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## Kauai's Urban Canopy Cover in County Parks

**Abstract:** The Tree Canopy Viewer was designed by the Division of Forestry and Wildlife and the U.S. Forest Service to understand current canopy cover and to determine the implementation of new and existing management plans. The question of how urban canopy cover could be expanded and with which species of trees was explored. Native species were defined as those that arrived to the Hawaiian islands through natural processes, while non-native were defined as those that entered the state through assisted introduction. Research indicated that urban canopy is important in community areas and that species specific trees are less important because of the overall benefit these trees provide.

### Introduction:

Trees provide critical infrastructure to communities. Their canopy provides ecological, economical, and human health benefits. Kauai is a product of a singular central volcano, Kawaikini. Land space on Kauai island is divided by weather patterns that occur as a result of this geography. Four county parks were selected to represent urban canopy on the different sides of the island. These public areas are used by community members who as a result benefit from the tree services. The purpose of this study is to analyze the current canopy cover in high use county parks and its potential for expansion with a focus on native and non-native tree species.

### Background:

The Tree Canopy Viewer (TCV) includes 13 layers of data. The viewer includes a statewide canopy raster layer (created using 1-meter resolution LiDAR and MAXAR Vivid imagery), providing a snapshot of canopy up to 2020. The Citizen Forester Program of Hawaii has worked to map individual trees statewide. This is done using the TreePlotter Inventory. Since the program is input by citizens and organizations, the comprehensiveness of the data can vary depending on the contributor. The county parks that were chosen were comprehensively mapped

with individual trees where the most amount of data was reported. These categories include an ID number, genus, species, tree condition, ecological benefits, and others.

The intention was to cross reference the data from TreePlotter and the TCV to determine how much of the canopy cover was really caught through the LiDAR and MAXAR imaging and compare it to the ground truthed data that identified species individually. While there is statewide data in each program, Kauai was determined to be the focus of this study as it is my primary residence. The ground truthing work could be vouched for since the locations were easy to visit.

The four chosen parks are Lihue County Park, Kekaha Gardens County Park, Lydgate Beach Park and Poipu Beach Park. Each represents a cardinal direction on the island. Lihue County Park represents the east side, Kekaha represents the west side. Poipu Beach Park represents the south side and Lydgate Beach Park represents the north side of the island. The canopy coverage in each area correlates to the weather in these locations. The orographic effect is responsible for this occurrence. Air from the windward side of an island collects moisture from the ocean. As this air with collected moisture is blown by regular tradewinds to the opposing side of the island, the leeward side the result is drier climate on the leeward side, (NOAA, 2018). Kekaha receives the least amount of water as it is on the leeward side. Poipu Beach Park and Lihue county park receive an intermediate amount of rain with the first and Lydgate Beach Park receiving the most amount of rain being closest to the windward side.

County parks were decided upon because they are public access areas and had tree species data gathered through the citizen forester program of Hawaii Tree Plotter Inventory. This data is complete for the selected areas. Data can be added to this tool through public surveys as well. These areas are highly utilized by the public for recreation, however, not all areas have equal tree canopy cover. All areas also do not have the same acreage.

In terms of canopy cover itself, two of these parks represent canopy coverage in coastal areas while two represent coverage in more inland areas. This relates to the species found in both areas and provides some depth to the study. For the purpose of this study native is defined as "...plants that came to the Hawaiian Islands by natural means such as jet stream air currents, on or in birds, or by floating to the islands borne by ocean currents," (Bornhorst et al., 2003). Common types of native trees found in coastal and inland areas in Hawaii include; Naio (*Myoporum*), 'A'ali'i(*Dodonaea*), Manele (*Sapindus saponaria*), and 'ohia (*Metrosideros polymorpha*) (Bornhorst et al., 2003). There are not as many 'native' trees as categorized by the

previously stated definition of native because it's difficult for tree seeds to naturally disperse this far. As a result, some consider the 24 Hawaiian introduced canoe plants to be native like the niu (*Cocos nucifer*), kou (*Cordia subcordata*), milo (*Thespesia populnea*), and kukui (*Aleurites moluccana*). Common types of non-native trees found in coastal and inland areas in Hawaii include; Ironwood (*Casuarina equisetifolia*), Monkeypod (*Samanea saman*), and Haole koa (*Leucaena leucocephala*) (Invasive Species Profiles, 2021).

Ironwood is considered by the Hawaii Department of Land and Natural Resources (DLNR) to be one of Hawaii's most invasive horticultural plants. It grows quickly and with a shallow root system that leaves it susceptible to falling. Ironwood can crowd out other vegetation in the canopy and at the forest floor through its dropped needles. As a coastal species, it can interfere with endangered sea turtle and seabird nesting (Hawaii Volcanoes National Park).

Methods:

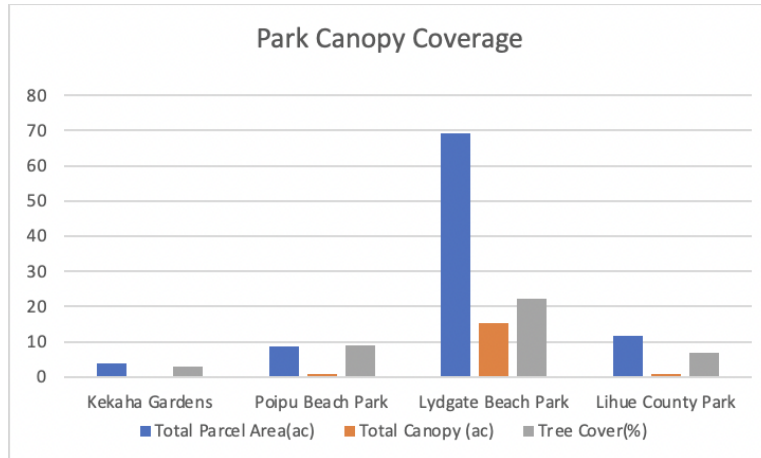
To determine the percentage of current urban canopy cover in the county parks, data from the TCW was selected based on the Tax Map Keys for the areas. Research was done to develop a species guide for the native and non-native trees present in Hawaii's canopy. Data from the Citizen Forester TreePlotter was then assessed to discern which species were present in these county parks as well as the amount of their associated ecological benefits provided. A species list and ID guide infographic was created for the community to identify urban canopy cover tree species in other community areas.

Results:

After the analysis of the following county parks; Lihue County Park, Lydgate Beach Park, Poipu Beach Park, Kekaha Gardens Park. The tree canopy in each area varies widely with the most prevalent trees being Ironwood. The county park with the most tree canopy cover percentage is Lydgate Beach Park.

Using the Hawai'i Urban Canopy GIS Data, the total tax map key (TMK) of the area analyzed was 175.816 acres, while the total canopy coverage in acres was 33.421 acres. The total tree canopy cover percentage was identified at 19.009 %.

The below graph illustrates the relationship between park acreage and canopy cover.



Ecological benefits associated were evaluated in the following categories; overall monetary benefit, carbon(lifetime), carbon(annual), air quality (annual), and stormwater (annual). Ecological benefits as outlined through the Treeplotter are, “Benefits are only calculated for trees with defined species, DBH, condition, and crown light exposure based on i-Tree research,”(Tree Plotter Inventory). The park with the most ecological benefits was Lydgate Beach Park.

Lydgate Beach Park had the most canopy cover and thus associated ecological benefits at a total annual monetary benefit of \$3,328.74. This park had a total parcel acreage of 69.34 with a total canopy of 15.39 acres. The tree canopy cover percentage was 22.19, making it the park with the most tree canopy cover. There were 743 plotted trees on the parcel. The top three most prevalent tree species were Ironwood, Coconut palm, and Beach heliotrope making up 80.48% of the plotted trees.

Poipu Beach park had the second most canopy cover and thus associated ecological benefits at a total annual monetary benefit of \$341.04. This park had a total parcel acreage of 8.72 with a total canopy of 0.79 acres. The tree canopy cover percentage was 9.12. There were 127 plotted trees on the almost 4-acre parcel. The top three most prevalent tree species were Coconut palm, Haole koa, and Fiji fan palm making up 65.8% of the plotted trees.

Lihue county park had the third most canopy cover and thus associated ecological benefits at a total annual monetary benefit of \$132.26. This park had a total parcel acreage of 11.67 with a total canopy of 0.82 acres. The tree canopy cover percentage was 7.01. There were

39 plotted trees on the parcel. The top three most prevalent tree species were Giant Crape Myrtle, Malabar Chestnut, and Monkeypod making up 57.89% of the plotted trees.

Kekaha Gardens park had the least canopy cover and thus associated ecological benefits at a total annual monetary benefit of \$40.41. This park had a total parcel acreage of 3.99 with a total canopy of 0.113 acres. The tree canopy cover percentage was 2.84, making it the park with the least tree canopy cover. There were 17 plotted trees on the almost 4-acre parcel park. The top two tree species plotted were Singapore Plumeria and Monkeypod making up 100% of the plotted trees.

#### Discussion and Conclusion:

The total canopy coverage acreage correlates to the total parcel acreage. The general trend was the larger the area, the more canopy coverage there is. Comparing the tree canopy from the TCV data to the individual species identification from the TreePlotter inventory data, it was determined that the most prevalent species of trees were non-native. Hawaiian introduced species were also present in each park. There was also a correlation between the amount of ecological benefit and canopy coverage. The larger the canopy coverage, the greater the monetary ecological benefit.

Some of the most populous non-native tree species were Monkeypod and Ironwood. These species made up the greatest percentage of urban canopy cover. Ironwood is mainly coastal and dominates the largest beach park, Lydgate where there are 244 identified Ironwood. Monkeypod trees were more populous in inland parks and were less populous in individual trees plotted, yet still made up significant canopy coverage percent because they are large shade trees. Lydgate Beach Park has the most monetary amount of ecological benefits because of all of the Ironwood. This indicates that while there is a higher percentage of non-native trees in these county parks, the trees that are present provide significant ecological benefits as well as community benefits in the form of shade, green space, and oxygen. Coconut palm, a Hawaiian introduced plant, was significant in numbers yet did not provide as much urban canopy coverage because of their canopy structure.

The results can be used to inform planning for the expansion of urban canopy coverage in county parks. A focus doesn't need to necessarily reside in planting more native trees, rather planting trees that provide significant ecological and community benefit and are well suited to the given ecosystem.

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