GIS & REMOTE SENSING NEWS

FIJI USER GROUP, Number 10 (9501), February 1995

Welcome to the first edition of the news letter for 1995. The “Internet in Fiji” issue dominated the first user group meeting of the year and it is clearly an important communications tool for gaining access to GIS & RS data. Remember that up to 90% of the cost of a GIS is the actual data and faster methods to find up-to-date and accurate data is extremely important. Another use for the Internet will be publishing data and or data catalogues which are projects that all custodians of data should consider. This issue contains an article describing the Internet in Fiji and includes a press release following the presentation at USP of the Internet survey report. It is inevitable that Internet access and use will spread through the proposed enhanced service which can only benefit all users.

There are contributions from Management Services Division (Forestry), Native Lands Trust Board, USP, as well as consultants, specialists and providers in the GIS & RS field.

Again we welcome contributions from national, regional and international users. Yes, you can reach us by Internet - see back page for the addresses!

UPDATES

• SOPAC has a new Deputy Director. Alf Simpson who was the Director of Mineral Resources Department, joined SOPAC in February, replacing Jim Eade.

• George Saemane will be the GIS Laboratory manager at USP. He can be contacted by phone: 212651 or 313900 ext. 2551.

• USP intends to reserve one computer for GIS software testing. Several software packages will be available on this machine where users can evaluate the different GIS applications.

• The ESCAP GIS and Remote Sensing workshop will be held at the Tradewinds convention centre 13-17 February, 1995. The workshop will provide participants with an overview of applied GIS and remote sensing in the region. There will be participants from the majority of the island states and the regional organisations and personations will include applications of these technologies from users in the Fiji.

• Osea Tuinivanua (MSD-Forestry) has postponed his postgraduate study in Germany at the University of Freiburg from April (as stated in Newsletter 9407) until June this year.

• The last GIS and Remote Sensing User Meeting in 1994 was held in December at USP. The theme was the potential for a new Internet link to Fiji and the options for implementing this service. For more information see “The Internet in Fiji” by Les Allinson in this newsletter.

• The first GIS and Remote Sensing User Meeting in 1995 was held 7 February, again at USP. Osea Tuinivanua explained the potential and limits of secondary forest stratification in Fiji. There are secondary forest types with strong correlation between the dominant species and spectral characteristics. Other secondary forest types do not have such a clear spectral feature. Further, the share of a forest species in the canopy is not represented by the share in timber volume per hectare, which is the forest system of unit measure. More on this subject later on in this newsletter.

• Osea Tuinivanua demonstrated in a second presentation the potential of GIS for planning forest plantation sites. Information such as logged forest, slope map soil are combined to avoid plantations being established in virgin forest or on insufficiently fertile soil.

• The following organisations outlined their plans for 1995:

• **Department of Environment** will establish an environmental data base. In May a consultant will arrive to assist in this job.

• **Energy Department** has no GIS at present. However, there is a potential to use GIS for a mini hydro program for rural decentralised production of electricity. The department will train people in GIS applications, later a decision will be made on the purchase of a system.

• **FEA** will establish GIS facilities.

FLIS will concentrate on the topographical data base. The following layers of available sheets from the new Lands Department map series will be scanned in New Zealand: 1) topography 2) hydrology 3) land use.

• **Lands and Survey Division** will not establish their own GIS facilities as it will use the system at FLIS. They will store all geodetic data in their own database at FLIS. The stereo mapper will be updated to analytical instruments.

MRD will create a detailed catalogue of available GIS data. In Viti Levu a hazard mapping project will start. Further, a geological map of Viti Levu at 1:250,000 scale will be produced.

MSD-Forestry will relate their

spatial and non-spatial data to catchment areas. All water catchments will be digitised. The monitoring of forest cover will continue with new SPOT data. AIDAB will continue to fund the mapping of logging areas at 1:10,000 scale. A new European Union funded project will start to map plantation sites using GPS facilities. Aid from the government of Japan will continue.

• **NLTB** will further concentrate on the file transfer from their system to DXF format. FLIS announced that the first *mataqali* boundaries are available in this format. The problems related to map projection are not yet solved.

• **PWD** starts a road inventory project. All roads will be mapped by driving along with GPS equipped cars and storing the co-ordinates later in a GIS for map production. The utilities section will attempt to use GIS and GPS techniques for water sewage mapping.

• **SOPAC** will continue to help member countries to establish their GIS facilities. During the next month SOPAC will purchase a CD writer which will be used for transferring the large offshore mapping and related datasets to member countries. It will also be used for archiving tapes to avoid data loss caused by fungus. This will be important for satellite data which sometimes still arrives on digital tape. An A3 size colour scanner with 600 dpi resolution will arrive soon to enable the scanning of aerial photos. SOPAC will analyse bathymetric information of digital satellite images. Air-borne SAR images will be produced for Fiji.

• **USP** will produce a video about GIS activities in Fiji. Four public GIS workshops will provide technology transfer as well as the normal training classes.

■ *by Thomas Kremmers, University of Freiburg*

PC–ERDAS 7.5 PROGRAM BUGS

The bugs reported in this article concern the PC-ERDAS 7.5 programs SEED (version 7.4.08.449) and CMATRIX (version 7.4.04.435).

SEED is the training sample selecting program that has to be used prior to supervised classification procedures like MAXCLAS. It offers three different ways to gather the sample pixels, always using a so called "seed" - or model-pixel, against which the pixels that are contiguous to it are compared with respect to conditions or parameters set by the operator.

During the program run, a searching or growing algorithm is performed which adds those pixels to the training sample that fulfil the conditions set. While looking for the sample pixels each accepted pixel is highlighted in the graphics overlay with a colour from the graphics overlay default colour palette according to the number specified by the operator. After completion of the run the statistical parameters (total number of points, mean, min, max, standard deviation, the histogram and the covariance matrix) are stored for each training sample as signature in a *.SBD file. The boundaries of the training samples are kept in a *.DIG file, which is automatically created, when the question at the beginning of the program "Save associated polygons?" is answered with "Yes". This is a must when the program CMATRIX is to be used afterwards, because CMATRIX computes a test classification on the basis of the training area polygon.

For defining the training samples the operator can specify spectral or spatial parameters or a combination of both as follows:

a. Spectral Parameters

As spectral parameter the spectral distance between each candidate pixel and the mean of the sample is used. The spectral distance (for explanation see ERDAS FIELD GUIDE) allows the control of the amount of homogeneity in the sample. Specifying a low spectral distance value will lead to a more homogenous training sample with a low standard deviation and smaller number of incorporated pixels. Training samples with low standard deviation improve the probability to separate them distinctly from each other and help to avoid conflicts in assigning pixels to the different classes when using a classification algorithm. Finding the appropriate value for the spectral distance is a trial and error process weighing up the acceptable standard deviation and the needed minimum number of pixels to achieve a statistically reliable sample.

When the acceptable spectral distance is found, all pixels that are contiguous to the seed and fulfil this condition are taken into the sample and the polygon is created by taking the coordinates of the boundary pixels of the highlighted training area.

BUG! Creating the polygon, respectively its shape is the critical point that causes the problems when computing a CMATRIX afterwards.

A lot of 'filled' areas can occur, which means, that boundary pixels are directly facing each other when

Figure 1. Filled and bottle-neck or cut-off-areas in polygons.

seen from inside the polygon. Furthermore the polygon can contain areas which I would like to call 'bottle-neck' areas and which are `cut off' from the rest of the polygon. For illustration see Figure 1.

When the polygon is saved from the graphics overlay plane into the *.DIG file after accepting the signature by writing it to the *.SBD file, the program seems 'to forget' some of these critical areas or the program CMATRIX does not recognise them.

This error can be detected when comparing the number of total points given for each training sample in the *.SBD file with number of total points listed in the CMATRIX printout. When this error occurs the number of points given by CMATRIX is smaller and the computed classification accuracy are therefore not reliable.

When the error does not occur, feel lucky!

b. Spatial Parameters
Here the operator can specify a spatial maximum distance, in pixels, that a candidate pixel can be from the seed or you can draw a bounding polygon in the overlay plain. Then the seed pixel has to be positioned inside the polygon.

BUG! When drawing a bounding polygon using the seed option "Draw on graphics plane?" the created *.DIG file is only in file coordinates, even if your image is geocoded. The map coordinates are not transferred to the *.DIG file.

The problem may be solved, when using polygons that were predefined with the program DIGSCRN. Here the map coordinates are transferred to the file.

Also keep an eye on the shape of your digitised polygons, because pixels in "filled" and "cut-off" areas (see above) are not taken into account. Only pixels in the "open" part of the polygon are marked and highlighted.

c. Both Spectral and Spatial Parameters
This is a combination of a. and b. and therefore may incorporate all the problems listed above.

It is dissapointing that SEED and CMATRIX programs do not work properly. Especially because the "spectral distance" option would have been a useful tool for quick and easy determination of training areas. Geosystems, the ERDAS distributor in Germany, gave the information during a telephone call (9 February, 1995) that unfortunately there will be no more bug-fixing for PC ERDAS 7.5.

■ *by Dick Watling Ph.D., Environmental Consultants Fiji*
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Is a GIS the answer to all your problems? . . . not if you are a site of national significance!

This article raises some issues arising from the rapid adoption of computer aided technology by many resource management agencies over the past few years. It is written to be thought provoking rather than critical, and in a desire to stimulate reflection and serious consideration of the real issues. The article ends on a more positive note, looking at one particular issue for which GIS could be a very useful management tool, Fiji's Sites of National Significance (SNS).

The last five years has brought computer-aided data storage, analysis, drafting, remote sensing and information systems to the small company and government department. And for those who have had the opportunity to visit or work with many Pacific Island and South East Asian Governments over the last decade, the changes seen are nothing short of dramatic.

The advantages of the technology in the resource management sectors are obvious, all allowing for quick, flexible and visually-oriented presentation, highly impressive to politicians, decision makers and non-specialists. It is also greatly favoured by donors for exactly the same reason.

However, there are an increasing few who believe that the race to seize this modern technology is, in many cases, at the expense of the foundation and purpose which the technology serves, specifically collection of reliable data and active management. There is a tendency to believe that if you can see it in several different forms on a monitor or on a customised map sheet, then that is the essence of natural resource management. Once this stage is reached then the task is accomplished, these tools have become an "end" rather than a "means to an end".

In many Pacific Island Countries, for instance, these technology driven initiatives are leading to the reprocessing of dated information, often of dubious quality rather than the appropriate collection, interpretation and application of new data which is the real need. The emphasis is firmly in the "office" with increasing needs for computer operators, digitisers, database specialists, remote sensing analysts and the like. This is all at the expense of the field activities specifically data collection and resource management. Training of foresters, geologists, hydrologists, ecologists, climatologists and the like appears to be lagging; data collection is, in some cases, actually being reduced as financial and technical resources are reassigned to the "office and its hungry technology base".

Donors are heavily involved in this process and hence its consciousness in the "over-aided" Pacific. Recipients like the technology, while for donors it is cost effective and convenient to provide hardware and a specialist. There is little doubt that, for instance, when the choice is between some sophisticated hardware producing attractive soil maps, which Government or Donor would plumb, and the alternative, lengthy training of a local soil scientist and the analysis of 10,000 new soil samples.

Of course it is not all bad and the potential is very good but some serious thinking should be afforded as to what all this technology is analysing and how it can actually result in improved resource management in the field. It is quite clear that more technical and financial resources are required in the field.

Sites of National Significance
Fiji's State of the Environment Report collated a Preliminary Register of Sites of National Significance which contains 140 "natural" sites which are those of biological, ecological, geological, geomorphological and landscape interest. Cultural and archaeological sites are not included at the moment, but it would obviously be useful for these to be added.

The Preliminary Register is by no means exhaustive and represents the published and archived knowledge of a few interested individuals acquired over many years, results of some Government initiatives and specialist knowledge. These sites are under increasing pressure from a whole variety of development initiatives, some have been lost.

The Register is obviously a useful collation of data but in itself is of little use unless attached to a management framework. Quite obviously too, entering the large number of scattered sites of varying areas into a spatial database which can then be utilised in the GIS of the various resource management agencies would be a sensible option in order to broaden the institutional awareness of these sites. The managers of Forestry GIS, have of their own initiative, already undertaken this for sites within or close to forested areas. This is when the first management problem is confronted. Where are the boundaries of these sites? How important are they?

At present these questions are entirely unanswered and so in reality, these sites are still a "paper" initiative, devoid of any management setting. This is something that needs to be rectified, however, as this is where the real difficulties surface because of the lack of any obvious institutional or legislative framework. The same problem that has resulted in at least five different Government agencies or departments becoming involved in "Protected Area Management".

When a specific agency is given the responsibility and the legislative backing, the question is what type of management would be appropriate for such diverse sites. Because of our proximity to New Zealand, Australia and the United States, thoughts usually tend towards Government run National Parks which are in reality an entirely unsuitable arrangement for Fiji's SNS as these are all "privately" owned by landowners. Only the most significant may eventually be acquired by Government through satisfactory arrangements with the landowners. The remainder will require other forms of passive control without alienation. To this end, we should be looking at National Parks in Europe and Sites of Special Scientific Importance (SSSI) in the UK which are much more suitable models as they allow people/owners to get on with their lives even though they are in a National Park or own an SSSI. It is only when a change to the character of the site is envisaged does any form of development control emerge.

In summary, a system worth considering for management of the SNS is: an agency with the responsibility of documenting SNS including boundaries, inventory, degree of significance etc.;the agency would officially notify landowners concerned and would be responsible for a database which could be linked to all the major resource management agencies;a system of monitoring would need to be introduced, having the sites linked to government GIS etc. would be a first useful move, otherwise the Provincial Authorities may well be best placed to undertake general surveillance;a legislative framework is required to institute the agency and to enable control of any developments which would change the intrinsic character of such sites; andopportunities be identified and institutionalised for landowners to best benefit from the presence of the sites on their land holdings.

GIS Training at the University of the South Pacific

In response to a growing GIS community and calls for training and education, the University of the South Pacific developed a GIS Unit in late 1993. Its primary missions are to provide educational and research support for USP, provide training (workshops, short courses, etc.) for USP and the user community, support local and regional GIS efforts (especially the GIS User Forum), and to serve as a computer technology node for the region. The Unit's teaching lab has 20 PCs networked to the central USP Vax, running a variety of GIS and associated programmes, such as PC ArcInfo, ArcView, Idrisi, PopMap, OSU-MAP, ExploreMap, GIST, Tredmar (image processing), and several CAD, graphics, spreadsheet, and statistical packages. The central research and support lab has four PCs (more forthcoming) and uses ArcInfo as the primary GIS, assisted by the programs mentioned above plus a suite of other support softwares. Peripherals include a large digitiser table, large plotter, colour and monochrome printers, CD drive, and field data equipment. USP's other facilities are also available, such as a state-of-the-art Media Centre and Computer Centre.

An introductory GIS course is offered in Geography (GE204), using primarily a hands-on laboratory approach to learning. It is being developed into a distant learning class, also, eg., video and audio tape lectures, home practicals, communications via e-mail, etc. A special "illustrated GIS Primer" has been written to meet the needs for beginners, particularly those with little computer experience and having English as a second language. The GE204 course will be offered in Semester I this year, using ArcInfo as the primary GIS. There are designs for additional courses, eg., remote sensing. Also, planning is underway to meet the demands for professional certification, such as a diploma programme. Resource enhancement is necessary to support larger efforts but encouraging campaigns are underway.

The GIS Unit is under the direction of Dr. Bruce Davis of the Geography Department and is managed by Mr. George Saemane, a recent arrival from the Solomon Islands. Currently four student assistants are working full time during the summer, but more will be added when the semester begins in mid-February. The core group is growing and capabilities are improving, as evidenced by increasing complexity of service tasks undertaken.

Preliminary plans for 1995 are to secure an additional faculty position to support the diploma course and to offer workshops and short courses. Acquisition of additional equipment and facilities continues, as does the growth of in the number and quality of assistants. Data resources need to be enhanced, including conversion of numerous standard maps to digital format. Several research projects are planned and should include integration of remote sensing data. A major commitment to the user community remains and will be the cornerstone of the GIS Unit's growth and support for the year.

For further information, please contact Bruce Davis (212-589 or 313900, extension 2589, fax at 301487, or e-mail DAVIS_B@USP.AC.FJ) or George Saemane (212651, 301487, extension 2651, or e-mail SAEMANE_G@USP.AC.FJ).

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LONG–TERM CHANGES OF SUVA REEF FLAT COMMUNITIES

FROM CONVENTIONAL IN SITU SURVEY AND REMOTE SENSING METHODS

This work is concerned with the combined use of conventionally gathered data and remote sensing methods to study the communities of Suva Reef, Fiji. A principal objective was to observe coral reef processes that could not be studied effectively by either method individually.

The in situ surveys have provided detailed information on reef community dynamics at a small scale while the airborne images have been able to reveal the longer term general patterns.

The airborne images provide sampling relatively regularly over a longer period (1945-1991) while the in situ surveys are occasional. The in situ observations provided occasional “snapshots” in 1984, 1989 and 1991 of six transects on the reef flat. The airborne images, on the other hand, filled the gaps in space and time that cannot be provided by in situ observations.

The results of the in situ surveys show massive changes to the reef substratum caused by sea urchin excavations. Four decades of habitat changes documented from airborne images showed that the magnitude and spatial extent of these changes were related to likely causes. In particular, the long term patterns of spatial changes of seagrass beds revealed that there were oscillations in the regrowth and losses. Seagrass beds extended towards the lagoon in some years and regressed in others.

Other disturbances have also made significant contributions in shaping the community structure of Suva Reef flat between 1945 and 1991. Major causes of disturbances were tsunami and cyclone damage, flood damage, starfish predation and effects of human activities. Tsunamis have probably caused more damage to the structure of the reef than any other disturbance occurring between 1945 and 1991.

In order to evaluate the usefulness of remote sensing in comparison with conventional in situ sampling methods for monitoring Suva Reef, a summary of monitoring methods and events being monitored is presented in Table 1. Where both methods were used to monitor events, the most effective of the two methods is marked with an ‘**x**’.

Table 1. Methods to monitor events in the Suva reef. **x** = the most effective method.

Events	Remote Sensing	In Situ	Both Methods	Deduced by both methods
Tsunami	+			
Starfish predation				+
Flood	+			
Sand dredging	+			
Sea urchin exacavations		x	+	
Fishing pressure		+		
Reclamation effects	x		+	
Effects of agriculture, deforestation and related activities	x		+	

Remote sensing provides a synoptic view of Suva Reef that has never been appreciated before. The historical record of changes documented from airborne images demonstrated the usefulness of remote sensing as a tool in determining long term changes in reef habitats. The lack of local expertise to conduct in situ surveys in the past has hindered any accumulation of long term data for any Fijian reef. Therefore the only way to answer questions on long term status of Suva Reef is to consider information from airborne images.

Information on the spatial patterns of habitats on the reef flat provided the most valuable contribution of airborne images to the understanding of long term community dynamics on Suva Reef. Moreover, as a result of information obtained on spatial patterns the likely causes of changes of habitats were able to be related to the environmental history prevalent at any particular period. Furthermore, remote sensing has greater benefits when used in conjunction with in situ survey data to examine the possible causes of change.

Remote sensing as a tool has a lot to offer in terms of understanding Suva Reef as

FOREST SOCIAL PRODUCTS

Introduction

GIS analysis has shown that there is not only deforestation in Fiji, but there is also a large area of secondary forest containing introduced fast growing species. A socio-economic database was planned as part of the forest monitoring system at MSD-Forestry because there is a need to assess the reasons of forest cover change. Further, it should assess the social benefit the forest provides for the land owners. It could help to show that Fiji’s natural forest has value which is important for the rural population beside the national income from tropical timber.

Information was gathered by the field teams during establishment and measurement of permanent sample plots. The villagers in the vicinity of the sample plots were interviewed.

A total of 16 villages were interviewed. The number of households per village range from 12 to 85 with an average of 58 per village.

Local Use of Timber

Timber is used by the villages for furniture, construction of houses, fencing and so on. The need for woodcarving and boat building are very specific. Woodcarving and boat building need special tree an entity as well as in remote reef areas. Although the loss of information at species level is recognised, the information on the direction of change is vital in the overall understanding of significant habitat changes and their likely causes.

The experience gained from remote sensing analysis should enable reef ecologists to re-evaluate the current methodology of monitoring long term coral reef changes. There should, however, be a balanced approach to the question of scale in which the monitoring is taking place. An appropriate scale should be able to distinguish between significant changes and "noise" from any conventional in situ survey.

by Les Allinson, Computer Systems Manager, SOPAC

THE INTERNET IN FIJI

Introduction

As we approach the end of the 20th century and the promise of the information highway becomes a reality for the developed countries it is clear that users in Fiji, the hub of the South Pacific, are at a critical point of gaining access to this highway. The highway has one common and global vehicle: Internet which is the largest network of networks in the world and Fiji users have several possibilities for getting on board. We look at the history of the net, the current status in Fiji as well as possible scenarios for access. The smaller island countries also have a possible option for sharing the services and these will also be outlined.

What is the Internet

The Internet is a network of networks made up of millions of interconnected computers. It came into being as ARPAnet (Advanced Research Project Agency Network), an experimental distributed network of computers designed in the 1970's by the US Defence Department to withstand a nuclear attack where no one computer was a central hub. The National Science Foundation then built NFSNET along the same lines as ARPAnet to connect research and educational institutions and with the lifting of access restrictions in the early 1990's commercial networks joined the Internet.

The phenomenal success of the Internet can mainly be attributed to the fact the no one really owns the net and the technology is open and

species and should be monitored in the future.

The amount of timber for construction was estimated with 1.8 m^3 per household per month. Because small dimensions are used the estimation is difficult and most probably the figure is overestimated. The local use has negligible impact to the forest because it's selective cutting of trees with small dbh (diameter at breast height (130 cm above ground)).

Kerosene stoves are getting more popular, but firewood continues to play a dominant role in rural areas. The fuel consumption is estimated with stack pile firewood of 2.7 m^3 per household per month. Fuelwood collection has no negative impact on a healthy forest. In respect to kerosene, the use of fuelwood does not contribute to the enrichment of global dioxide.

Water Supply

Full forest cover sustains a stable water supply and good water quality. Forest canopy reduces erosion during heavy rain the quantity of sediments is low. Generally, most villages get the water supply from the nearest creek, the average distance is recorded with up to 250 m. Only 20% of the recorded villages have their own water wells.

More than 50% of the visited villages noted a change in water quality. The reason should be investigated.

Food and Medicine from the Forest

It was noted by the field teams that there is an increase of medicine supply by pharmacies which replaces local traditional medicine. However, more than 80% of the visited villages get most of the medicine still out of the forest. More than five times a week somebody is collecting plants used for traditional medicine. Villages named the following plants as important for medical treatment. The sequence shows the percentage of villages which named the plant.

Drautolu (69%), Wabosucu (44%), Qiqilia (38%), Wi (38%), Vativati (25%), Totodro, Vacea Maca, Vuetinaitasiri, Kavika, Dabi, Vulokaka.

Forest products are added daily to the food in rural areas in Fiji. The villagers named several fruits and plants provided by the forest.

Hunting provides important protein in the nutrition content of the meal. The teams noted an average of one third of a pig per household per month. During season, bat hunting provides additional protein.

Livestock Farming

There was an average of more than 4 cattle per household recorded. This shows that cattle are an important part of food supply and income. Cattle were found in all villages and all villages have cattle grazing in the forest. It is possible that cattle farming was practised mostly in cattle farms before and now the practise has changed to smaller herds of cattle driven into the forest around the village. This would explain the increase of introduced species such as African Tulip in pasture land.

Goat farming takes the second place. An average of nearly 3 goats per household were noted.

In some villages horses are part of the livestock (0.5 horse/household).

The impact of livestock farming to the forest is not known in Fiji. There might be a damage on the regeneration, however, this must be investigated. Within the forest the soil erosion caused by cattle is less than in open pasture land.

Recommendation

The socio-economic database is only a start and will be continued by forest field teams. It must be linked to spatial data to investigate the forest value for rural areas and the impact on the forest. Further it has to be linked to data bases of other departments in Fiji such as Agriculture and Hydrology. Proposed investigations of reasons and impacts may modify the database structure.

For more information contact Osea Tuinivanua, MSD, Forestry, Fiji.

non proprietary.

Internet is a layered service which offers interactive access for querying information, file transfer (ftp) and e-mail where interactive access and ftp requires connection to a full Internet node or Internet Service Provider while e-mail can be transferred by an e-mail only session. Thus e-mail can be seen as the most basic of the service.

What can a User in Fiji get now?
At present, users in Fiji have no Internet host which is accessible to the public. There are the following options:

USP (University of the South Pacific) has provided a Internet host for university staff and associates. The host is the top level domain for Fiji and has full Internet access via a dedicated international circuit to AARNet (Australian Academic and Research Network). The speed of the circuit is 4.8 Kbps which is somewhat slow for an ISP and there is limited availability of accounts.

SPC (South Pacific Commission) hosts the Sustainable Development Network which allows staff and others working on sustainable development and related projects access to a dial-up e-mail service (a MS-DOS PC running simple network services named PACTOK) which regularly transfers e-mail with the Internet via a host in Australia. Similar dial-up services are provided in several island countries. The SDN project is funded by UNDP. This service is only available to SPC staff and those affiliated with SDN projects and limited for e-mail

SOPAC (South Pacific Applied Geoscience Commission) has a Unix host which regularly transfers e-mail with ORSTOM, New Caledonia, which is an Internet host connected in turn to ORSTOM, France which is on the Internet backbone. This service is only available to SOPAC staff and affiliates and limited to e-mail. The mail interface, however, is Microsoft Mail which is consistent across local and Internet e-mail.

PEACESAT (Pan Pacific Education and Communications Experiment by Satellite) is a non commercial satellite based communications network allowing connection of many sites in the Pacific in a mesh topology for the transmission of voice and data. There is a PEACESAT very small aperture terminal (VSAT) located at SPC, Nabua, as well as at Fisheries Department, Lami. Of these two Fiji sites, SPC, regularly exchanges Internet e-mail with the PEACESAT headquarters site in Honolulu. These e-mail exchanges have to be manually scheduled and again the service is limited to SPC staff and affiliates.

The only other option for a user who cannot access any of the above is to subscribe to a service provider outside of Fiji such as Compuserve in Australia which offers Internet e-mail in addition to its many user forums. The disadvantage of such service is the high cost which is the sum of subscription charge, volume charge and the major charge item, international communication tarrifs.

None of these options provide cost effective access for users outside the above organisations/services and the only full Internet access is via a low bandwidth circuit to Australia. The situation had become a case of users exploring their own options due to constraints and there seemed no likelihood of a cooperative effort. The need for a study was identified by USP and a consultant, Gabriel Accascina, was commissioned under Asia Foundation funding to produce a report which explored Internet Services for Fiji.

What are the options for Fiji?
The study identified the existing providers and users and arrived at a recommendation of the formation of a consortium of users who would manage the Fiji main ISP which would provide full Internet access and which would be funded by contributions from the various organisations where the annual fee would be proportional to the size class of the organisation. This in turn would determine the bandwidth allocated to that organisation.

An example of the possible organisation size, fee and bandwidth for year one is shown in Table 1 overleaf.

The estimated cost of establishing and operating an ISP for Fiji would be FJD 230,000 for the first year with a 19.2 Kbps leased line to Australia and FJD 326,000 for the second year with a 64 Kbps leased line. It is envisaged that seed funding would be needed to cover the cost of establishing and operating an ISP for Fiji for the first year after which time it would be self sustaining.

The comprehensive report on Internet Services for Fiji was presented at USP on Thursday 6 February by Gabriel Accascina and received support from a large group of potential users. A steering committee was formed at the meeting and it is anticipated that this committee will act rapidly in identifying funding sources for the first year seed cost.

There are of course other options to a consortium and one would be for a commercial company to operate an ISP where the company could be a telecommunications provider. However, it appears that the expertise in implementing and operating Internet services is within USP, SOPAC and SPC which favours the consortium approach.

What are the options for small island countries?
The introduction of an ISP in small island countries using the consortium model may not be feasible for some time due to the high cost of international communications and the small number of potential users. The short and medium term solution would be to use the PEACESAT network to connect the small island countries to Suva or Honolulu and then onto an ISP. The PEACESAT network is being upgraded in 1995 from analogue to digital and it is expected that many of the sites in the Pacific will have been upgraded by mid 1996 which should allow each site to dedicate a portion of its bandwidth for X.25 which can be used to access an ISP in Suva or Honolulu.

Summary
The introduction of an ISP will greatly assist users in Fiji by providing access to Internet services for both import and

A Study on the Expansion of Internet Services in Fiji

A feasibility study on the expansion of Internet services in Fiji is being conducted by the University of the South Pacific. The USP contracted Mr. Gabriel Accascina, Information and Communication Consultant, to conduct a study on the social, economical and technical aspects of offering Internet services to interested organisations in the country. The study was funded by the Asia Foundation.

As Internet becomes more and more ubiquitous, many potential users have been approaching the University asking for Internet connectivity. USP, though has been unable to fulfil the demand mainly due to technical and funding limitations. The study presented by Mr. Accascina concludes that it is possible to offer reasonably priced Internet services in Fiji by forming a Consortium of users, as it has been done succesfully in other developing countries.

For those who are not familiar with it, the Internet is a network of millions of computers around the world. This network allows users to send electronic mail messages to each other and to access a very large information base. It also allows users to “publish” their information on the network for others to retrieve. Internet services also allow overseas users to access available information relative to Fiji, including economic, academic and trade/commercial information. This data exchange may be extremely important for the future of the country as it will allow users in Fiji to join the electronic community world-wide and take advantage of the Internet service to further its own development.

For more information please contact: Dr. John Clayton, Director, Computer Services, USP, 313900 or Mr. Gabriel Accascina, Information and Communication Consultant, 304989.

Table 1.

Class	Employees using computers	Annual fee FJD	Bandwidth
Large	more than 50	14,000	4.8 Kbps
Medium	between 6 and 50	6,000	2.4 Kbps
Small	5 or less	2,000	1.2 Kbps

export of information but more importantly it will place Fiji on the information highway map which is essential for attracting investors in the technology sectors. As well, there is a solution for the small island countries to share in Internet access and bring the whole Pacific onto the highway.

For a copy of the report "Internet Services in Fiji" contact Gabriel Accascina, Information and Communication Consultant, Tel: 304989 Fax: 304981 or John Clayton, Director of Computing Services, USP, Tel: 212422.

■ *by Osea Tuinivanua, MSD, Forestry Department*
Suva, Fiji

STRATIFICATION OF SECONDARY FOREST IN FIJI

Introduction

GIS analysis overlaying the forest cover mapped by satellite data over the forest area mapped by the last inventory in 1969 showed that more than 20% of today's forest area was mapped as non forest 25 years ago. Field checks showed that this area is really covered with forest. Field assessments were carried out to investigate the available woody biomass, the number of trees and the species composition.

The field observations stratified this secondary forest into three main types by structure and species composition:

- African Tulip dominated vegetation
- Guava dominated vegetation
- Raintree forest

34 plots were measured in areas detected as Secondary Forest by GIS overlay analysis. 29 plots can be considered as Tulip dominated vegetation. Four plots must be considered as Guava dominated. One plot was covered by Bamboo.

Further investigations were carried out to stratify this secondary forest by satellite image processing of Landsat images.

African Tulip dominated Vegetation

African Tulip was introduced in the 1930´s and now naturalised and very common where the origin is still unknown. In the 29 plots an average timber volume per hectare of 95 m3 was measured for all trees equal or greater 10 cm dbh (diameter at breast height (130 cm above ground)) respectively 56 m^3 for trees equal or greater 35 cm.

The tree composition in secondary forest classified as "African tulip" forest type is dominated by this species (*Spathodea campanulata)* which 49 m^3 per hectare (53%). Koka (*Bischofia javanica*) takes the second place with 9 m^3 (10%), followed by Ivi (*Inocarpus fagiferus*) with 8 m^3 (9%). The introduced species

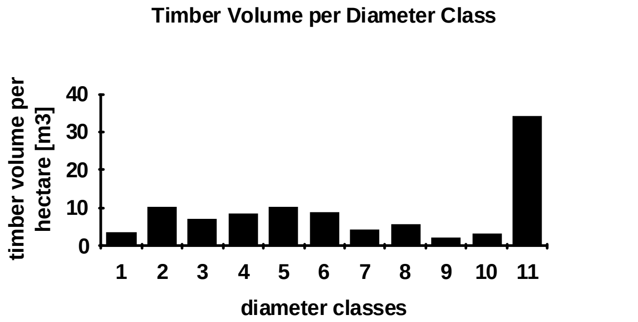

Figure 1*. Timber volume per hectare per diameter class in Tulip Forest. Diameter class 1 between 10 and 15 cm dbh, class 2 between 15 and 20 cm dbh etc. Diameter class 11 contains all trees with 60 cm dbh and greater.*

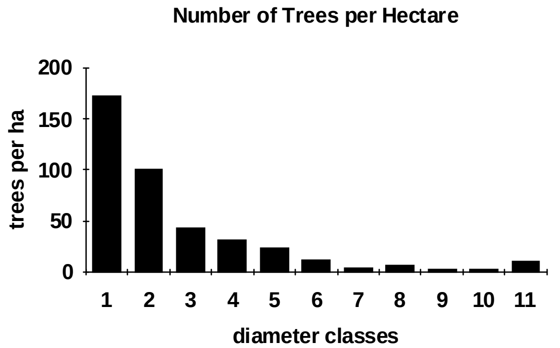

Figure 2*. Trees per hectare per diameter class in Tulip Forest. Diameter class 1 between 10 and 15 cm dbh, class 2 between 15 and 20 cm dbh etc. Diameter class 11 contains all trees with 60 cm dbh and greater.*

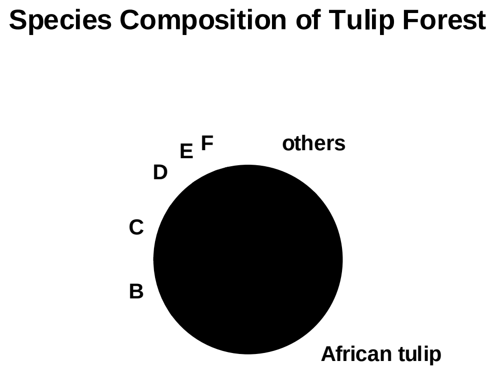

Figure 3*. Species composition in secondary forest dominated by African tulips in terms of timber volume per hectare of all tree equal or greater than 10 cm dbh. A = African Tulip, B = Koka, C = Ivi, D = Mocemoce, E = Makosoi ni veikau, F = Yemane, G = 40 other species*

Mocemoce or Raintree (*Samanea saman*) has a part of 6 m^3 or 6%, followed by Makosoi ni veikau (*Cyathocalyx insularis*) 4 m^3 (4%) and another introduced species Yemane (*Gmelina arborea*) 2 m^3 (2%). The rest (16%) is distributed among 40 other species including four introduced species, Uto, Guava, Mahogany and Moli Madarini.

Guava Dominated Vegetation

During the field checks it was noted that some areas of the secondary forest are covered by vegetation dominated by Guava trees/shrubs. This parts of the forest have a very low woody biomass (25 m^3 per hectare for all trees greater or equal 10 cm dbh) and they are dominated by Kauvula (*Endospermum macrophyllum*). However, there were only three sample plots measured in this vegetation type the accuracy of the given figures is week. Further, Guava dominated the area by visual impression, but most of these shrubs have a diameter less than 10 cm and they do not count in the statistic.

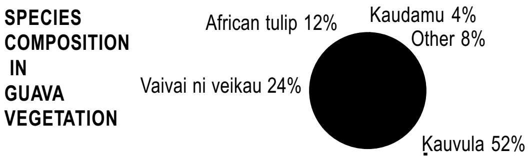

Figure 4*. Species composition in three plots measured in Guava dominated vegetation. Notice: Guava does not appear in the statistics because most diameter of this shrubby vegetation is less than 10 cm! However, it probably has an important influence on the spectral characteristic.*

Raintree Forest

Raintree (*Samanea saman*) growth in the low-lying alluvial sites and river valleys. Its adaptability has resulted in its widespread to covering the upper natural forest sites in the drier zones of the Vanua Levu and Viti Levu. The exotic tree species was introduced from Hawaii and has naturalised itself in Fiji (Berry and Howard 1973). The extent of distribution is influenced by human and the grazing cattle with redistribution of seeds. It has a significant environmental role not only as soil erosion control but as habitat for bird and animal life. The timber has been widely used for carving.

19 Plots were measured in Raintree Forest. The inventory team found trees up to 1.5 m dbh. The number of trees per hectare is lower compared with Tulip dominated forest cover, but there are much bigger trees growing on these sites.

Stratification of Secondary Forest by Satellite Images

The visual interpretation has shown good contrast between these different secondary forest types, natural forest as well as non forest area. Also within the secondary forest a stratification with digital Landsat data seems to be possible.

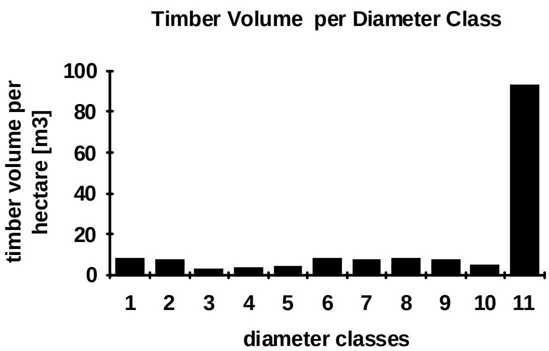

Figure 5*. Trees per hectare per diameter class in Raintree Forest. Diameter class 1 between 10 and 15 cm dbh, class 2 between 15 and 20 cm dbh etc. Diameter class 11 contains all trees with 60 cm dbh and greater. Most timber volume is concentrated in diameter class 11 which indicates that there are many big trees.*

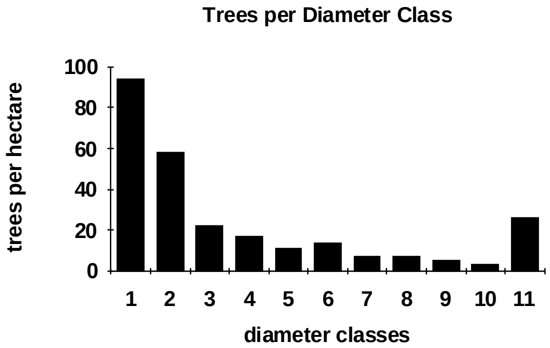

Figure 6*. Trees per hectare per diameter class in Raintree Forest. Diameter class 1 between 10 and 15 cm dbh, class 2 between 15 and 20 cm dbh etc. Diameter class 11 contains all trees with 60 cm dbh and greater.*

Table 1. *Contingency matrix showing the best possible digital classification discrimination. Raintree was not found in the area in which the digital satellite data analysis took place. MDF = Medium Dense natural Forest DF = Dense natural Forest.*

	Guava	Grassland	African tul.	Vau	MDF	DF
Guava	87%	1%		4%	2%	
Grassland	2%	95%				
African tul.	1%	2%	75%		2%	
Vau	2%	1%	2%	86%		5%
MDF			18%		88%	7%
DF	6%			8%	9%	84%

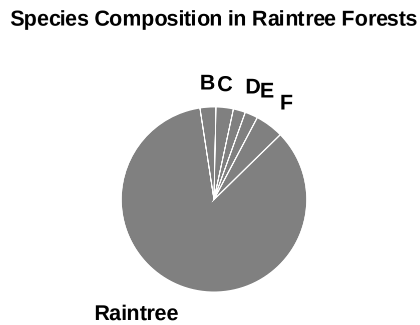

Figure 7*. Species composition in Raintree Forests in terms of volume per hectare. The dominance of Raintree (85%) is obvious. Only 15% of the woody biomass is covered by 22 other species. B = Maqo ni veikau 3%, C = Koka 3%, D = Gadoa 2%, E = Vaivai ni vavalaqi 2% F = others 5%.*

To build a contingency matrix only the pixels of the training areas are classified by the image analysis program. A contingency matrix shows the percentage of pixels that were classified as expected. The matrix in Table 1 indicates that further investigation must be done before performing a maximum likelihood classification. But it also showed that certain spectral difference which can be seen visually is recognised by the digital classifier. Vau (*Hibiscus tiliaceus*) shrubs could be identified clearly in the image, further field sample plots have to be established. African tulip is a forest type which contains many other species and influenced by the seasonal behaviour of this species. Most probably the visual interpretation has to assist digital image classification. Further investigations are ongoing.

Conclusion

Forest stratification has to be done with remote sensing data to map the strata boundaries in order to monitor forest and land use change. At present, only satellite data is available for a coverage of all forest areas in Fiji. While aerial photos are available there are large areas where photos are not available. Further investigation is necessary to identify a better correlation between spectral signatures and woody biomass as a parameter of tree composition, in order to produce maps with higher information content which can be used by policy makers.

However, staff who have experience in both forestry and remote sensing data interpretation are required to produce maps with the necessary information content.

■ *by Mike Poidevin, Project Cartographer, MSD*
Forestry Department, Suva

DIFFERENTIAL GLOBAL POSITIONING SYSTEM (DGPS)

at the Department of Forestry, Fiji

Introduction

During 1994, Management Services Division, Department of Forestry, Fiji, installed a differential global positioning system. The GPS was purchased as part of the Fiji Forest Resource Tactical Planning and Environmental Project, an AIDAB and Government of Fiji funded project. The system is now operational and will offer an improved mapping capability to forestry operations.

The System

The GPS system was supplied by Trimble Navigation through Lukemine Enterprises, a local company in Fiji. The base station is the Pathfinder community base station (PFCBS). The roving unit is a GeoExplorer. Proper use of the system yields 2-5 metre accuracy, which is adequate for general mapping applications. An operator will also require a computer and processing software. The software used by forestry is Trimble Navigation's Pfinder.

Differential GPS

A single GPS receiver can only provide an accuracy of 100m (95% of the time). Obviously, this may be useful for small scale mapping applications, or in helping one find their way. In order to achieve 2-5 metre accuracy, a method called differential GPS must be employed. This method requires two (2) GPS receivers. One is called the base station receiver, and the roving unit is called the rover.

The base station must be installed over a mark, of which the exact co-ordinates must be known. Ideally, this point should be surveyed in by surveyors, who provide the co-ordinates in the WGS-84 datum. Forestry have such a point located on the forestry garage at Colo-I-Suva. The base station is permanently sited here and requires a computer to be connected during differential operations.

Differential Correction

Differential GPS requires that one receiver, known as the base station, be placed on a known reference position. It receives GPS data from all satellites in view. One or more rover receivers collect GPS at unknown locations using a subset of the same satellites that the base is receiving data from. The GPS positions collected by the base station are compared to the known location, and the offset differences are used to improve the accuracy of the rover positions.

Differential GPS corrections can be applied at the time the data is being collected in the field (real-time differential GPS using radios). Differential corrections can also be applied in the office once the rover and base station files are transferred to a PC. This is called postprocessed differential corrections. Forestry does not have a real-time capability and thus employs the postprocessed technique.

Field Operation

A typical mapping application for forestry is the location of forestry trails and log dumps. While forestry undertakes mapping using aerial photography, the photography is usually dated, or the roads and log dumps constructed after the photography has been taken.

The computer is connected to the base station, which logs all satellites in view at 5 second intervals (this interval can be altered by the user). In the field, the rover unit is held outside the vehicle and driven along the forest trail. At 5 second intervals, those satellites in view are logged to the rover unit. The vehicle is driven at a relatively slow speed to ensure proper logging of the feature. When a log dump is reached, the user selects the feature definition for a log dump and records satellite information (for approx. 30 seconds). The feature for the forest trail is re-selected and logging of the trail continues until completion.

Back in the office, the data captured by the rover unit is downloaded to the PC. Using the Pfinder software, differential correction is undertaken on the sets of data. This data can be plotted and converted to a GIS format. The Pfinder software computes the final co-ordinate values in Fiji Map Grid co-ordinates. Likewise heights are converted from WGS-84, height above ellipsoid (HAE) to their correct height above sea level.

If the user has carefully followed the correct procedures, then the final co-ordinates should be in the 2-5 metre range. NOTE: This method can be where the rover receiver is within 500 km of the base station. Ideally, the rover unit should be less than 100 km, as the accuracy falls off approximately 1 metre per 100 km from the base station.

■ *by Kevin McConell, Lukemine Enterprises*

SMALL GPS SURVEYS IN FIJI

Two small surveys with the Trimble GeoExplorer utilising differential GPS (DGPS) techniques have recently been undertaken, one close to Suva, and the other approximately 100 km west.

The first, as an aid to PWD (Public Works Department) in the location of a suitable route for a gravity sewer line, was in secondary growth bush on the north-eastern outskirts of Suva. Six road centre line pegs of the proposed new regional road were found, and each of their positions fixed by logging for 30 seconds with the GeoExplorer handheld over the peg. A creek was then traced with a further 23 positions being fixed by logging for similar time spans. It was not necessary to cut any bush to obtain satisfactory satellite readings. Field time amounted to 4.5 hrs.

Differential corrections, processed with files which were logged on the Department of Forest's Trimble Community Base Station (CBS), yielded pleasing results. Distances between the road centre line pegs calculated within 0.4 m – 1.0 m of the plan surveyed distances. The output plot of the creek traverse was then used as a guide for a total station survey of the proposed sewer route. An output file in DXF format was also produced.

The second survey was in completely different conditions. The Sigatoka Sands, 100Km west of Suva, are almost completely devoid of vegetation but contain a well-known historical site. Evidence of Lapita pottery and early Fijian occupation, 2500 years ago, have been the subject of excavations for several decades.

There is a fear that a cyclone could damage the site so a certain degree of urgency has resulted in the current excavation by Fiji Museum staff, and volunteers, which commenced early January. Two sites within an approximately 100 m square are being studied.

GPS was used to fix the positions of 4 pegs from which stadia surveys were carried out, 2 possible burial sites, 4 pottery scatter sites, and to define the current locations of sand ridges. Burial sites were identified by the Museum archaeologist who calmly bent down and picked up human teeth just lying on the sand. A bit of a surprise to the uninitiated.

On this occasion, 60 or more positions were logged at each location, with the largest file, involving a walk in the hot sun and strong wind along the top sand ridge, totalling 1190 positions. About 2.5 km distance was traversed in a total field time of a little over 2 hours.

Post processed data has been combined, is available in Fiji Map Grid coordinate format, and will be compared when future GPS surveys of the site are carried out.

Lukemine Enterprises
Phone/Fax # 370858.

■ *by Tevita Wara, NLTB*

NLTB LIS – AN UPDATE

Our last brief report appeared in the 1994 February issue of the Newsletter. In addition to our last report we would like to inform you of our work progress to date, our on-going work program and to touch briefly on the future development of the NLTB-LIS.

NLTB-LIS Work Progress

We have completed our primary goal of capturing data on all customary land ownerships in the Republic of Fiji. This program commenced January 1988 and was completed at the end of April 1994. The maps used for capturing these data are the original Native Land Commission maps on the basic scales of 1:12672,1:6336 and 1:3168. In addition we also captured cadastral mapping series of Native Lands obtained from the Department of Lands and Survey on the scales of 1:1584,1:3168,1:6336 for the Central division and 1:12672 for the Western Division. Briefly the work progress during our data program from 1988-1994 is as follows:

- Eastern Division-1988
- Central Division-1989-1990
- Western Division-1991-1992
- Northern Division-1993-31/4/94
- Map Facetisation of the Republic of Fiji-May-December 1994

It must be noted that in addition to the cadastral data captured during this period we have also captured forestry data provided by Management Services Department of the Ministry of Forests from the Fiji Forest Inventory by Land Resources Division of the D.O.S of United Kingdom and Soil/Land Classification and capability provided by the Land Use Department of the Ministry of Primary Industries from report on Soil Classification of Fiji by Wright/Twyford. Both these projects were discontinued in early 1991 on the advice of both Ministries on the availability of new data.

On-going Work Program

In December, the Native Land Trust Board approved several recommendations in a report prepared jointly by the New Zealand Department of Survey and Land Information, FLIS Support Centre and Information Systems Department, NLTB. One of its main recommendations was the establishment of an on-line telephone link between FLIS Support Centre and NLTB Vanua Centre to facilitate the transfer of data from NLTB-LIS to FLIS Support Centre and visa-versa. The communication link was established, the Join Task Force who were assigned to implement the data transfer exercise were not successful as expected due to teething problems experienced using the 2 SIF translators on both sides. Solutions to the problems were found towards the end of last year and both parties will continue with this exercise this year.

CONTACTS

Organisations within Fiji who receive and provide contributions to this newsletter:

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