Urban Biogeography of Fungal Endophytes in *Metrosideros excelsa* in San Francisco

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What are endophytes?

Endophytes are microbial organisms, generally bacteria and fungi, that live symbiotically inside the leaves of plants (1). Inoculation experiments have shown that specific species of endophytes can have an impact on their host's overall health, including factors such as susceptibility to disease (1). In the wild, endophytic communities display remarkable species diversity, even among individual trees from the same species (3). In this study, we sought to document biogeographic patterns of fungal endophytes in an urban setting.

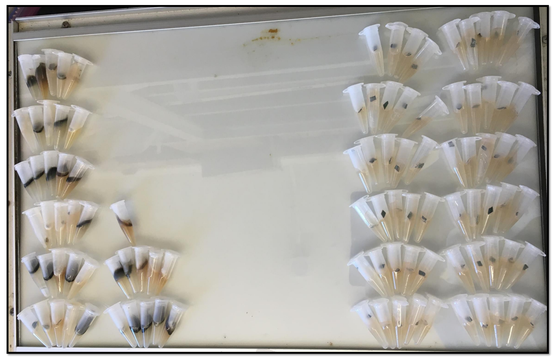
Tree Species Selection

Metrosideros excelsa was chosen because it is widely planted in San Francisco, and its endophytic communities in its native home of New Zealand have been well-studied (2). It is also closely related to *Metrosideros polymorpha,* a Hawaiian species whose endophytes have also been studied (3).

Site Selection

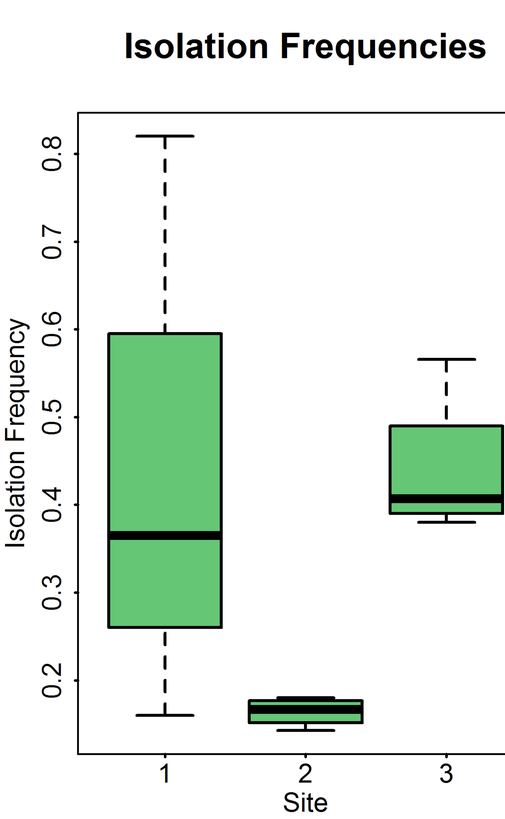
The Urban Forest Map was created by a nonprofit organization in an attempt to map and identify every tree in the city, which includes over 1,000 individuals of *Metrosideros excelsa.* We used this data, combined with temperature and traffic data from across the city, to select sites representing a variety of environmental conditions.

Maps courtesy of the Urban Forest Map website (https://www.opentreemap.org/urbanforestmap/map/).



Culturing Methods

We collected several branches from each tree and brought them back to the lab. We then surface-sterilized a subset of leaves with bleach and ethanol to kill off any surface microbes. Then we cut the leaves into small pieces and put them into slant tubes filled with malt extract agar. For each tree, we prepared 6 leaves and made 100 tubes. After two weeks, we evaluated them for fungal growth. For tubes that grew, we subcultured the fungi onto larger plates in order to better evaluate their morphotypes and accumulate sufficient tissue for future barcode gene sequencing and voucher preparation.



Balboa & 27th Avenue

High-traffic, moderate temperature, mid-elevation.

Montgomery & Merchant

Urban, higher temperature, low elevation.

Burlwood & Los Palmos

Low-traffic, lower temperature, higher elevation.

Results

The isolation frequency of foliar fungi differed significantly between the sites (Kruskal-Wallis $p < 0.05$), with Site 2 showing the lowest median isolation frequency. We also qualitatively observed different fungal morphotypes between sites.

What's next?

We will sample more trees downtown to confirm that this initial observation is robust. Further, we plan to sequence the Internal Transcribed Spacer (ITS) locus of these fungi, in order to better understand the correlation between endophytic species and urban environmental factors.

References

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