

Using Botanic Garden Collections to Augment Genetic Diversity For Conservation of *Brighamia insignis*

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Brighamia insignis - Courtesy of CPC web page



Brighamia rockii - Courtesy of CPC web page

Introduction

The combination of habitat degradation and the loss of natural pollinators has resulted in a drastic reduction in wild populations of *Brighamia insignis*. Only 20 individuals are known in the wild today. In an attempt to ensure the survival of *B. insignis*, the National Tropical Botanic Garden (NTBG) in Hawai'i is conducting manual pollination and collection of seed. The combination of rapid decline in numbers and small population size has resulted in a concern that insufficient genetic diversity exists to maintain a stable natural population. It has been suggested that one possible means of augmenting the genetic diversity in the wild would be through the use of pollen and seed from plants currently held in botanic garden collections. Using isozymes, Gemmill et al (1998), was able to show that the collections held at the NTBG were representative of the diversity found in the wild and would therefore serve as suitable stock population to augment natural populations. In this study, we have collected *B. insignis* tissue from a number of botanic gardens worldwide, including NTBG, and screened them using inter-simple sequence repeat (ISSR) markers in an attempt to quantify the amount of genetic diversity that is currently held in *ex-situ* collections. From this, we hope to determine the feasibility of using Botanic Garden collections to augment the diversity of natural populations.

Brighamia spp. (Cabbage on a stick)

The genus *Brighamia* is composed of two morphologically similar species *B. insignis* (Fig 1) and *B. rockii*, which are long-lived perennial members of the family Campanulaceae. Both *Brighamia* species are halophytic, sea-cliff dwelling, succulent plants (Gemmill, et al. 1998). The morphological features of *Brighamia* make it taxonomically unique (Lammers, 1989). One of their most distinguishing features is a large swollen unbranched stem which tapers toward the apex, supporting a crown of tightly packed leaves and auxiliary inflorescences of erect flowers (Lammers, 1989). Mature plants usually reach between 1-2.5 meters in height but have been known to grow in excess of 5 meters (Rock, 1919).



Fig 1: *Brighamia insignis* growing on the cliffs of Hawai'i. (Picture from Center for Plant Conservation (CPC) web-page)

Historically, both species of *Brighamia* occurred on four of the main highland islands of Hawai'i (Fig 2). Currently *B. insignis* is restricted to Kaua'i and Ni'i hau and *B. rockii* to Moloka'i (Gemmill, et al. 1998). In 1940 *B. insignis* consisted of 5 populations and only 40 total individuals. Current CPC estimates place the number of remaining *B. insignis* at 4 populations of only 20 individuals and *B. rockii* at 5 populations at less than 100 individuals

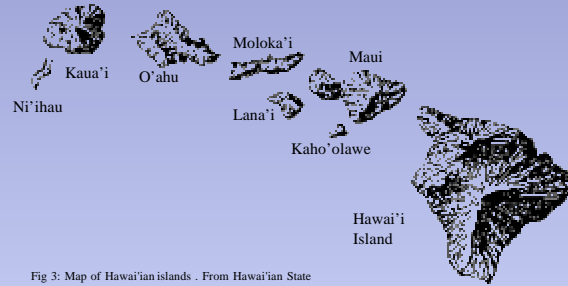


Fig 3: Map of Hawai'ian islands . From Hawai'ian State Park Web page <http://www.state.hi.us/dlnr/dsp/index.html>

Both species are federally listed as endangered (Federal Register, 1994). They are at risk of extinction due to the loss and degradation of their habitat, defoliation from feral goats, and competition from alien plant and animal species (Gemmill, et al. 1998). In 1992, the species experienced a near fatal blow when hurricane Iniki destroyed approximately half of the individuals from Na Pali Coast populations and a number of individuals of the Haupu area, both of which are on the island of Kaua'i (Perlman 1992; Steve Perlman, Hawai'i Plant Conservation Center, pers. comm., 1992).

Importance of Genetic Diversity

Genetic variability is thought by many to play an integral part in long-term survival and continued evolution of a species (Gemmill, et al. 1998). Genetic variation can buffer populations against selection pressures which arise from environmental change (Batista, 2001). A reduction of genetic variation can lead to inbreeding depression and an inability to respond to environmental changes. Therefore in order to properly design conservation strategies, we need to know the extent of genetic variability that currently exists in the wild (Batista, 2001). In genetically depauperate populations, deliberately augmenting genetic diversity can help to alleviate inbreeding depression and maximize genetic variation.

Materials and Methods

Brighamia tissue samples were collected from seven Botanic Gardens around the world, including National Botanic Garden of Belgium, Grun Stadt Zurich, Waimea Arboretum Foundation, National Tropical Botanical Gardens, The Zoological Society Of San Diego, the Botanic Garden Copenhagen and the Chicago Botanic Garden. DNA was extracted and analyzed using 5 ISSR primers. Each individual was run twice and only clear reproducible bands were scored.

Results

For this analysis, we compared the collection held at the National Tropic Botanic Garden in Hawai'i to a composite of individuals collected from Botanic Gardens around the world. *Brighamia Rockii* individuals were also compared to *Brighamia insignis*. All samples were scored for 14 polymorphic loci, each individual had a unique genotype. Within the *B. rockii* individuals, 6 of the 14 loci were polymorphic, compared to 12 polymorphic loci within the *B. insignis* samples from the National Tropical Botanic Garden in Hawai'i, and 14 polymorphic loci from collections of *B. insignis* around the world. Results from the AMOVA test show that 90% of genetic variability was accounted for within the National Tropical Botanic Garden collections, while the remaining 10 percent could be found in other additional collections.

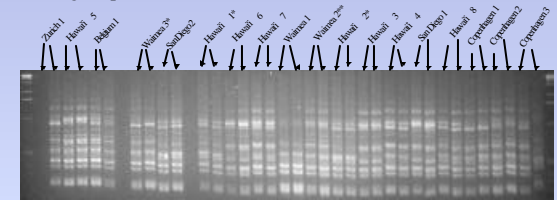


Figure 4: Example of Gel showing diversity at loci sites

Table 1:	
Zurich	Grun Stadt Zurich
Hawai'i	National Tropical Botanic Garden
Belgium	National Botanic Garden of Belgium
Waimea	Waimea Arboretum Foundation
San Diego	The Zoological Society Of San Diego
Copenhagen2	Botanic Garden Copenhagen
	*Denotes <i>Brighamia rockii</i> , ** Denotes <i>Brighamia hybrid</i>

Discussion

Although we are still in the process of collecting more data, our current results show that the individuals of *B. insignis* held in Botanic Gardens around the world may possess additional genetic variability. This additional variability could be used in augmenting natural populations for conservation purposes. We are currently waiting on tissue samples from natural populations in Hawai'i so that we can make a more direct comparison. Previous studies have shown that genetic variability in natural populations of *B. insignis* is low, which might suggest that collections will be a useful tool in augmenting genetic diversity in the wild.

Literature Cited

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