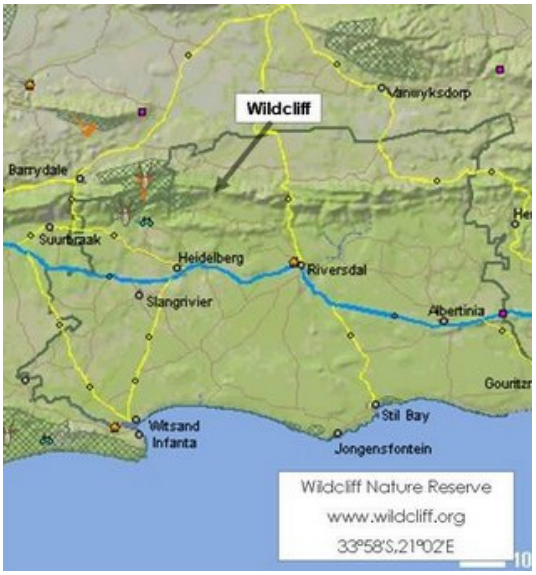
Proposed Research Project

Mapping Aliens at Wildcliff

Hanna Morgan
hanna@hillcountryconservancy.org



Wildcliff is a wilderness reserve along the Langeberg mountain range of the Western Cape in South Africa. It was purchased in 2007 by Ian and Jennifer Giddy on behalf of the Wild Cape Nature Trust for the purposes of conservation, restoration, research and education. The reserve consists of '955 hectares, deep kloofs with afro-montane forest, rocky mountaintops and high meadows of fynbos.' (Giddy, 2008)

Situated 17km north-east of Heidelberg, the reserve is centered at about 33º57'S, 21º2'E with elevations from 290m to 1130m. The boundaries lie between 20º58.9'E on the west to 21º3.0' on the east, and 33º58.5'S on the south to 33º55.9' at the northernmost point.

Introduction

Nestled at the southwestern tip of the African continent is an area known by biologists and like-minded professionals as the Cape Floristic Region. This area has flora, and to a lesser degree fauna, that is so starkly distinctive from that of the land immediately adjacent to it that it has spellbound naturalists from the time of its discovery by European explorers in the 16th century. It is considered one of the world's six floral kingdoms, and one of the richest areas of plants in the world. Covering less than 6% of the entire South African country, the flora of the Cape Floristic Region (CFR) comprises 44% of all South African species (Arnold & de Wet, 1993). The species diversity per geographical region covered is therefore unequalled, especially for an area in a temperate climate such as that of South Africa. To add to this, a large majority of these floral species are found nowhere else in the world.

The main component of the CFR is the Fynbos Biome, made up of ericoids, proteoids, restoids, and geophytes. These plants are readily recognized by the sclerophyllous (hard, tough and leathery leaved) and microphyllous (small leaved) nature of almost all woody plants. Their unique plant reproductive strategies, adaptability to fire, patterns of seed dispersal by insects, and patterns of endemism and adaptive radiation are of outstanding value to science. Although there are five biomes contained within the CFR, the fynbos contain the majority of the

floral diversity - almost 7,000 out of the 8,600 species. For this reason, the CFR is often considered 'essentially Fynbos.'

However, the fynbos and other unique floral communities of the Cape are under increasing threat of the persistent march of alien invaders. 29 of the native plant species have already become extinct largely as a result of the devastation caused by alien vegetation, and over 1,400 of the plants are considered by the South African Red Data Book as endangered. Given the size of their distribution, this is unusual and most likely also attributable to the fact that many of these species are extremely localized in their distribution.

Alien plants which infest large tracts of otherwise undisturbed mountains and flats have severe impacts on the native ecosystems in addition to these exceptionally localized flora species. In fact, invasive alien species are regarded as the second greatest threat to global biodiversity by scientists worldwide (IUCN, 1997), second only to habitat degradation and fragmentation. Since the Wildcliff Nature Preserve is a conservation area and not subjected to fragmentation or degradation, it could be deducted that the number one threat facing biodiversity conservation at Wildcliff is that of invasive alien species. A substantial portion of the preserve has been invaded by these plants, dominated by the Australian black wattle. Although not all alien plant species are aggressive by nature, the black wattle poses a significant threat to the watershed and the regions biodiversity. It intercepts rainfall, increasing the vegetation and biomass level, drying out the already scanty soils and even sucking the streams at sometimes.

Black wattles (*Acacia mearnsii*) are evergreen trees ranging from 5-10m high with dark green leaves, pale yellow or cream fragrant flowers, and dark brown pods with fine hairs. They were brought from Australia to South Africa in 1928 in hopes that it would provide fuel, building materials, and shade. By the time anyone took note of its aggressive nature, it had already spread to the Gxulu River and began suppressing the areas natural vegetation. A number of other invasive plants made their way into South Africa over the years as well, and almost all of them were deliberate introductions for purposes of agriculture, forestry, or even just shade.

Cluster Pine trees (*Pinus pinaster*) are also a problem at Wildcliff. These trees cover several hectares of the hill above Talari. They are considered a Category 2 invasive in South Africa's listing of Weeds and Alien Invasive Plants. Since these and other exotic plants have no natural enemies, they out-compete native species, allowing them to spread at alarming rates, impede the growth of natural vegetation, and destabilize the stability of the region through an increase in soil erosion and wildfires. Like the black wattle, many of them have a tendency to reduce ground water levels and dry up streams. Added to the severity of the situation is South Africa's dry climate and chronic water shortages. Working For Water noted that 12 million South Africans lack access to potable water, but these alien invaders manage to use 3.3 billion cubic meters more water than native vegetation annually.

A cluster of black wattles and pine trees at Wildcliff

Alien Vegetation Management at Wildcliff

Due to the threat of further infestation, the eradication of invasive alien plants has become a substantial and challenging undertaking as a part of Wildcliff's mission to restore the native landscape. Although the task is daunting and may take several years, managers, researchers and volunteers have been off to a commendable start. They have also teamed up with Cape Nature Conservation and the South African government's *Working for Water* program to develop and follow through with their removal. The primary focus is on the elimination of existing dense strands and halting any further spread of the wattle. They have already removed the extensive irrigation system remnant of the ranch which used to occupy a portion of the reserve, and chopped down two of the dense strands along the Heron Stream. Volunteers have also made efforts to remove seedlings and saplings in the less dense areas of the infestation.

The next step of the plan under development is to complete the vegetation mapping projects on the reserve. Alexander Dowding's research aimed to record and evaluate the distribution of the vegetation biomes in order to understand the spatial and temporal trends on the reserve using a geographical information system (GIS). A handheld Garmin GPS was used in the field to demarcate the boundaries of each habitat type and identify key native and invasive species within these areas. Dowding and others circumnavigated these areas using the GPS to establish their coverage, and then walked through them to identify key indigenous tree locations using the GPS. These point locations of trees included only those trees that were 1 meter or more in height and when multiple trees of the same species were encountered in close proximity one reading was taken in the middle of the group noting their approximate number. Currently the recordings of habitat boundaries are being converted into polygon shape files. Those of tree locations will be represented as a layer of point locations in the GIS. Points representing more than one tree will be taken into account by adding a field into the attribute table created by ArcMap for the shapefile. When a map is created to display the results of this project, these points will be weighted (with a larger point than the single strands) to represent their density.

An Invasives Mapping Project was also recently accomplished using Google Earth and supplementing the information gathered with GPS ground-truthing. This resulted in polygons representing areas of eradicated black wattle, areas of black wattle, and areas with a mixture of pine and black wattle. Eventually these datasets will be compiled with other spatial information to create a kind of 'before' map of the plants distributions prior to extensive eradication measures.

This GIS will serve as an important tool for the overall assessment and management of this program because of its capacity to store, manipulate, analyze and display spatial data with relative ease. Management of invasive species such as the black wattle are inherently dynamic and spatial problems – new infestations are likely to arise, some areas of previously mapped infestations have already been eradicated, and density will almost certainly change gradually.

Objectives and Methodology:

The primary aim of my involvement in the invasive eradication process is to continue other's efforts to remap, monitor and interpret the changed alien vegetation coverage as the eradication process alters the vegetation mix at Wildcliff.

It is my hope that taking advantage of alien plant inventory information and GIS information will allow for accurate analysis of invasive plant management needs. This could also enhance the time and effectiveness of invasive plant management actions taken. Data stored in the GIS can also serve as a baseline for long-term monitoring and assist with the evaluation of changes in exotic plant populations over time or the detection of new plant infestations.

My work in regards to this project will vary depending on the needs of the conservation managers at any point in time, but some of the other tasks I hope to complete include the following:

- Immediately start work on creating an up-to date shapefile displaying the current distribution of Australian black wattle at Wildcliff to ensure a high temporal resolution of data for future analysis.

- Create a spatially explicit dataset and map depicting the density class of invasive vegetation cover. 7 density classes are likely be used, based on aerial canopy cover; 0.1–1%, 1–5%, 5–25%, 25–50%, 50–75% and 75–100%.
    - Depending on issues such as accessibility, this will either be done using satellite photos (which are generally either too expensive or the resolution is too course) or by creating a grid and taking GPS point data where possible.
- Assess specific needs for and subsequently collect data regarding the environmental conditions immediately surrounding large strands of the invasive plants. This may include a variety of maps designating areas that are critical to the health of the ecosystem. For example:
    - A map showing the distance from invasive boundaries to other species of heightened conservation interest or those with high levels of sensitivity.
    - Data layers depicting distance to the nearest water source (possibly merely by creating graduated buffer areas around wetlands)
- Format a template base map for use in future invasive management maps. Predefined colors and orientation are desired for uniformity in presentation. Layers should depict:
    - Weed infestations by species
    - Topographic features
    - Man-made features including the residence buildings on the preserve, power lines, and possibly the previous location of the agricultural irrigation system
    - Vegetation classifications
    - Wetlands
- Develop a simple weed management database which can be used to help chart progress and serve as a visual and statistical aid for future planning. Databases give uniformity to data entry, better organized information storage, and easy retrieval of data. They can be used to monitor spatial and attribute data about invasive species occurrence, infestation trends, and their management treatments.

Conclusion

Much of the data in any information system is constantly growing and changing, and this is undeniably true also in alien vegetation eradication programs. Alien cover will be checked on a quarterly basis (or whenever efforts have been made to eradicate particular species), and each monitoring cycle means a new set of data.

With the invasives GIS at Wildcliff, managers will be able to view (in layers) areas of treatment, current distribution of invasive plants, and historical distribution of invasive plants (most likely in 6 month occurrences). A robust database separate from the GIS layers will also be used for maintaining tables of vegetation data so that maps can be created to depict vegetation density, etc.

Using GIS and geodatabase technology, an assessment of the history of spread, present distribution, and risk of spread can be viewed explicitly in order to assist managers in identifying areas requiring proactive intervention. The spatial arrangement of invasive species on the reserve is of primary concern to managers in order to locate possible foci of dissemination. GIS analysis interrogates species distribution and abundance patterns, providing the means to assess areas of concern. Maps will also provide information showing the success of the treatment efforts at Wildcliff.

References Cited

Giddy, 2008
Weeds and Alien Invasive Plants
IUCN, 1997
Arnold & de Wet, 1993
Alexander Dowding's research