Spatial information and the study of plants in South Africa

Plants in space

by **Les Powrie,** National Botanical Institute, Kirstenbosch Research Centre

Ha! That title caught your attention! No doubt it engenders in your mind the image of plants drifting in the vastness of the Universe. Well, this they do, but they are firmly rooted on a substrate on planet Earth. It surely would be exciting doing research on plants in a space station, but that would then be studying plants in outer space, not in space as I have in mind. The space to which I refer is that which describes the location of, or 'where' a plant occurs.

Each plant occupies space. The roots penetrate the soil and the aerial parts explore the air or water above the substrate. They are exposed to influences of climate, soil, water, atmosphere and physical impacts. In the National Botanical Institute we have made use of sophisticated GIS (Geographical Information Systems) as a tool for describing the space that the plants occupy.

The use of spatial information, sometimes using GIS, has been part of the study of plants in South Africa since about 1497 when the sailors who approached the shores of the Cape of Good Hope used the presence of *Ecklonia maxima*, the kelp growing off our coast, to indicate that they were approaching the Cape. As early as

ABOVE: View of the Earth as seen by the Apollo 17 crew travelling to the moon. This translunar coast photograph extends from the Mediterranean Sea area to the Antarctica south polar ice cap - the first time it was possible to photograph the south polar ice cap. Note the heavy cloud cover in the southern hemisphere. Almost the entire coastline of Africa is clearly visible. The Arabian Peninsula can be seen at the north-eastern edge of Africa. The large island off the coast of Africa is the Madagascar. The Asian mainland is on the horizon toward the north-east. The Gulf of Oman and the Red Sea can be seen. Photo: NASA (http://lisar.larc.nasa.gov/index.cgi).

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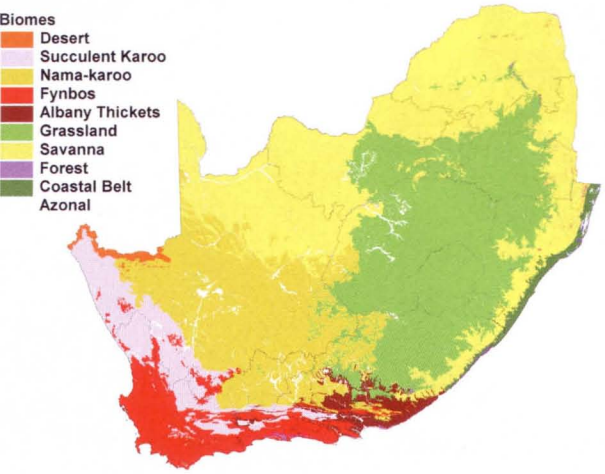
1605 the South African plant *Protea neriifolia* was illustrated in European literature. Any information that has a spatial component - something describing the physical space that a plant occupies in terms of its latitude, longitude and altitude - can be used in GIS. Space, in GIS terms, is defined relative to the centre and axes of the Earth. Thus, it could be applied on any body in outer space as long as equivalents of north, south, east, west and mean sea level are defined for the body. For simple two-dimensional studies, all that is needed are x and y co-ordinates. Altitude can be obtained by reading from a map using latitude and longitude, or by using an altimeter.

The better the spatial information that is recorded, the more valuable the data will be for further studies as GIS becomes more and more a common application in ecological, horticultural, educational and botanical studies - the main foci of the work of the NBI.

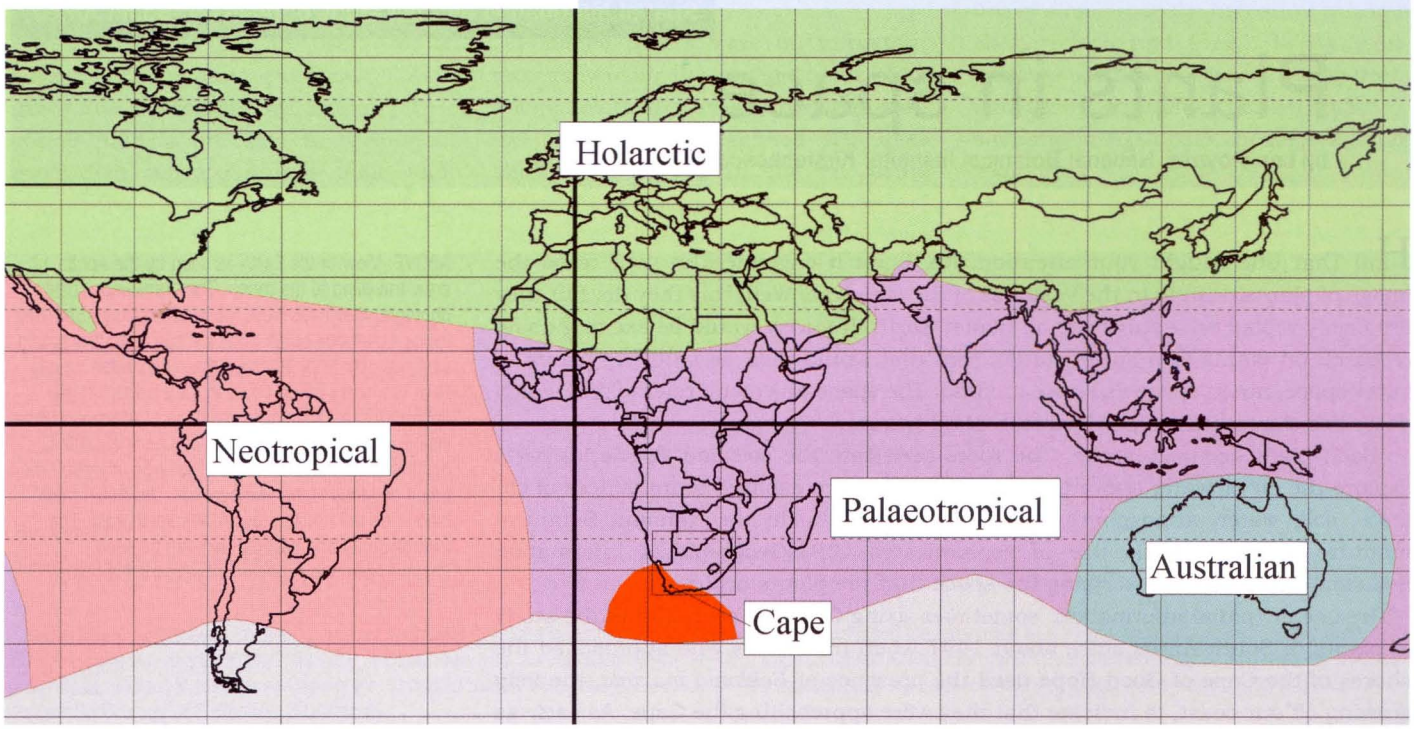
From the time that I started collecting plants in 1978 I was impressed by the need to give accurate locality information. I related live and pressed specimens, and any photos taken, to their locality.

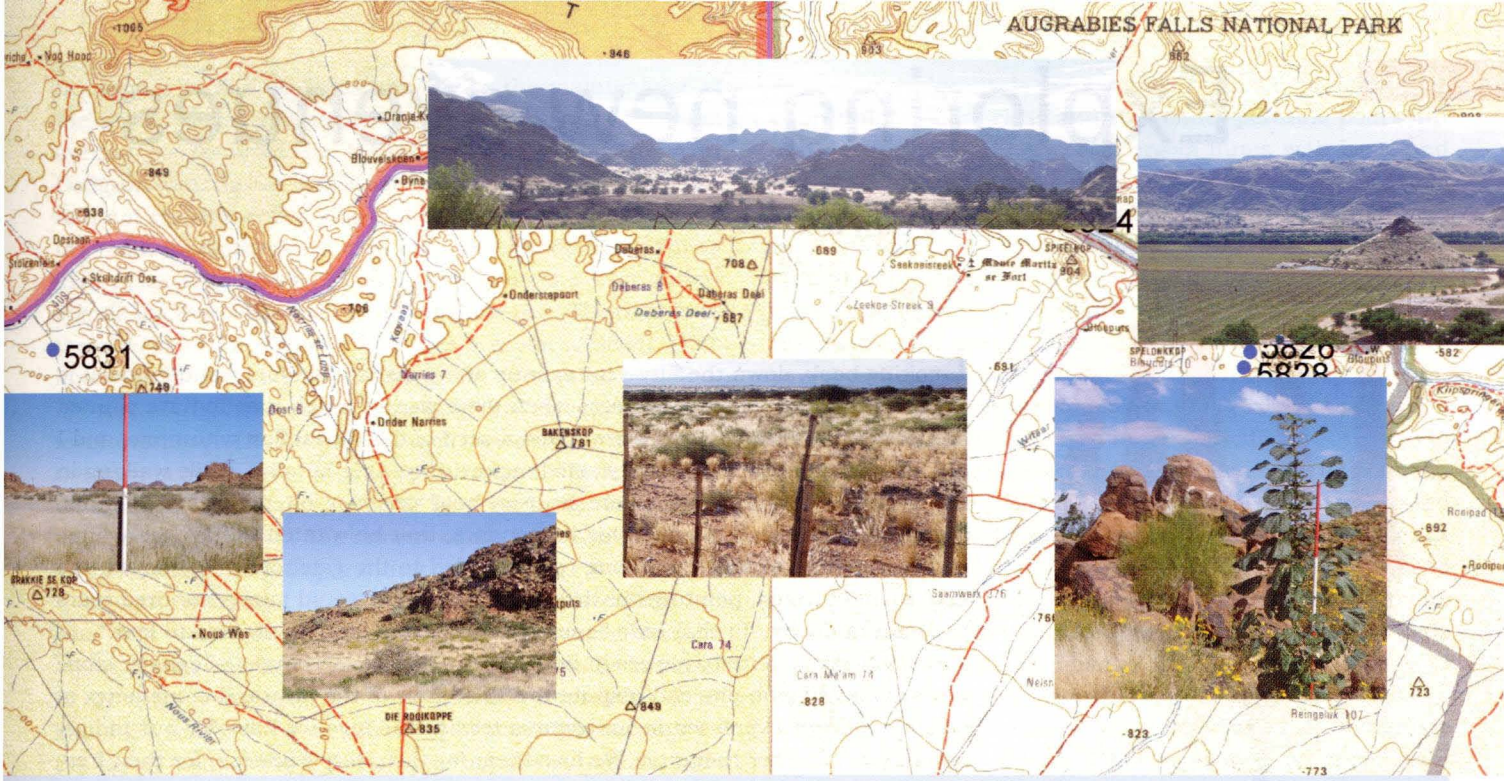
I used to calculate the latitude and longitude using a 1:50 000 topographical map but now recording positions has become much easier with GPS (Global Positioning System). These simple instruments collect information from satellites orbiting the Earth, and by detecting the time taken for the satellite's signal to reach the receiver, they calculate precisely where the instrument is - its distance from the equator (latitude), from the Central Meridian (longitude) and above sea level (altitude). It even translates the distance into metres, or to degrees of latitude and longitude as desired by the user!



LEFT: At a national level, GIS (Geographical Information Systems) is an essential tool used in the development of the new *Vegetation Map of South Africa, Lesotho and Swaziland*. In 1953 Acocks published his *Veld types of South Africa* with a description of seventy veld types. In 1996 Low and Rebelo published their SAAB Map, *Vegetation of South Africa, Lesotho and Swaziland* with sixty-eight vegetation types. We are now compiling a new map with more than 400 vegetation types. This map has three levels of groupings, essentially at a biome level, a bioregion level and at the vegetation unit level.

BELOW: Using GIS on a global scale: a map of the floristic regions of the world.





ABOVE: Pop up photos - we tracked our movements using GPS (Global Positioning System) and can look at photos to remind ourselves what the landscape looked like.

My work in this field has encompassed the **global scale** recording of the location of our Cape Floral Kingdom on the world map, the **continental scale** recording of vegetation types in Africa, the **provincial scale** recording of NBI projects in each province, right down to the very **small scale** plotting of the locations of individual plants in garden beds.

My involvement with spatial information began long before my introduction to GIS. I, as many of you have done, initially worked on paper. Prof. Huntley, CEO of the NBI, recorded on a paper map the vegetation units of the Quicama National Park in Angola. Our gardeners report verbally or on paper to their supervisors about the plants planted out in specific beds. We all record and use spatial information in the work that we do.

The NBI and its partner organizations such as the Botanical Society, have produced reports using spatial information. These include species lists and publications such as Mary Maytham Kidd's 1950 *Field guide to the plants of the Cape Peninsula*, and Beth Gibbs Russell's recording of plant taxa in each province using the PRECIS (National Herbarium Pretoria (PRE) Computerized Information System) database that started as early as 1974.

PRECIS is used to create regional species checklists, guide in the planning of collecting trips, looking at spatial differences within species (for example the flowering times of the same grasses occurring in different regions) and in countless other fields.

I have assisted many members of staff at the NBI with mapping species distributions for various publications, including biome and climate maps, and I have used GIS and GPS together to track our movements in the Sperrgebiet of Namibia, the Richtersvled and many other places. We have found it very useful to use GIS to quickly locate a photograph taken in an area in order to remind ourselves of what the landscape looked like. I have even used photographs taken in space of the Earth - satellite images - such as you will probably have seen on television or in print.

So in this way we might stretch our concept of studying plants in space to include studies in outer space of plants in space.

For a list of references and further reading, please email the editor at voget@kingsley.co.za or fax your request to 021 423 1403.

The author

Les Powrie is based in the Landscape Ecology section of the Ecology and Conservation Programme of the National Botanical Institute, based at the Kirstenbosch Research Centre. He works a lot with GIS (Geographical Information Systems) and plant ecological databases, and has been involved in plant behavioural and climate change research, among other things. His main emphasis at present is completing the new *Vegetation Map of South Africa, Lesotho and Swaziland*.