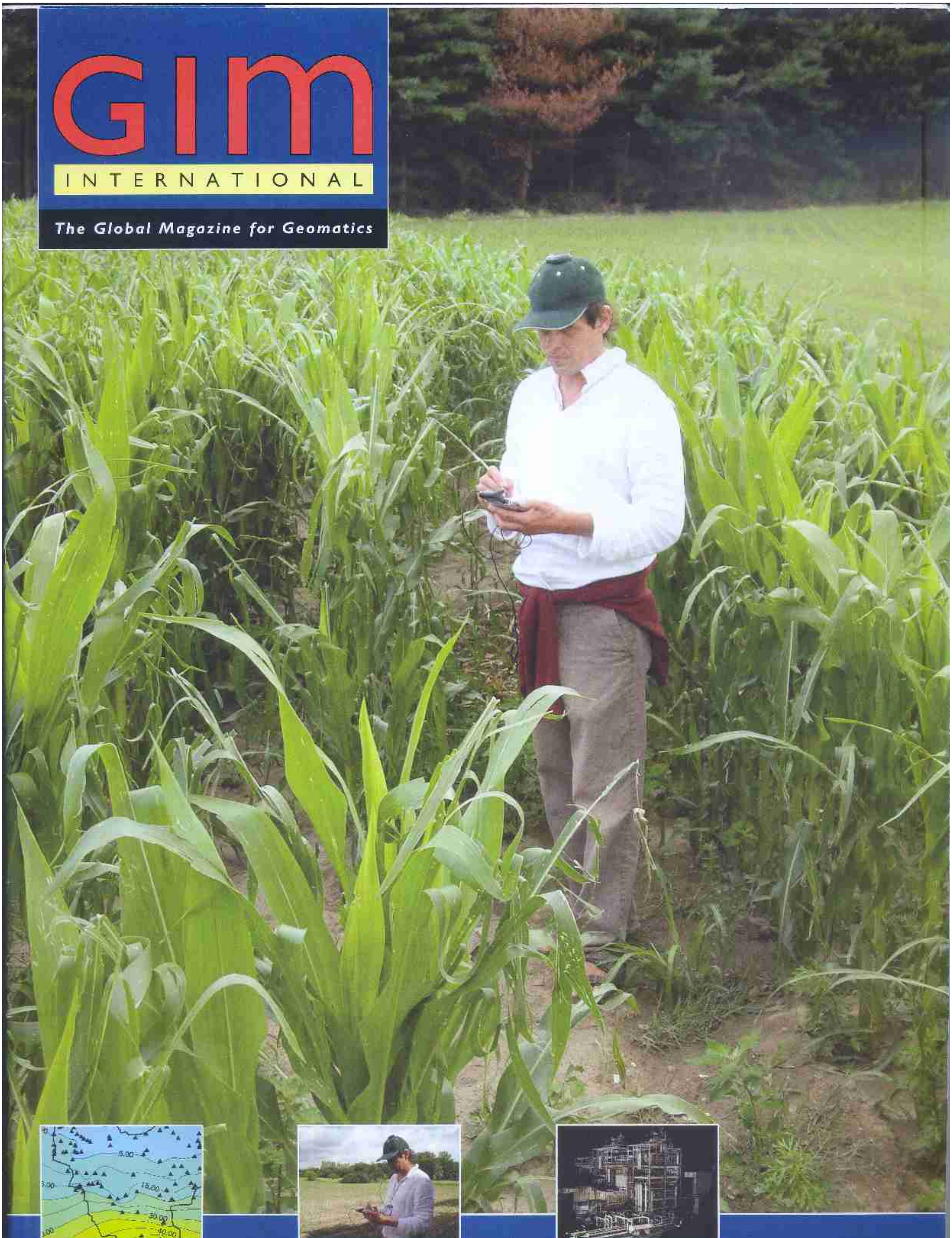
GIM INTERNATIONAL

The Global Magazine for Geomatics



Land Subsidence in Urban Areas of Indonesia

Field Area Checks Using GPS

Development of the ILRIS-3$_6$D

a GITC publication

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Features

THE FRONT COVER

More than a million fields are measured each year using GPS, an important operational tool in checking on the eligibility of farmers for EU subsidies. Accurate measurement is helped by lightweight systems making using of customised software. Improvements expected with EGNOS and Galileo will bring even bigger future benefits for field inspectors. More about field-area checks using GPS on page 33. *(Courtesy of Joint Research Centre of the European Commission)*

Using GIS and GPS in Annapurna Conservation Area of Nepal

Biodiversity Surveying and Monitoring

GIS and GPS offer enormous potential to improve existing methods of biodiversity surveying and monitoring, supporting sampling design, data collection, visualisation, analysis and data management. The author describes experience gained in the Annapurna Conservation Area of Nepal.

By Nawa Raj Chapagain, King Mahendra Trust for Nature Conservation, Nepal

Increased human population and industrialisation has caused degradation of wildlife habitat and, with that, biodiversity. The major steps adopted globally for the conservation of biodiversity are the establishment of protected areas, including national parks, wildlife reserves and conservation areas; enforcement of conservation laws and activities aimed at raising awareness. However, the problem still remains critical, especially in the developing countries, where local people heavily depend on biodiversity resources for their livelihood. Scientific monitoring is required to ensure conservation and sustainable utilisation of resources. Recent observations on climate change have also increased global attention for the need for biodiversity monitoring. The initiative Building Capacity for Biodiversity Monitoring and Assessment was launched to devise, test and recommend a biodiversity monitoring system for protected areas of Nepal. The project is funded by the UK Darwin Initiative and implemented by the King Mahendra Trust for Nature Conservation (KMTNC) and UNEP-World Conservation Monitoring Centre, with support from Edinburgh University.

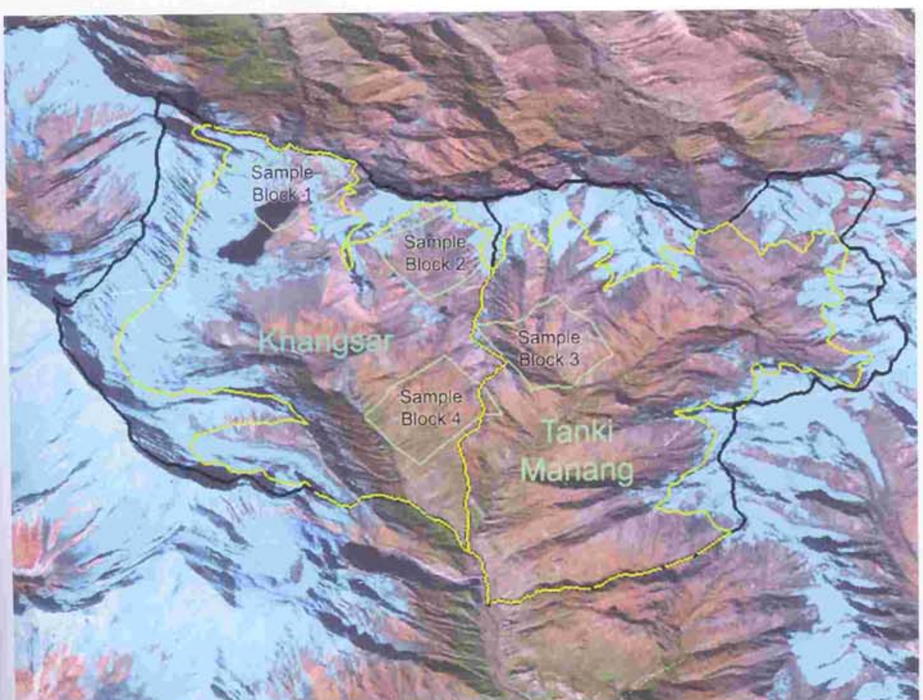

Figure 1. Sample blocks identified using GIS for monitoring of snow leopard and blue sheep in Khangsar and Tanki Manang VDCs of Manang, Nepal. (Background image: Landsat TM, 1990, available free of charge.)

Conserving Biodiversity

Biodiversity in Nepal came under threat in the 1950s, when large tracts of forests were cleared for human settlement in hills and mountains. Conservation efforts began in the 1970s. Today, Nepal has established sixteen protected areas across the country: the total area under protection is 18.2% of the country's area (147,181km^2). With an area of 7,629km^2, the Annapurna Conservation Area (ACA: see sidebar) is the largest protected area in Nepal that has successfully experimented with the philosophy of an Integrated Conservation and Development Project (ICDP), now a model conservation philosophy for several developing countries.

Annapurna Conservation Area (ACA)

The ACA region stretches from the lowland sub-tropics of the middle hills to the permanent snow-cover of the Himalayas, and beyond the alpine grasslands in the Trans-Himalayan region to parts of the Tibetan plateau. The variety in habitat has made ACA quite rich in species diversity: 102 species of mammals, 478 species of birds, 39 species of reptiles, 22 species of amphibians, and 1,226 species of flowering plants exist here. Several endangered species live in the ACA regions, such as snow leopard (*Uncia uncia*), musk deer (*Moschus chrysogaster*) and cheer pheasant (*Catreus wallichii*). Nearly 100,000 local people and 50,000 tourists share the space with wildlife, making the area vulnerable to environmental damage.

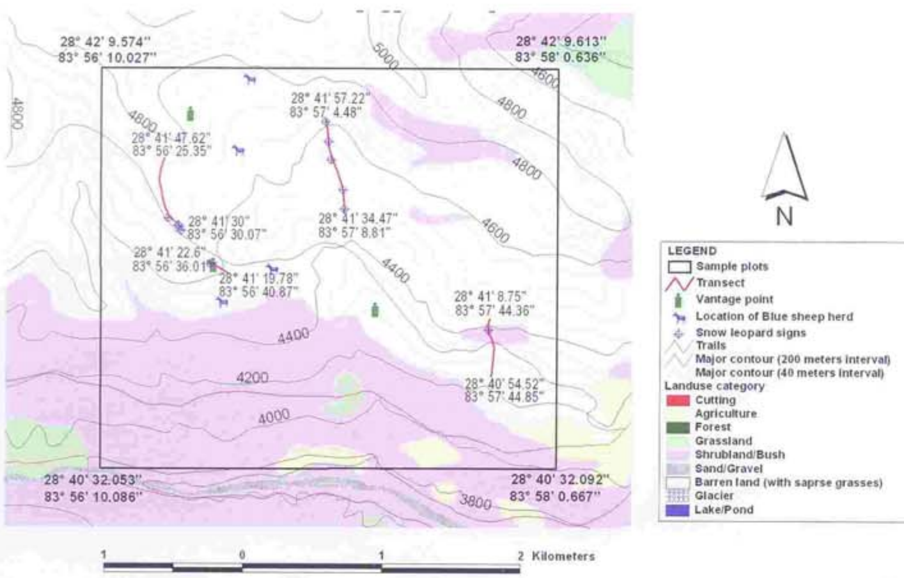

Figure 2, Snow leopard and blue sheep monitoring data integrated in GIS.

Monitoring Systems

Though conservation has come a long way in Nepal, few biodiversity monitoring systems exist, and those that do address only some large mammal species of the Terai region. Monitoring involves taking repeated measurements and comparing them to understand the causes of change. Thus, biodiversity monitoring involves:

- carrying out repeated surveys to find out the size and extent of the population of a certain species and the quality of their habitat
- analysing results to find out trend and rate of change.

Monitoring needs to be done against a predefined conservation objective. Such an objective could, for example, be to increase the population of Blue Sheep (*Psuedois nayaur*) to 500 in a certain area, within a given time. In this case, the population of the current year is required in order to define the target for the future. By using standard methods and field protocols, data is collected and analysed to determine the rate of progress. In the field data collection procedure, data analysis and presentation GIS can assist ecologists and managers in getting their work done efficiently and with more attractively presented results.

GIS Examples

A first example of where GIS can assist biodiversity monitoring is in the stage of identifying potential areas for monitoring. For example, a management team wants to monitor snow leopard in Manang. Using criteria concerning the habitat of snow leopards, GIS enables the team to identify areas where they live. By overlaying within a GIS environment map layers of distribution criteria, areas which match all the criteria can be identified within minutes. This saves much fieldwork time, especially in mountainous areas where most wildlife habitat areas are accessible only on foot.

Another important contribution potentially made by GIS is in locating sample plots, which plays a crucial role in the validity of datasets and the results obtained from them. Using GIS, sample plot location can be identified either randomly or systematically. Sample plots thus identified can be overlaid with the three-dimensional GIS model, which gives an exact impression of their real field location. The location of these plots (plot corners) can be extracted from the GIS and identified in the field using GPS. Three-dimensional maps can help to lo-

Figure 3, Ground coverage (%) data interpolated, determined using geostatistical tools.

cate plots in the field easily (Figure 1).

After locating sample plots in the field, data is collected using standard methods and forms. Such data can be stored, displayed and analysed in GIS to reveal spatial patterns (Figure 2). Visualisation of field data on maps provides important information such as occurrence and clustering with respect to associated habitat variables. The collection of this information using traditional analysis and dissemination techniques would be both time consuming and would provide less impressive results. Field data can be used in combination with habitat variables map to develop a habitat preference index.

Another advantage of GIS is that all data has a uniform addressing format in the form of latitude, longitude, and sometimes also altitude. Addressing with coordinates very much eases the location of sample plots and transects for repeated measurements. It can be used for integration of data obtained from various sources. Geostatistical techniques offer interpolation tools that take into account continuously changing spatial variables, which can not be done with general statistics. Such interpolation tools are useful for generating stocking density, especially of floral biodiversity (Figure 3).

Final Remarks

Satellite remote sensing can further add value to the use of GIS in biodiversity monitoring. Satellite images analysed with GIS can provide habitat information for the years prior to the start of a monitoring programme. Some older satellite images are available free of charge, such as ASTER (http://asterweb.jpl.nasa.gov/) and selected date scenes of Landsat. The ACAP monitoring programme is making use of images derived from both these two satellites.

Further Reading

- Tucker, G., Bubb P., de Heer M., Miles L., Lawrence A., Bajracharya S. B., Nepal R. C., Sherchan R., Chapagain N. R. (2005): Guidelines for Biodiversity Assessment and Monitoring for Protected Areas. KMTNC, Kathmandu, Nepal.◆

Biography of the Author

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