

**Spatial Analysis Report of two invasive species**  
**Himalayan Blackberry (*R. discolor*) and Giant Knotweed**  
**(*P. sachalinense*)**  
**found in Stanley Park**  
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## **Abstract**

We have prepared this project for two purposes; as a spatial analysis project mapping the land suitability for two invasive plant species in Stanley Park, and as a decision support tool to better inform control methods for eradication of two invasive species desired by the Stanley Park Ecological Society (SPES). We will indicate priority areas and needs for current and future species management activities to be undertaken by the SPES in the Park. Himalayan Blackberry (*Rubus discolor*) and Giant Knotweed (*Polygonum sachalinense*) have been introduced into the Lower Mainland and can be found throughout Stanley Park. These non-indigenous species are highly adaptive and have certain life history traits that increase their competitive ability to exclude native plants of the understory. It has also been suggested that dense thickets of these invasives have the ability to suppress seed germination and seedling growth of native tree species, which becomes increasingly important for forest regeneration in lieu of recent blow-downs causing high disturbance areas throughout the Park. We have personally collected sample point data from September to November 2007 using two GPS units. We have integrated these points of the invasive species found in the Park with existing feature data provided by the SPES to form interpretive maps; coverage maps of both species and land suitability maps for future spread based on a number of criteria. GIS software used included MapInfo, ArcMap and IDRISI Andes.

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## 1.1 Introduction

Non-native species of plants are introduced to sites by humans, and should they survive, may spread uncontrollably and outcompete native species in their natural geographic locations (Caplan, J.S., 2006). In Stanley Park, Vancouver, British Columbia, invasive species such as Himalayan Blackberry (*Rubus discolor*) and Giant Knotweed (*Polygonum sachalinense*) aggressively outcompete native species and establish themselves throughout the park. In December 2006, there was a severe windstorm that disturbed much of the Fraser Valley. This windstorm blew down masses of trees throughout Stanley Park, creating areas of severe levels of disturbance (Mitchell, S., 2007). Such natural phenomenon creates openings in ecological niches, where an abundant amount of nutrients become available to organisms. Nutrients become available through increased exposure to organic debris, light and moisture that would otherwise have been reduced due to dense forest canopy cover (Caffrey, J.M. et al, 1999). A concern in the park is that invasive species will crowd out native species, by establishing themselves within these new ecological niches.

## 1.2 Study Species

Both of these species thrive in moist environments, at low elevations, in disturbed areas; as such areas have increased insolation and nutrients. Understanding the ecology of these invasives is an integral part of eradication methods (Pojar, J. & Andy MacKinnon, 2004). *R. discolor* an annual species, whereas *P. sachalinense* is a perennial species (Beerling, D.J., 1993).

*R. discolor* and *P. sachalinense* propagate through disturbed habitats (Caplan, J.S., 2006). *R. discolor* reproduces both through seed production and through extensive root networks. Much of this species' resources and energy is expended towards reproduction. Seed filled berries are produced in high numbers in adult plants and dispersed by birds and other animals. This energy is achieved by *R. discolor* outcompeting other neighboring plant species, more effectively consuming available nutrients; water, nitrogen and light. (Caplan, J.S., 2006)

*P. sachalinense* grows in moist soils, often near fluvial channels, where its plant fragments disperse by being carried downstream (Caffrey, J.M. et al, 1999). This nuisance plant is very difficult to remove, as remnants of *P. sachalinense* stem sections and roots can re-establish themselves into a thriving plant. Recreational activities aid in the dispersion of this species, as fragments and seeds can be transported on tires, shoes, landscaping equipment etc. (Caffrey, J.M. et al, 1999). This species also reproduces by cloning from its extensive root network and through seed dispersion.

## 2.1 Methods

The first purpose of this study is to cartographically portray the spread of *Rubus discolor* and *Polygonum sachalinense* throughout Stanley Park using ArcMap, a vector based GIS software tool. Second, the project analysis was done in a Raster environment using IDRISI Andes. The resultant land suitability maps can later be used to determine priority plants to eradicate, in order to prevent further spread. These maps will also help to determine the **extent of spread** of these species throughout Stanley Park and the **sites most at risk** of being taken over by either of these species based on certain criteria outlined in section 4.1

Invasive species (Himalayan Blackberry and Giant Knotweed) along the recreational trails of Stanley Park were recorded with Garmin GPSmap 76 and Magellan eXplorist 500 GPS units. Data was collected off of all of the recreational trails of Stanley Park (including the Seawall). *Rubus discolor* (Himalayan Blackberry) and *Polygonum sachalinense* (Giant Knotweed) were recorded within view sight (approximately 10m) from the trails. Invasive plants found on the borders of landscaped areas and roads were infrequently recorded (Controlled environments).

Sample points were recorded with the GPS units, according to how the vegetation feature would be displayed in the GIS. Large masses of either species are most appropriately represented as polygons, so several sample points were taken around the vegetation masses.

## 2.2 Data Acquisition

*Waypoints collected by Garmin and Magellan GPS units* (explained in section 2.1)

*Ortho Photo* – taken in June 2007

Permission to use Spatial Data collected previously by the SPES (Stanley Park Ecological Society) This data was digitized in 2007 from the February 2007 orthophoto of the region.

*Stanley Park trail network*

*Stanley Park road network*

*Water bodies*

*Riparian Zones and ephemeral streams*

*Blowdown Areas* – survey data by Diamondhead Industry after January 2007 blowdown

### File Format

All data acquired from SPES was converted from .tab files (MapInfo software format) into .shp files using the MapInfo file conversion tool. Waypoints were imported as XY co-ordinates through Excel into a point layer in ArcMap.

### Projection

All data was re-projected in ArcMap using the geographic transformation tool in ArcToolbox into Transverse Mercator NAD\_83 UTM zone 10 projection.

### Modifying Collected Data

Buffers of varying sizes were assigned to the collected data points. The buffers' size depended on the extent of spread. Isolated individual plants or small plant clusters are represented by points with a natural 0.5 m buffer. 0.5 m was the chosen value to ensure all vegetative and root biomass was accurately accounted for. To represent significant sized clusters, points were chosen to have buffer of varying sizes surrounding them (1, 1.5 and 2m), based on the size of the plant cluster.

The collected attribute data was appendaged to the GPS point data, in ArcGIS. Further shp. files were derived from the attribute data (Himalayan Blackberry layers, Giant Knotweed layers, Canopy cover layers etc.)

### Importing into IDRISI

Shapefiles were initially rasterized by layer in ArcMap for import into IDRISI by ASCII format.

## 2.3 Attribute Data

While the spatial data was collected, surrounding attribute data for each point was also recorded;

- (a) % canopy cover (this impacts insolation and exposure to light),
- (b) Proximity to disturbed areas
- (c) Degree of the disturbance.

The proximity to disturbed areas would be a data point found to be within 50m, to an area that has been disrupted either by natural causes or anthropogenically. The extent of the disturbance was rated on four levels; high, moderate, low and none. These extents were determined based on how much of the forest canopy was removed, over what spatial area, and how severely the pedosphere was disrupted and how much debris was left behind. Soil type was assumed to be homogenous and continuous throughout the park; Ferro-humic Podzol.

### 3.1 Model Specifications

A MCE was applied to get a land suitability index individually for blackberry (figure 1) and knotweed spread (figure2). Certain areas of the park were considered unsuitable for spread (constraints) while all other areas represent an index of suitability based on the factors below (figure3).

*Constraints* – Boolean Images

Hydrological Features – Lakes, Rivers, Ocean

Developed areas – Roads, trails, buildings, landscaped areas

Stanley Park base map – An orthophoto of Stanley Park

*Factors* – in order of importance

1. *Species Coverage*

Larger patches will increase the frequency of animal foraging and increase the chance of seed disposal from host plants, than smaller patches.

2. *Proximity to disturbance*

Plants located in or near disturbed areas (within 50m) will have highest likeliness to spread further than those further away from disturbed areas

3. *Type of canopy cover*

The ability for these invasive species to spread is highly dependent on their ability to photosynthesize. Thus, more light availability would allow for faster reproduction. Blackberry is foliated year round. Zones of deciduous or mixed forest canopy will allow light down to the understory during the late fall, winter and early spring seasons. This increases resource availability for invasive species.

4. *Proximity to streams and water bodies*

Vegetative propagules and seeds can be transported via waterways.

### 3.2 Results

Figure 1 depicts the land suitability map for *Rubus discolor*. In this sensitivity analysis tan colored areas are the most suitable sites for dispersion of this species. Dark blue colored areas represent lowest suitability. As expected, heavier weighted factors (blow-downs and existing coverage areas) correspond with the areas of highest suitability. Water bodies and dense clusters of coverage were also found to increase the site suitability. Areas where no data was collected and where no invasives were found have the lowest suitability index.

Figure 2 is the land suitability map for *Polygonum sachalinense*. Highest suitability was found adjacent to water bodies and stream networks. Blowdown areas corresponded with moderate suitability for this species.

The coverage map (figure 4) represents the existing extent of spread of both invasive species. The denser clusters were on fringe areas, open areas, and close to waterbodies. Scattered points were found throughout the park along recreational trails. The current extent of spread of *Rubus discolor* far exceeds that of *Polygonum sachalinense*. From the extent of coverage map for *P. sachalinense* (figure 5), this species tends to grow under open canopy, near water bodies and fluvial networks.

### 4.1 Model Evaluation

## Model Limitations

*GPS inaccuracy* – Accuracy varied when sampling depending on cloud cover, forest cover and other environmental factors.

- Points were corrected with the aid of a high resolution orthophoto, and corrected accordingly.
- Sample points may not be consistently accurate when canopy cover was greater than 50%, due to accuracy limitations on 2-D locational correspondence with Landsat satellites.

*Sampling inconsistency*: inconsistency of sampling along road sides in park and landscaped

- We justified this shortcoming as roadways and landscaped areas are considered controlled environments because these areas are frequently visited by curators, tourists, motor vehicles, and risk of spread by animals is less likely.

*Factors and Constraints*: perhaps not all factors were accounted for. Four factors were chosen based on existing knowledge of growth criteria for *Rubus discolor* and *Polygonum sachalinense*

- Constraints like landscaped areas could still act as reproduction vectors. (ie. Seed banks could exist under grass areas) Water could also act as an avenue for vegetative spread.
- Other factors may influence the potential spread of invasives in the park. Wind, elevation, slope, differences in micro-environments, soil types. This data was considered but omitted due to it being unavailable.

*Weighting*: The weighting system used in the MCE analysis was based on knowledge, from the literature used in the research of this project and expert advice of reproductive strategies of *R. discolor* and *P. sachalinense*. The importance of each factor has a certain degree of subjectivity and is open for constructive criticism.

*Projection Misrepresentations*: In both of the MCE analysis maps a large area south of the lower lake is represented as highly unsuitable for the dispersion of these species. In this area no sample data was taken, as it was out of the extent of the research area. Also, this area does not fall within the MCE's factor criteria.

The canopy cover was based on attribute data points taken in the field. Due to this, we were unable to generate a complete forest canopy cover representation for the entire park. Exaggerations were made in the final coverage map, in order to make the smaller points more visible, at a smaller scale.

## 5.1 Discussion

The MCE models were determined based on the weighted factors listed in section 3.1; it is possible that other confounding variables may exist. The MCE models presented in this project are hypothesized projections of potential suitable sites. These sites may be different in the real world depending on nutrient quality and quantity, of which these models were indirectly based on.

From these models it is apparent that disturbed areas and areas near fluvial channels and water bodies are most suitable for the inhabitation of *R. discolor* and *P. sachalinense*. Monitoring these sites and eradication of invasives found adjacent to and at these sites is essential in allowing natural successive development among the native species.

The extent of spread of *P. sachalinense* exists mainly near fluvial channels and water bodies, with a relatively open canopy. This species effectively disperses along the side banks of fluvial channels, thus monitoring the downstream side banks is essential in ensuring that this species does not take over ecologically sensitive riparian zones.

## 5.2 Management Suggestions for Stanley Park Ecological Society

Sections of Giant Knotweed were found in few sparse sites over the entire park. Because this species effectively disperses via waterways, it would be advisable to look into the removal of this species at critical source sites; the small patches found at the intersection of Ravine Trail and Beaver Lake Trail, and the patch along the south-end of the Lost Lagoon bridge. Other areas of concern are the largest patches along Raccoon Trail, which are in close proximity to major blow-down areas. Large patches of *P. sachalinense* were also found near water networks, along the west side of the Sea Wall. This may suggest that this species prefers this side of the park to the east side because of the higher exposure to direct sunlight.

Himalayan Blackberry was found extensively throughout Stanley Park. There are many small *R. discolor* plants found (represented as single points) on many of the forest trails. There were almost always a few patches of this species found near blow-down areas. These smaller plants could be effectively eradicated, while they are still young. Large patches of this species should be at lowest priority of species removal, as they are already established and will require much more time and resources for eradication.

## 6.1 Conclusion

In the future, the invasive plant species studied in this project may become a problem by outcompeting indigenous species in certain suitable locations. Using existing knowledge of plant ecology can minimize the impact invasives can have on disturbed ecosystems. Of interest, is the potential of spread into recent large scale disturbances in Stanley Park caused by major windstorms in late 2006 and early 2007. The land suitability maps created (as a function of field data and multi-criteria analysis using existing spatial data of the region), can be used as management strategy tools for use in controlling the spread of invasive species in Stanley Park. The coverage maps created indicate priority areas to focus on, if eradication of these plants is desirable in the near future. For future invasive species study, additional criteria may be incorporated, or the weighting systems adjusted on the MCE framework laid out by this analysis.

## 7.1 Figures

Figure 1. Multi-Criteria Evaluation, Land Suitability Model for Himalayan Blackberry (*R. discolor*)

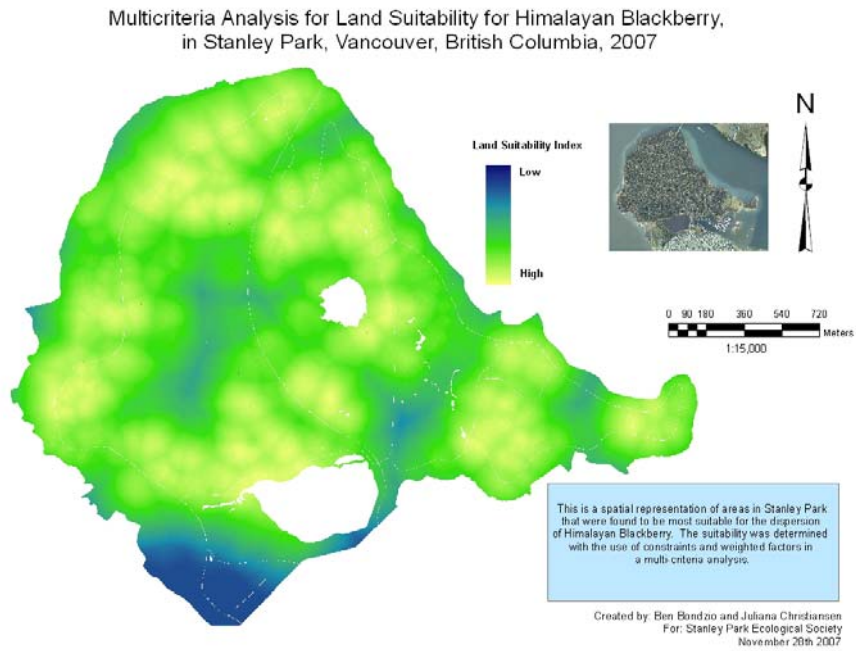


Figure 2. Multi-Criteria Evaluation, Land Suitability Model for Giant Knotweed (*P. sachalinense*)

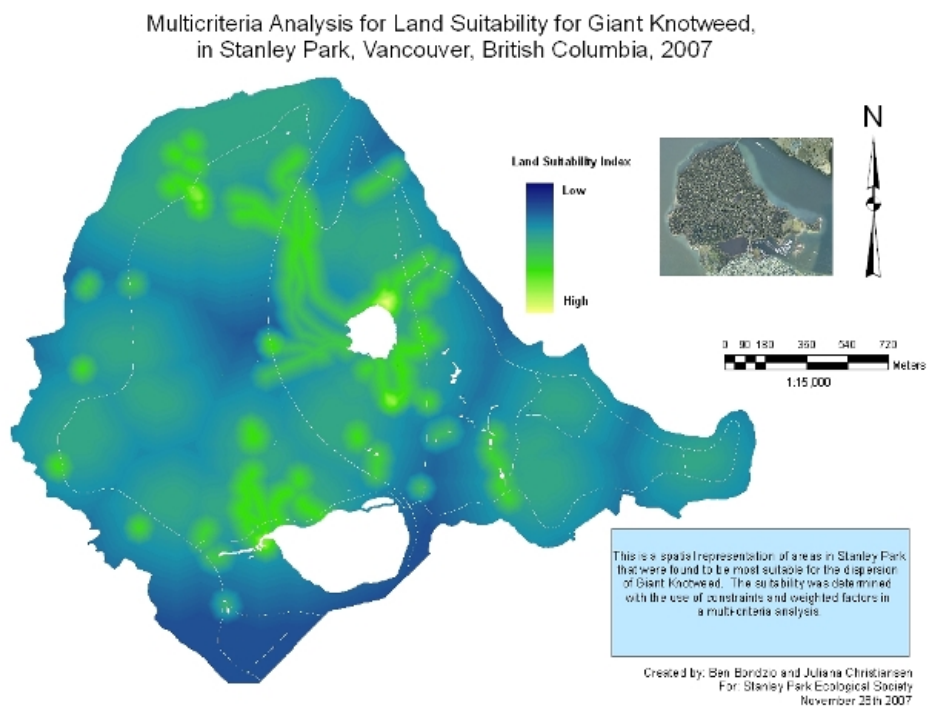




Figure 3. Multi-Criterion Evaluation, Factor and Constraints: Raster projection factors and constraints that were used in the MCE.

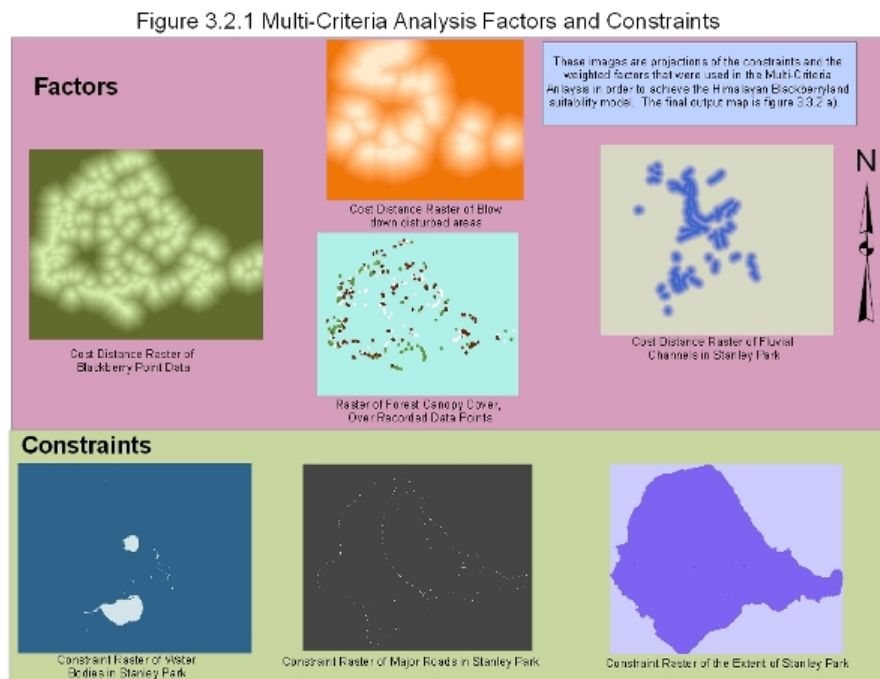
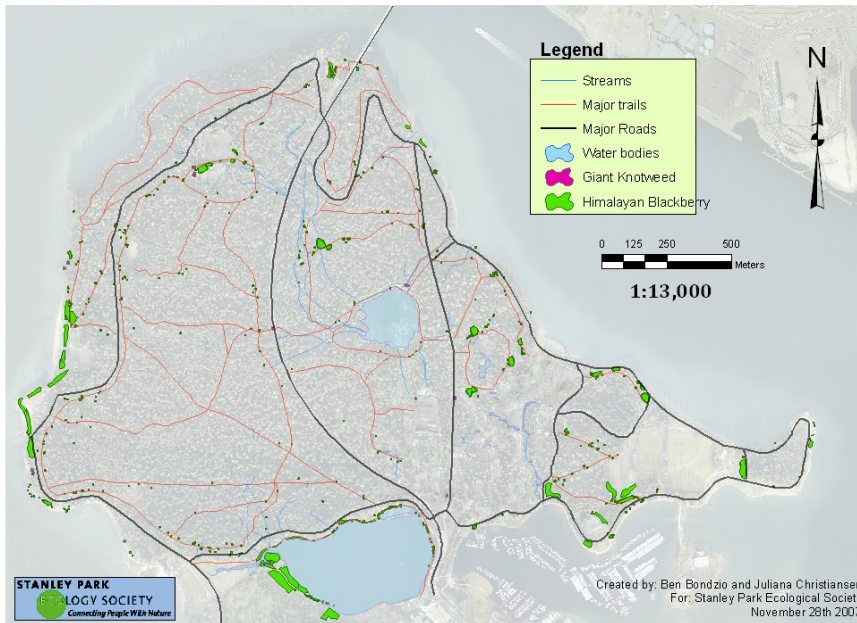


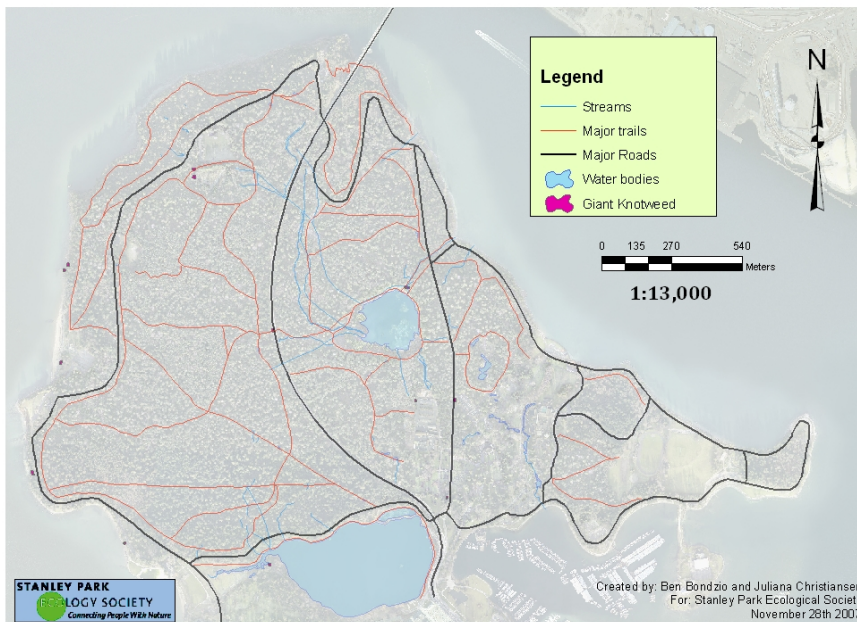
Figure 4. Spatial Extent of Spread of Himalayan Blackberry (*R. discolor*) and Giant Knotweed (*P. sachalinense*).

**Figure 4. Recorded Extent of Spread of Invasive Species; Himalayan Blackberry and Giant Knotweed Stanley Park, Vancouver, British Columbia, Fall 2007**



**Figure 5. Spatial Extent of Spread of Giant Knotweed (*P. sachalinense*)**

**Figure 5. Recorded Extent of Spread of Invasive Species; Giant Knotweed Stanley Park, Vancouver, British Columbia, Fall 2007**



## 8.1 References

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## Acknowledgements

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