Adventure Safaris and Conservation in the Okavango Delta of Botswana

Botswana's Ngamiland Adventure Safaris, based in Maun, northern Botswana, is using ArcView GIS to develop a GIS that will support conservation of an area of outstanding importance in the heart of the Okavango delta. The software was provided by GIMS, ESRI's distributor in South Africa.

Under Botswana's land use planning system, the Okavango delta is divided into areas that are managed by wildlife tourism and safari companies. Ngamiland Adventure Safaris manages area NG25. NG25 occupies a crucial position in the heart of the delta, just south of the point where the incoming Okavango River divides into the channels that feed the rest of the wetland system. NG25 thus acts as a primary nutrient trap and displays great biological richness. Within its 600 square kilometers, wildlife densities are high and the landscape varies from lush, verdant tropical lagoons and forested islands to drier savanna woodland. A lodge, Jao, and two camps, Kwetsane and Jacana, have already been built, and two more camps are planned. The facilities are spectacular and luxurious but carefully designed to blend into their embracing woodland surroundings. During the next few years, with environmentally sensitive management this high-potential area can become one of the premier wildlife sites in the region.

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Additional Information

GIS in Adaptive Environmental Management

Once established, the GIS will support the adaptive management of NG25. By monitoring ecological changes using a system of sampling transects and plots, they will develop better under,landing of the dynamics of the area, allowing them to modify their management activities in accordance with the natural pattern and process of the concession.

In particular, Ngamiland Adventure Safaris will use ground transects to monitor wildlife abundance and distribution. An important aspect in their management philosophy is control of illegal hunting activities and reduction in the conflicts between wildlife in NG25 and people in adjacent lands. Ngamiland Adventure Safaris believes that their efforts to improve management of wildlife should result in significant increases in populations of key species such as elephants, lions and other predators, zebras, wildebeests, giraffes, and buffalo. With sufficient protection, NG25 could rival Moremi Game Reserve.

The GIS system will also address issues in environmental management. Ngamiland Adventure Safaris aims to use ArcView GIS to support monitoring of sewage and waste water management, solid waste disposal, road impacts, lodge and camp construction, logistic operations, and control of pests such as tsetse flies and mosquitoes. In this way, it can ensure that their operations are conducted with minimal environmental impacts on NG25.

Progress to Date

The project is a challenging one because of the amorphous nature of the delta landscape-its dynamic ecology, driven principally by annual flood regimes, and the lack of permanent landmarks that can be used to assist in georeferencing and theme registration. In addition, access to remote, wetter parts of the area is possible only by helicopter, dug-out canoe (mokoro), or on foot.

So far, Ngamiland Adventure Safaris has concentrated on establishing an ArcView GIS database as a central repository of existing

information about the distribution of natural resources, infrastructure, and activities in NG25.

The first activities involved creating a landscape theme for the area, mapping roads and infrastructure, and creating a vegetation map.

Background Landscape Theme/Coverage

A satellite image was used as a reference for the basic background landscape map of NG25. The image appears to have some distortions, which is inevitable, but Ngamiland Adventure Safaris suspect these distortions are larger than they might be. Latitudinal errors appear more significant than longitudinal ones.

The satellite image was used to define landscape units that were digitized as a new theme of polygons in the GIS. This landscape polygon coverage, therefore, contains any errors that are inherent in the satellite image.

The landscape polygon coverage was later edited to maintain registration with the roads that were automated with GPS (i.e., if a road followed the edge of a floodplain, border of permanent swamp, etc.), and this was not the case when the roads theme was overlaid on the landscape polygon image. The landscape polygons were edited to correspond with the road alignment.

To finalize their landscape theme for use in operational maps, Ngamiland Adventure Safaris can therefore :-

- Rely on the satellite image a, the background. Since Ngamiland Adventure Safaris will use GPS for navigation in NG25, this will require that the image be corrected by collection of ground control points and use of the ArcView Spatial Analyst extension. It further satellite images are acquired. Ngamiland Adventure Safaris can use these to evaluate landscape-level trends. The disadvantage is that imagery is expensive, so further images may not be available to Ngamiland Adventure Safaris.
- Rely on the landscape polygon coverage developed from the image but gradually modified to register with all GPS points collected--a sort of informal ground truthing. For Ngamiland Adventure Safaris, this theme will be easier to interpret and manipulate than the satellite image. Implicit in this approach is that they rely on GPS as the most accurate source of data and base their "reality" in NG25 on GPS readings. However, without referring to a corrected satellite image, it will not be possible to correct any landscape polygons in the coverage that do not feature landmarks such as roads or major river channels.
- Do a bit of both correct the satellite image as far as possible using Arc View Spatial Analyst, then use the corrected satellite image to make further edits to the landscape polygon coverage, but only where there was no conflicting information from any roads, river channels, and campsites that have been recorded using a GPS. The result should be a map that is at least partially corrected by ground control points and is more forgiving when navigating by GPS.

The third option seems the most practical one.

Roads and Tracks

The roads and tracks in NG25 were captured with a Garmin GPSII GPS. Track logs were made with the Precision option selected. The UTM Decimal Degrees Projection was used with Cape Datum.

The road mapping exercise was conducted in November 1999 and provided an enjoyable opportunity to survey parts that were accessible by Land Rover.

Ngamiland Adventure Safaris staff encountered large herds of buffalo and zebras, plus impalas, red lechwe, greater kudu, tsessebes, reedbuck, bushbuck, wildebeests, warthogs, giraffes, etc. Predators encountered included lions and jackals. Currently, wild dogs are very rare visitors to NG25, but it is hoped that their occurrence will increase as game densities improve. The area supports numerous small groups of elephants. Fortunately, this part of the delta does not feature the very large breeding herds of elephants, which have caused damage to the woodlands in drier areas of northeastern Botswana.

A recent poaching incident in the north of the area involved local men using horses and donkeys to hunt giraffes, but the culprits were intercepted before they did too much damage. A challenge to law enforcement work is the wet nature of the north and eastern parts of the area, which makes it impossible to access many places during the annual floods.

Location and Layout

Ngamiland Adventure Safaris staff tested the feasibility of using a handheld GPS unit to map out one of the campsite complexes. Not surprisingly, when working at such a large scale (a few tens of meters between buildings) the results were not sufficiently precise

would probably allow them to pinpoint the sites of individual structures and facilities within the camps.

Similarly, without access to a differential GPS facility and a distortion-free landscape coverage, it seems that regularly visited sites, such as sample transects and plots, tsetse flytraps, etc., will have to be located by conventional GPS and include reference to well-known landmarks such as roads, distinctive islands, lagoons, and trees.

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