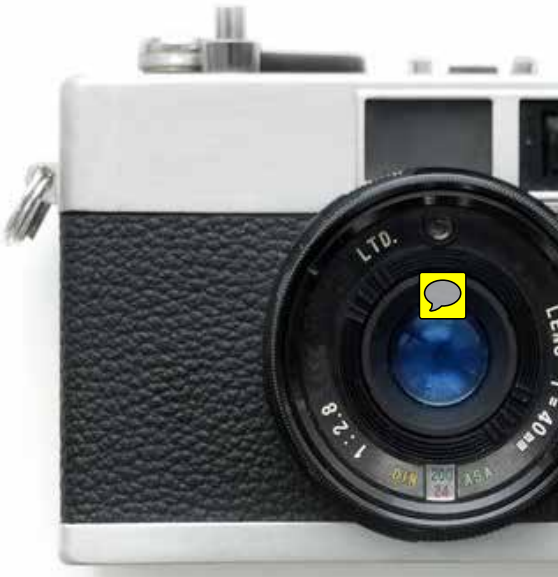
The camera never lies



Using repeat photography to document forest change in Table Mountain National Park

by **Zoë C. Poulsen** and **M. Timm Hoffman**, Plant Conservation Unit, University of Cape Town

Indigenous forests cover only 0.56% of South Africa's total land area. They have a highly fragmented distribution extending in an archipelago of patches from the southern tip of the Cape Peninsula through to Limpopo in the north. South Africa's forests are among the most species-rich temperate forests worldwide, with diversity increasing across the country in a south-west to north-easterly gradient. The forests of Table Mountain National Park are therefore relatively species-poor and in consequence often neglected in research and conservation planning.

Despite this they are considered to be of high conservation importance and are home to several endemic species, including two species of moss, numerous arthropods and the Critically Endangered Table Mountain Ghost Frog. Table Mountain National Park is home to two different types of forest: Western Cape Afrotemperate Forest and Western Cape Milkwood Forest. The latter is confined primarily to the coastal zone.

Forests and fire

In the Cape Floristic Region (CFR) forest occurs primarily in fragmented patches between fynbos. Western Cape Afrotemperate Forest forms the majority of forest cover on the Cape Peninsula and it is most commonly found growing inland in areas sheltered from fire where there is high moisture availability, such as rocky boulder screes and adjacent to streams in mountain kloofs. Western Cape Milkwood Forest has much lower species diversity and is found in scattered patches along the coastline growing on deep sand dunes where groundwater seeps are present.

Unlike the neighbouring fynbos vegetation, forest is highly sensitive to fire and will only burn under exceptional circumstances, such as during periods of high summer temperatures accompanied by strong winds or after prolonged drought. Areas of forest will naturally expand and contract in size through time according to the intensity and frequency of fires in adjacent fynbos which burn the forest margin. If fire is excluded from an area for a protracted length of time, forest will expand and colonize adjacent fynbos. Several researchers have expressed concern that in areas of the Peninsula where urban development has restricted the spread of fire, forest has 'invaded' to the detriment of species diversity in Peninsula Granite Fynbos. In contrast, it is also feared that increasing fire frequencies as a result of changing climate are likely to cause areas of forest to shrink. More research is thus needed.

Historical distribution of the Peninsula forests

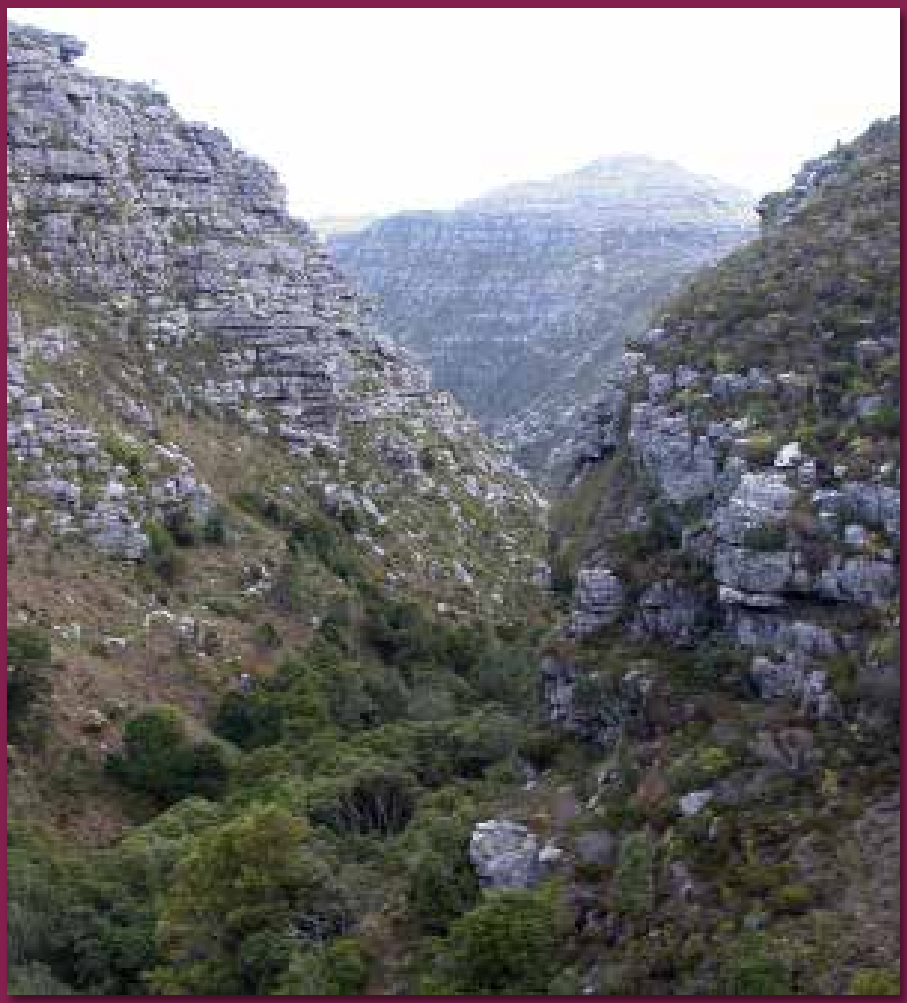
There has been considerable debate in the literature about the extent of forest exploitation after Van Riebeeck arrived at the Cape in 1652. Available evidence of forest distribution on the Peninsula prior to 1800 is highly contradictory and patchy in nature. It was widely believed by earlier authors that the contemporary scattered fragments of forest on the Peninsula are remnants from far more extensive areas. Van Riebeeck wrote of a swathe of forest extending from Orange Kloof on the southern slopes of Table Mountain all the way down to the shores of Hout Bay. It has been suggested that this forest was cleared in the first 50 years after colonial settlers arrived at the Cape in 1652. While there is not much evidence to support this view, it has been widely perpetuated in the historic and scientific literature.

In 1699 Adriaan Van Der Stel stated that the Peninsula forests contained no more usable timber. In 1772 Thunberg wrote: 'There are no forests in the vicinity of the town, except a few small ones high up in the clefts of the mountain'. It is easy to conclude from this that extensive deforestation took place, but other authors have made the point that detailed scientific information of sufficient temporal depth is not available and it is impossible to tell how extensive the Peninsula forests were in the past. Available descriptions of the early vegetation of the Cape are very sketchy and limited to vague accounts written by sailors while en route from Europe to the ~~West~~ Indies. Current knowledge of forest and fynbos ecology suggests that some earlier authors may have misinterpreted the historical evidence to reach the wrong conclusions. We will probably never know whether Van Riebeeck's suggestions that there were extensive swathes of forest on the Cape Peninsula in the 1600s are true or simply the effect of 'Chinese whispers' down the ages.

The detective work begins: Using repeat photography to measure change

Repeat photography is a powerful medium that can be used to document environmental change through time and was harnessed as the main tool in this project. We set out to try and answer some of the many questions surrounding the past and present extent of the Peninsula forests, as well as trying to elucidate why these changes are occurring in the context of forest and fynbos ecology. This study used both aerial and ground-based repeat photography to document changes in forest distribution over time. Repeat photography can be defined as locating the position of where an existing photograph was taken, occupying the same site and taking a new photo to create a photo pair of the same view.

We sourced our original images from a variety of sources, but a number came from the photographic archives of the Mountain Club of South Africa as well as the ~~National~~ Archives. Our results showed that indigenous forest cover on the Cape Peninsula has increased by more than 65% since 1944. There was also a significant increase



TOP: Original photo by Cameron from the Mountain Club of South Africa Archives (c. 1900) looking down Disa Gorge on Table Mountain south-west towards Grootkop. The vegetation in the kloof is dominated by riparian shrubs.
ABOVE: Repeat photo showing the same view in 2011. Forest cover has significantly increased in the kloof and is dominated by moisture-loving forest taxa such as Cape Holly *(Ilex mitis)* and Rooiels *(Cunonia capensis)*. Photo: Zoë C. Poulsen.

in the number of patches of forest over the same time scale from 149 to 174. With the exception of one other study (Luger & Moll, 1993) this is the first time that such high rates of increase in forest extent have been recorded in South Africa. The highest rates of increase occurred in Blinkwater Ravine and Orange Kloof on Table Mountain owing predominantly to long-term fire exclusion at both of these sites. Statistical modelling showed that local variation in forest patch size, mean annual temperature, rainfall and geology explained the main differences in the rate of forest patch change. However, the analysis only explained 39% of the change that had taken place. It is therefore also important to consider the past effects of fire and other landscape changes.

Further clues from the historical literature

The landscapes of the Cape Peninsula have a long history of human-induced fire. The Khoisan who inhabited the Cape prior to the arrival of the first European colonists burnt the veld to increase yields of bulbous plants such as watsonias which were eaten as a high carbohydrate food. Regular veld burning continued long after the European settlers arrived although its purpose changed to being a tool to increase forage yields for livestock. However, this was a controversial practice and in 1687 a law was passed which forbade the setting alight of pastures without prior government permission. Penalties for contravention were harsh: a 'severe scourging' on the first offence and death by hanging on the second. Despite this, veld burning continued unabated and fire frequencies of 1–3 years were reported to the severe detriment of the natural environment and vegetation.

In 1924, the prominent botanist Neville Pillans wrote: 'Forest has been greatly reduced by the ravages of fires. Formerly every ravine was clothed and most mountain streams were bordered with belts of trees. At present most streams take their course between bare banks where charred stumps of trees are continually being reduced along their margins'. Furthermore, in 1930 Adamson and Salter suggested that: 'The vegetation has been much modified by fire....trees and shrubs have been much reduced in numbers. Forests have been very much reduced in area'.

This and other evidence from both historical literature and repeat photography suggests that the changes observed in the distribution and extent of the Peninsula forests are at least in part driven by a long-term human influence on the landscapes of the Cape. High frequency veld burning for agriculture depleted the

TOP: Original photo by Elliot from c. 1900 looking in a north-westerly direction across Table Mountain. Vegetation comprises forest in patches and along drainage lines, within a matrix of fynbos vegetation with a high grass component. Photo E5451 from the Elliot Collection (Western Cape Archives and Records Service).

ABOVE: Repeat photo taken showing the same view across Orange Kloof on Table Mountain in 2011. There has been significant expansion of forest cover into the adjacent fynbos vegetation and the boundaries between forest and fynbos are now less well-defined. The surrounding fynbos vegetation now has a far greater shrub component and grass cover has significantly decreased. Photo: Zoë C. Poulsen.

extent of forest and changed the structure of the surrounding fynbos vegetation. Findings from the repeat photography dataset show a significant increase in the height of vegetation and shrub cover in the Peninsula's fynbos vegetation. This further supports the idea that the observed changes reflect a recovery of the forests after their degradation and depletion through too-frequent fires.

Now urban development dominates the lowlands of the Peninsula, meaning that fires are unable to travel through the landscape as they would have done in the past. Some areas such as Orange Kloof and Kirstenbosch have now effectively become 'fire shadows' that never burn for decades at a time. This has led to the widespread expansion of forests on the Peninsula.

The way forward

This detailed record of the changes in distribution of the Peninsula forests through time has significance for the management of the Table Mountain National Park particularly in terms of the importance of fire. The increase in forest cover throughout the park as a result of fire suppression may have implications for biodiversity of other vegetation systems in the reserve, particularly that of Peninsula Granite Fynbos. It is critical that further research is undertaken to further understand the impacts of these findings, particularly in the face of changing climate.

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READING

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