw 9 high, 6 medium, 3 low, and 0 very low importance values, indicating 9 additional criteria achieving positive consensus. There were no objections to these results by the expert panel during the confirmation of findings stage. Additionally, in accordance with the study’s methodology (Ritchie et al. 2021), the remaining 9 criteria with medium (6) and low (3) percentage of importance values were scheduled to be removed from the third round due to having values < 70%. However, during the confirmation of findings verification phase that took place between the second and third survey rounds, members of the expert panel indicated that 7 of these 9 selection criteria should still be included for discussion and re-evaluation in the final round due to their perceived importance (“growth conditions,” “biological heritage,” “form/structure/morphology,” “oldest specimen of species in region,” “species-specific age,” “resistant to disease/climate conditions,” and “other unique quality”).

The final round of the survey had a 92% response rate with an average submission time of 17.1 days. The panel were presented 41 closed and 10 open-ended questions. The 9 criteria examined (7 recommended by the expert panel from the previous round and 2 additional criteria produced during the second round), saw 3 high, 5 medium, 1 low, and 0 very low percentage of importance values, indicating 3 positive consensus criteria. There were no objections to these results by the expert panel during the confirmation of findings stage.

Of the 47 selection criteria considered by the expert panel throughout this study (initial 45 criteria in addition to 2 more introduced throughout the study)(Table 3), 39 reached consensus. Of these 33 achieved positive consensus and are recommended for inclusion in Hawai‘i’s Exceptional Tree Program (see Table 4 for criteria definitions), whereas the 6 negative consensus criteria should not.

Table 3. Exceptional tree selection criteria percentage of importance values throughout the study based on criteria category. ≥ 75 = high importance, ≥ 50 – < 75 = medium importance, ≥ 25 – < 50 = low importance, < 25 = very low importance.

Criterion	Percentage of importance Round 1	Percentage of importance Round 2	Percentage of importance Round 3	Percentage of importance Final Values	Category
Aesthetics	84.6	N/A	N/A	**84.6**	Aesthetics
Oldest specimen of species in region	46.2	61.5	50.0	**50.0**	Age
Species-specific age	53.9	46.2	50.0	**50.0**	Age
Nonspecific age	61.5	38.5	N/A	**38.5**	Age
Program-specific age	15.4	N/A	N/A	**15.4**	Age
Ecological/habitat value	84.6	N/A	N/A	**84.6**	Benefits
Significant environmental value	84.6	N/A	N/A	**84.6**	Benefits
Socio-cultural benefits	Introduced in R3	Introduced in R3	83.3	**83.3**	Benefits
Economic benefits	53.9	76.9	N/A	**76.9**	Benefits
Endangered	100.0	N/A	N/A	**100.0**	Botanical/horticultural/ arboricultural/ biological value
Rarity	100.0	N/A	N/A	**100.0**	Botanical/horticultural/ arboricultural/biological value
Botanical/horticultural/ arboricultural/ biological value	100.0	N/A	N/A	**100.0**	Botanical/horticultural/ arboricultural/biological value
Specific species/species significance	92.3	N/A	N/A	**92.3**	Botanical/horticultural/ arboricultural/biological value
Seed source/propagation stock	69.2	84.6	N/A	**84.6**	Botanical/horticultural/ arboricultural/biological value
Resistant to disease/climate conditions	53.9	69.2	83.3	**83.3**	Botanical/horticultural/ arboricultural/biological value
Endemic	69.2	69.2	N/A	**69.2**	Botanical/horticultural/ arboricultural/biological value
Biological heritage	69.2	61.5	66.7	**66.7**	Botanical/horticultural/ arboricultural/biological value
Indigenous cultural associations	100.0	N/A	N/A	**100.0**	Cultural value
Local significance	100.0	N/A	N/A	**100.0**	Cultural value
Cultural value	92.3	N/A	N/A	**92.3**	Cultural value

Table 3 continued on next page

Table 3. Continued

Criterion	Percentage of importance Round 1	Percentage of importance Round 2	Percentage of importance Round 3	Percentage of importance Final Values	Category
Social/community value	92.3	N/A	N/A	**92.3**	Cultural value
National interest	84.6	N/A	N/A	**84.6**	Cultural value
Religious/spiritual value	84.6	N/A	N/A	**84.6**	Cultural value
Legends and oral histories*	61.5	84.6	N/A	**84.6**	Cultural value
Productive trees	38.5	76.9	N/A	**76.9**	Cultural value
Outstanding example of species	76.9	N/A	N/A	**76.9**	Form/structure/ morphology
Form/structure/morphology	53.9	46.2	75.0	**75.0**	Form/structure/morphol-ogy
Unusual/curious growth form	23.1	N/A	N/A	**23.1**	Form/structure/morphol-ogy
Remnant	69.2	84.6	N/A	**84.6**	Historical value
Historical value	84.6	N/A	N/A	**84.6**	Historical value
Historic person/memorial planting	69.2	76.9	N/A	**76.9**	Historical value
Represented in historical documents	76.9	N/A	N/A	**76.9**	Historical value
Historical witness	69.2	76.9	N/A	**76.9**	Historical value
Landmark/location/landscape	100.0	N/A	N/A	**100.0**	Landmark/location/ landscape
Relic specimen	84.6	N/A	N/A	**84.6**	Landmark/location/ landscape
Collection/grove/avenue	76.9	N/A	N/A	**76.9**	Landmark/location/ landscape
Survivor tree	Introduced in R3	Introduced in R3	66.7	**66.7**	Landmark/location/ landscape
Unusual species for area/outside natural range	23.1	N/A	N/A	**23.1**	Landmark/location/ landscape
Edge of natural range/localized distribution	23.1	N/A	N/A	**23.1**	Landmark/location/ landscape
Unique location/context	23.1	N/A	N/A	**23.1**	Landmark/location/ landscape
Other unique qualities	46.2	61.5	66.0	**66.0**	Other unique qualities
Champion size—cumulative points	61.5	100.0	N/A	**100.0**	Size
Species-specific size	69.2	92.3	N/A	**92.3**	Size
Champion size—category	76.9	N/A	N/A	**76.9**	Size
Nonspecific size	76.9	N/A	N/A	**76.9**	Size
Growth conditions	38.5	69.2	41.7	**41.7**	Size
Program specific/nonchampion size	7.7	N/A	N/A	**7.7**	Size

* Originally titled "Legends/mythical/folklore value." Modified to reflect expert consensus at the conclusion of the study.

Table 4. Definitions for Hawai'i's 33 recommended exceptional tree selection criteria. CES (cultural ecosystem services).

Category	Criterion	Definition
Aesthetics	Aesthetics	A visually impressive tree that stands out from others in the area. Exceptional trees with this characteristic often add an awe-inspiring component to the landscape. For example, this could be due to its representation of special size or age and form features in addition to others such as captivating flowers, seeds, leaves, and/or other aspects.
Benefits	Ecological/habitat value	A tree that provides significant benefits to organisms in the surrounding environment. An example would be a specimen that has large and/or old characteristics which can facilitate or support a large amount of life forms such as birds, bats, mammals, and even aquatic organisms should water collect in a crevasse.
Benefits	Significant environmental value	A tree that provides significant environmental benefits, usually in the form of ecosystem services such as carbon sequestration, stormwater runoff avoidance, reduced erosion, shading, reduction in the urban heat island effect, and pollutant removal.
Benefits	Socio-cultural benefits	A tree that provides significant socio-cultural benefits, generally in the form of CES. These benefits can be represented through aspects such as place-based knowledge/education and promotion of physical and/or mental wellbeing provided intrinsically by the tree. For example, the grove of 50 banyan trees along Bayan Drive in Hilo, Hawai'i.
Benefits	Economic benefits	A tree that provides significant economic benefits to a given geographic region, usually through ecotourism. An example could be an iconic tree that attracts visitors due to its historical, cultural, size, age, aesthetic, or other impressive traits.
Botanical/horticultural/ arboricultural/biological value	Endangered	A tree that is valued based on its endangered status worldwide. The International Union for Conservation of Nature's "Red List of Threatened Species" could be one resource for determining this.
Botanical/horticultural/ arboricultural/biological value	Rarity	A tree that is rare due to its infrequent occurrence worldwide.
Botanical/horticultural/ arboricultural/biological value	Botanical/horticultural/ arboricultural/ biological value	A tree that has unique or exceptional botanical, horticultural, arboricultural, or biological value. These trees are often a valuable source for future propagation efforts based on their genetic components.
Botanical/horticultural/ arboricultural/biological value	Specific species/species significance	A specific species of tree that is deemed to be of importance for a given program's area (e.g., 'Ōhi'a lehua [*Metrosideros polymorpha*] in Hawai'i).
Botanical/horticultural/ arboricultural/biological value	Seed source/ propagation stock	A tree that is an important source of seed or propagation stock.
Botanical/horticultural/ arboricultural/biological value	Resistant to disease/ climate conditions	A tree that is valued due to its ability to resist disease and/or exposure to climatic conditions over time. This could be applicable to specimens that are better adapted to a changing climate, particularly from a tree that provides significant socio-cultural benefits, generally in the form of CES. These benefits can be represented through aspects such as place-based knowledge/education and promotion of physical and/or mental wellbeing provided intrinsically by the tree.
Cultural value	Indigenous cultural associations	A tree of importance to indigenous cultures and/or associated with various indigenous events.
Cultural value	Local significance	A tree that is locally known as a key fixture within the community. The removal of such a tree can negatively impact the community through a change in aesthetics and/or loss of an iconic natural structure.

Table 4 continued on next page

Table 4. Continued

Category	Criterion	Definition
Cultural value	Cultural value	A tree that represents a wide range of cultural aspects and values which benefit a community or specific culture. This can include an association with past and current groups, such as a plant that was and remains a part of a specific group's culture. This tree can provide a sense of place for those in the local community, act as a fundamental component of a community's identity, etc.
Cultural value	Social/community value	A well-known tree that is prominent in the community and provides a connection for those who interact with it (e.g., memories associated with a tree or those that occurred in its vicinity).
Cultural value	National interest	A tree with a characteristic(s) so important that it is considered a vital component of a country's stated cultural/conservation goals. These trees can also be recognized and included in exceptional tree programs at lower geographic scales such as states/provinces, counties, and municipalities.
Cultural value	Religious/spiritual value	A tree that is associated with religious and spiritual practices.
Cultural value	Legends and oral histories	A tree that is specifically mentioned as being associated with legends and oral histories as depicted through stories, songs, dances, etc.
Cultural value	Productive trees	A tree that was planted and/or preserved due to its use as a culturally important resource (e.g., food source, medicinal purposes, useful materials, etc.).
Form/structure/ morphology	Outstanding example of species	An exemplary tree that represents a species optimal form/structure.
Form/structure/ morphology	Form/structure/ morphology	A tree that displays an iconic physical appearance, unusual physical growths, and/or other characteristics that set it apart from other trees (both of the same and alternative species). For example, the *Hitachi* monkeypod tree on Oahu.
Historical value	Remnant	A tree that represents the characteristics of a previously significant era (e.g., one that predates colonization), the work of a master artist, and/or possesses high artistic values. This includes, but is not limited to, tree lined avenues and areas where historically unique landscaping designs/styles are still visible.
Historical value	Historical value	A tree that is associated with a historical place, event, and/or date that had a lasting and important contribution to a given area (e.g., place, events, dates, etc.).
Historical value	Historic person/ memorial planting	A tree that was planted for, by, or in association with a historically significant person. A tree can also receive this distinction if it was planted to commemorate an event, group, or institution of importance.
Historical value	Represented in historical documents	A tree that is mentioned or visually depicted in historical documents (e.g., sketches, journals, photos, etc.).
Historical value	Historical witness	A tree that has "witnessed" an important historical and/or cultural event. This can occur if a tree is located at the site of a notable event and/or was somehow a part of the acts that transpired.
Landmark/location/landscape	Landmark/location/ landscape	A tree that is visually dominant in the landscape and often contributes aesthetically to the local area. This type of tree can also be associated with various historical events that it continues to represent. The removal of such a tree would drastically alter the local area in a negative way.
Landmark/location/landscape	Relic specimen	A tree that is a relic of a former ecosystem. For example, a species of tree that may have once been common in an area but now only a few individuals remain.
Landmark/location/landscape	Collection/grove/ avenue	A grove or avenue (including an allée) of trees that are grouped together in close proximity to provide an exceptional example of the species.

Table 4. Continued

Category	Criterion	Definition
Size	Champion size—cumulative points	A tree that has the greatest point total for its species in a program's geographic region based on girth (diameter/circumference), height, and crown spread. This criterion is used to determine "champion" status by adding various metrics to achieve a cumulative point score for a specific species. For example, one common method used by the nonprofit *American Forests* is: "Trunk Circumference [inches] + Height [feet] + ¼ Average Crown Spread [feet] = Total Points", but this method can vary based on geographic region. If 2 or more trees of the same species have totals within 10 points of each other, "co-champion" status will be awarded.
Size	Species-specific size	Size is used to compare physical metrics (height, diameter, canopy spread, etc.) only amongst trees of the same species to determine what is large. This helps to contrast the different physical metrics that various species can exhibit to more accurately show what is considered to be large. For example, a height of 100 feet or a diameter of 10 meters may be considered small for one species while very large for another.
Size	Champion size—category	A tree that represents the largest physical metric(s) for a species in a program's geographic region. This criterion is based solely on physical measurements such as height, diameter/circumference, and canopy spread. The "champion" title is awarded to the largest tree of each species in each of these 3 categories. A single tree can be the "champion" of multiple categories.
Size	Nonspecific size	Size is used for the designation of an exceptional tree without listing a specific minimum threshold value.

Program Components

The most significant findings from the study's open-ended questions can be found below and are organized based on the 5 program components examined (protection mechanisms; private property exceptional tree maintenance costs; funding; public education and outreach; and program management best practices). As some experts did not respond to all questions, the number of experts that provided feedback were identified when necessary.

Protection Mechanisms

The panel unanimously agreed (13/13 experts) that legal policies, regulations, and protections should be enacted to assist exceptional trees in Hawai'i. They stated that the current format of the program (i.e., each exceptional tree is protected unless it is a hazard to humans or property and/or no longer possesses the exceptional trait it was nominated for, requires a permit for pruning, retains its exceptional status even when a property changes ownership, etc.) works well, although enforcement of such laws and regulations needs to be effectively implemented. One expert suggested that AAC members could act as "enforcers" for the program; however, as the AAC relies upon volunteers and has minimal resources, this would be unlikely to transpire. Regardless of who acts as the enforcers of an exceptional tree program, it was made clear that one or more entities need to take the lead on promoting and protecting Hawai'i's Exceptional Tree Program to ensure its success. Specifically, county departments need to be involved in this enforcement process (i.e., Parks and Recreation/Division of Urban Forestry, Planning and Permitting, etc.) to improve the monitoring of known threats to exceptional trees. For example, whenever an exceptional tree is in an area scheduled for development/construction, the Department of Planning and Permitting should inform both the Department of Parks and Recreation/Division of Urban Forestry and the county's AAC. It was also advised that neighborhood watch and citizen forester programs should be approached to take on a supporting role to assist enforcement officers (i.e., Division of Urban Forestry staff).

Incentives vs. Penalties

Out of 12 experts, 92% (11 experts) felt that both incentives and penalties should be used to encourage

protective measures for Hawai‘i’s exceptional trees, although incentives should be the primary focus. Experts stated that a tax credit based on the average annual maintenance cost for an exceptional tree, produced from quotes provided by 3 different arborists, could be a useful incentive, which may also promote better periodic maintenance of these specimens which provide benefits to the community.

It was noted that the incentives currently associated with Hawai‘i’s Exceptional Tree Program need to be modernized, which could have the added benefit of increased promotion for the program if enticing enough. Specifically, updates should be made to the current $3,000 exceptional tree tax deduction to ensure that the incentive amount can adequately offset some or all of an exceptional tree’s maintenance costs.

Several examples of how penalties should be applied were provided by the panel. One expert felt that fines should be imposed and vary based on the act committed, such as “(1) careless chop down elimination of entire tree—fine is $6,000; (2) inappropriate pruning of tree from a noncertified arborist—fine is $2,500; (3)…if fines are unpaid, payment can be garnished from their income (tax or paychecks).” Another expert took this notion even further by stating that fines should be considered for those who intentionally neglect their exceptional tree(s). Others stated that fines should be based on tree value assessments/appraisals, with a specific focus on the factors that made the tree exceptional in the first place (e.g., if a tree had half of its canopy illegally removed, but it received exceptional status based on the aesthetics criterion, the fine would be higher due to this lost characteristic).

Enacting incentives and penalties for both property owners and developers were common themes, although many experts felt that incentives would be more impactful for property owners, while penalties would be more effective for developers. Out of 12 experts, 10 supported incentives for property owners, 5 were in favor of developer incentives, 5 supported penalties for property owners, and 7 were in favor of penalties for developers. Incentives could include maintenance assistance, tax incentives, rebates, and/or direct subsidies, while penalties may be seen in the form of fines, with one expert suggesting a monetary penalty amounting to 3 times the value of the exceptional tree that was removed. A different expert suggested that such an evaluation could be determined using “industry standard plant appraisal guidelines,” although no specific methods were proposed.

Conversely, penalties for developers “need to be higher and strictly enforced,” although it was noted that it “would be extremely hard to match the profits that the developer is going to make from the development of the land” and that implementing more substantial penalties for damaging or removing an exceptional tree could lead to fewer exceptional tree nominations. Incentives were suggested as a means to counter this potential nomination issue by generating public interest in the program through the provision of tree maintenance support and/or financial assistance.

A unique method to monitor and ensure the continued health of existing exceptional trees was provided by one of the experts. Their suggestion was that when a parcel of land containing an exceptional tree is sold, a certified plant inventory survey could be conducted. “If an existing Exceptional Tree is on the property, then the committee will be notified and action taken to verify that the tree will stay alive and healthy on the property. If a notable tree is on the property but not an Exceptional Tree, the new owner can decide to petition for the tree to be on the Exceptional Tree list.”

Finally, it was noted that special protections need to be afforded to exceptional trees during construction projects. These protections would go above and beyond currently established tree protection protocols to ensure that exceptional trees would be minimally impacted during construction activities.

Private Property Exceptional Tree Maintenance Costs

Out of 13 experts, 77% of the panel (10 experts) felt that maintenance costs for exceptional trees on private property should be covered by both the homeowner and government. Their reasons included that “the owner should have some investment in the tree” to keep them aware and engaged in the upkeep of their exceptional tree. Governmental assistance covering a percentage of an exceptional tree’s maintenance costs, awarding grants for property owners under a certain income threshold, and/or providing a tax credit (adjusted every 5 years to account for increased maintenance costs and/or inflation) were some suggested methods to provide exceptional tree maintenance support. Conversely, 2 other experts felt that the entire cost of maintaining an exceptional tree on private property should be incurred by the homeowner,

while another felt that a partnership between the government and a "watchdog organization" should be used.

Program Funding

Out of 12 experts, 83% of the panel (10 experts) agreed that Hawai'i's Exceptional Tree Program should receive funding through a multifaceted public/private approach led by the government (county, state, and federal), followed by the private sector, nonprofits, philanthropists, fundraisers, and funds collected from fines generated due to illegal activities affecting exceptional trees. This public/private funding model could also have the added benefit of introducing more stakeholders to Hawai'i's Exceptional Tree Program, which could increase participant involvement. The remaining 2 experts were not opposed to program funding but were concerned about what the funding would support (e.g., maintenance, resources for an AAC, etc.), how tree benefits would be quantified (i.e., potentially using the software *I-Tree* [USDA Forest Service, Washington, DC, USA] to determine ecosystem services), and if public tax dollars should be used for exceptional trees on private land.

Public Outreach and Education

There was general consensus that social media, websites, and community presentations should be the focus for exceptional tree public outreach and education programs. Community groups/nonprofits and the government (county and state) should collaborate on these initiatives, which could be highlighted on social media platforms such as Facebook, Instagram, and YouTube. Websites that contain a one-page exceptional tree fun facts document and exceptional tree maps could be used in combination with a social media presence to initiate outreach presentations. These presentations would be provided to community members, policy makers, and developers on a consistent basis to promote "everyday awareness of the exceptional trees program and the importance of trees in the urban and rural areas." Campaigns such as an "Exceptional Tree of the Week or Month" and monthly exceptional tree walking tours could also further inform the public about the existence of these trees. Finally, different demographics could be appealed to if radio (i.e., Hawai'i Public Radio) and/or TV programs (i.e., news stations) also promoted Hawai'i's Exceptional Tree Program. It was also suggested that a county's Department of Parks and Recreation/Division of Urban Forestry and AAC be tasked with educating property owners, developers, policy makers/politicians, and the general public about Hawai'i's exceptional trees to improve program awareness throughout the state.

Program Management Best Practices

The expert panel stated 11 program management best practices that should be utilized by an exceptional tree program in Hawai'i, all of which rely on an AAC being comprised of members that represent a "diverse group of backgrounds and knowledge." The first focuses on establishing a clear and concise set of criteria and nomination procedures to be used when selecting potential exceptional tree candidates. Second, several experts stated that there needs to be a current list of all exceptional trees in a county database. Third, laws and policies should focus on incentives, penalties, and a tree replacement program for removed or dead exceptional trees. Fourth, exceptional trees need to be monitored. This could be accomplished via annual inspections of each exceptional tree by a certified arborist to ensure they are alive, as well as to identify any maintenance needs. However, deciding who should pay for this maintenance is a contentious issue. Fifth, only a certified arborist approved by a county's AAC and/or Division of Urban Forestry using best management practices, such as those promoted by the International Society of Arboriculture (ISA), should be able to prune/maintain an exceptional tree. Sixth, outreach and education are essential components of an exceptional tree program. Seventh, increased collaborative efforts between stakeholders (i.e., arborists, developers, architects, etc.,) and improved communication with developers and government agencies (i.e., Department of Planning and Permitting) need to take place. Eighth, having an effective means of responding to community concerns and questions pertaining to exceptional trees was also stressed. This could also be improved through increased publicity efforts, accomplished by having a social media presence, informative maps, concise brochures, and facts sheets. Ninth, a long-term management plan should be produced for Hawai'i's exceptional trees. It was suggested that "people need to be 'visionaries' to expedite this long-term plan beyond their own lifespan," while also having procedures in place to prevent newly elected policy/decision-makers from being able to easily change the long-term management plan. Tenth, a portfolio of exceptional trees should be produced to assist interested individuals who wish to navigate the specifics of

Hawai‘i’s Exceptional Tree Program, with an emphasis on presenting examples that demonstrate each of the program’s selection criteria. It was noted that such a portfolio should be updated annually and include a clear definition of what constitutes an exceptional tree. However, the question of who would produce and maintain such a document was raised, something which the AAC would most likely need to decide. Finally, it was suggested that climate change risks pertaining to temperature, precipitation, drought/wildfires, and pests in Hawai‘i need to be researched. From this, ideal tree species could be identified and planted which might be able to better survive under future climate scenarios.

DISCUSSION

Selection Criteria

This study produced a list of 33 selection criteria that should be included in an Exceptional Tree Program in Hawai‘i. While this appears to be a substantial number of criteria, even if the consensus threshold was increased from ≥ 75% to 80%, 90%, and 100%, the number of high importance criteria for each would be 23, 11, and 7 respectively. This indicates a significant amount of agreement between the expert panel as to how exceptional trees in Hawai‘i should be identified. It is not surprising that many of the recommended exceptional tree criteria from this study are included within the 4 categories of *Historical Value*; *Cultural Value*; *Botanical/Horticultural/Arboricultural/Biological Value*; and *Size*, as these 4 traits are highly valued by exceptional tree programs elsewhere (Ritchie 2019; Ritchie et al. 2021). However, there were some interesting and somewhat contradictory aspects found that warrant further discussion.

Age

The lack of any *Age* criteria achieving a high percentage of importance was surprising, given that Hawai‘i’s current exceptional tree program uses age as one of its criteria. This inability by the panel to agree upon specific thresholds, concerns raised about time and resources required to implement certain age criteria, and the known difficulties associated with accurately determining a tree’s age have been found by others (Ritchie et al. 2021). This leaves the usage of exceptional tree *Age* criteria in a grey zone, where experts have noted their importance in an exceptional tree program (Ritchie 2019) but have to omit the inclusion of specific thresholds, shifting the onus of determining exceptional age onto the respective AAC or other review board. This appears to be a common problem for these programs worldwide, as the majority of case studies examined by Ritchie (2019) did not utilize specific age thresholds when *Age* criteria were part of an exceptional tree program.

Size

There were 4 *Size* criteria recommended for inclusion in Hawai‘i’s Exceptional Tree Program. Organized based on higher to lower percentage of importance values, these criteria were “champion size—cumulative points”; “species-specific size”; “champion-size—category”; and “nonspecific size”, and initially appear to contradict each other. However, exceptional tree programs that have multiple *Size* criteria do exist (City of West Hollywood 2006; Jim and Zhang 2013; Ritchie 2019; Minneapolis Park and Recreation Board 2024), suggesting that the use of the 4 *Size* criteria should be considered on a case-by-case basis, based on the knowledge of each species under review (i.e., if species-specific size thresholds are known for the species).

Endemic Status

The failure of the “endemic” criterion to achieve a high percentage of importance was also noteworthy, as this criterion is also currently used to identify exceptional trees in Hawai‘i. However, as this criterion was recommended during the program’s inception in 1975, this shift away from any endemic tree potentially receiving exceptional status could highlight a different direction the program is taking. For example, an endemic tree may have substantial value, but this status may act as supporting justification for a nominee to be awarded exceptional status, rather than the sole cause of it. Such a change could help to ensure that the stringent standards of Hawai‘i’s exceptional tree selection process are upheld by only recognizing truly exceptional trees. Furthermore, out of the 46 case studies examined by Ritchie (2019), Hawai‘i was the only exceptional tree program that explicitly stated “Endemic Status” as a selection criterion, showing that the use of this criterion is an exception to the norm.

Comparing Selection Criteria Findings with Other Exceptional Tree Research

It is interesting to note that all 16 of the exceptional tree selection criteria recommended by Ritchie et al.

(2021) reached consensus in this current study. This highlights the potential universal appeal that these 16 exceptional tree criteria may have regardless of geographic location or scale. Furthermore, it appears as if there may be a disconnect between the current exceptional tree selection criteria used by many programs around the world and those recommended by the expert panel in this study, as well as that of Ritchie et al. (2021). This disconnect can be seen when comparing these 16 consensus criteria identified in both studies to the criteria currently being used by many exceptional tree programs around the world (Ritchie 2019), which shows that 10 of these 16 recommended exceptional tree selection criteria were seldomly or never used by the 46 exceptional tree programs examined by Ritchie (2019).

This trend also applies to Hawai'i's 7 current exceptional tree selection criteria, as only 4 of these are included as part of the 16 criteria found by Ritchie et al. (2021). When comparing Hawai'i's 7 criteria to the 33 produced from this study, 5 of these are currently used by Hawai'i's Exceptional Tree Program, highlighting a potential need to re-evaluate the characteristics that comprise these trees. Future research replicating this study will be required to determine if this trend is conveyed elsewhere, including the greater number of consensus criteria observed at lower scales compared to higher ones (i.e., state/provincial vs. international). It is important to note that this study can be directly compared to that of Ritchie et al. (2021) as both studies used identical Delphi procedures, evaluated the same exceptional tree selection criteria, and did not share any of the same experts on their panels.

Program Components

Regulations and Enforcement

This study found that exceptional tree experts in Hawai'i see the value in a 2-pronged approach consisting of regulations and incentives to implement protection mechanisms that conserve exceptional trees. Both regulatory components and incentives have been shown to address tree loss (Ordóñez-Barona et al. 2021). Regulations are an important conservation mechanism (Stern 2006), particularly through strong ordinances which can lead to the preservation of nearly 75% of trees in areas where construction is taking place (Pike et al. 2021). However, the enforcement concerns raised in this study are not unique and have the potential to reduce the effectiveness of regulatory approaches (Clark et al. 2020) due to enforcement costs (Busbridge et al. 2021) and impracticality of implementation (Stern 2006). These issues can also be further exacerbated when government enforcement officers are unable to, or unwilling to, implement tree protection laws on private land (Ordóñez-Barona et al. 2021).

The inadequate resources allocated to urban forestry programs and conservation programs more broadly has been widely reported (Moskell et al. 2011; Driscoll et al. 2015; Busbridge et al. 2021), but this could be mitigated through collaborative efforts between urban forestry stakeholders which could lead to funding opportunities (Ugolini et al. 2015). Furthermore, enacting tree bond policies, as suggested by our expert panel, could assist in providing funds to protect trees and/or planting and maintenance efforts (Ordóñez-Barona et al. 2021), as tens of thousands of dollars could be provided to a local government if a tree isn't protected during construction projects (Hurley et al. 2018). The preemptive collection of financial collateral for tree bonds could also assist with enforcement efficacy, as all tree bond deposits are required in advance (Ordóñez-Barona et al. 2021).

Incentives

While stricter regulation, enforcement, and fines can assist with the retention of trees (Clark et al. 2020), incentives have also been noted as an important tree protection and retention mechanism (Maddison and Denniss 2013) that are preferred over penalties (Stern 2006), particularly by local governments due to reduced resource requirements, reductions in bureaucracy, less resistance from stakeholders, and an image of a less intrusive government (Ordóñez-Barona et al. 2021). This view applies to exceptional trees, as Britton et al. (2015) found that political support for "heritage trees" on public land was 93.5%, whereas this value was only 39.3% for private property (Britton et al. 2015), suggesting that incentives should be prioritized over regulations and their corresponding penalties to facilitate public participation and support.

Many different types of incentives can be used to retain trees in urban forestry and conservation programs more broadly. Free arboricultural maintenance and tax rebates have been proposed (Ordóñez-Barona et al. 2021), while others suggest a combination of monetary and social incentives (i.e., certificates, awards, etc.) could be used together to improve behaviors

around conservation needs (Stern 2006). Providing free arboricultural maintenance and tax incentives were identified by the study’s expert panel as ideal methods that should be used to protect Hawai‘i’s exceptional trees, although social incentives may also need to play a complementary role, as surprisingly few exceptional tree tax deduction claims have been made, with only 23 between 2011 and 2021 totaling $64,952.00 (Gary Suganuma, personal communication). These low redemption rates could be an indication that the tax deduction amount is insufficient to incentivize filing a claim, that the notarized documentation required is overly tedious, and/or exceptional tree owners are unaware that there is a tax deduction for maintaining trees on private property.

To help remedy this potential lack of awareness, advertising exceptional tree incentives should be a priority, as the outcomes could be more beneficial than increasing the monetary value of the incentive itself (Stern 2006). Hawai‘i’s Exceptional Tree Program has been highlighted as one of the world’s most innovative tree retention mechanisms primarily due to the state tax deduction offered (Ordóñez-Barona et al. 2021), however, with only 23 claims made over a decade, there is a clear need to further refine and improve the incentives offered by this program. Finally, similar to the private property tree retention methods identified by Clark et al. (2020), this research suggests a holistic view needs to be considered for Hawai‘i’s Exceptional Tree Program that would see tree protection mechanisms combined with increased education/outreach activities to foster public support with the aim of addressing the aforementioned regulatory and incentive deficiencies that currently reduce the efficacy of this urban forestry conservation program.

Public Outreach/Education

Urban forestry professionals have called for increased public participation (Baur et al. 2016) to foster awareness which could lead to positive views towards urban forest initiatives (Zhang et al. 2007). This is in agreement with the findings from this study which stated that social media, websites, and community presentations should be the focus of exceptional tree public outreach and education in Hawai‘i. There should be 2 distinct sets of documents when producing exceptional tree outreach content, with one designed for a homeowner and the other focusing on technical aspects that could be more applicable to professionals (Pokorny 1998). Our expert panel also suggested that a one-page exceptional tree “fun facts” document be produced to improve education and outreach activities, which is similar to what other urban forestry practitioners have recommended, the 2 most common being fact sheets and “how to” informational brochures (Pokorny 1998). Pamphlets, websites, videos, and workshops have also been recommended as useful urban forestry outreach methods (Driscoll et al. 2015), as well as activities designed to promote the benefits of urban forests, tree maintenance education, and hands-on involvement opportunities (Moskell et al. 2011), all of which should be considered by Hawai‘i’s Exceptional Tree Program. Facilitating direct experiences has been shown to produce a strong connection that can impact one’s view towards a given topic (Fazio and Zanna 1981) and could include events such as tours (Baur et al. 2016). Providing these opportunities to urban forestry stakeholders could improve their long-term engagement in urban forestry projects (Clark et al. 1997).

The expert panel also felt that nonprofits and government entities should collaborate on public outreach and education initiatives. Nonprofits can act as a catalyst that brings together research, policy, and urban forestry concepts, which is then disseminated through their education and outreach efforts (Konijnendijk and Gauthier 2006), while government agencies could interact with communities to foster behavioral changes and increased stewardship of urban forests (Ordóñez-Barona et al. 2021).

The benefits produced by an exceptional tree program must be effectively communicated and understood by relevant stakeholders (Britton et al. 2015). Using the public education and outreach recommendations produced from this study, in combination with those suggested by others, the effectiveness of this vital exceptional tree program component could be significantly improved.

Future Research

Future research should replicate this study at local, state/provincial, national, and international scales to see if a set of universally agreed upon exceptional tree selection criteria exists. These studies should also further investigate the exceptional tree program components identified in this study to unravel the interwoven complexities they share. These components should be viewed as a complex problem that requires

a holistic view to solve, as many program components impact each other, particularly public education and outreach, incentives and penalties, and funding opportunities.

CONCLUSION

This research represents one of the first systematic, peer-reviewed investigations of Hawai‘i’s Exceptional Tree Program, contributing new knowledge to a growing body of exceptional tree research, while also being applicable to urban forestry programs more broadly. The Delphi method was able to utilize the opinions and recommendations of 13 statewide exceptional tree experts to produce a list of 33 selection criteria that should be used to identify exceptional trees in Hawai‘i. Many of these criteria are the same as those suggested by others, prompting the possibility that a universal set of exceptional tree selection criteria may exist, although this study needs to be replicated in different geographic locations and at varying scales (i.e., municipal, state, national, and international) to confirm this. This study also identified 5 program components that are essential for an exceptional tree program in Hawai‘i, including effective protection mechanisms; increased public education and outreach efforts; program funding from a variety of sources; assistance with exceptional tree maintenance on private property; and the need to successfully implement identified program best practices.

Hawai‘i’s Exceptional Tree Program has been identified as an ideal urban forestry conservation program. However, as indicated by the expert panel in this study, there are significant improvements that need to be made to better protect Hawai‘i’s most majestic trees, which will require collaborative efforts from all relevant stakeholders if these trees are to be protected for generations to come.

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ACKNOWLEDGEMENTS

The authors would like to thank Dr. Brian Szuster, Dr. Dan Milz, Dr. Richard Criley, and Dr. Kent Kobayashi for their feedback throughout this study, as well as The Outdoor Circle for their support of this research by providing University of Hawai'i grant MA 5605093.

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Conflicts of Interest:
The authors reported no conflicts of interest.