#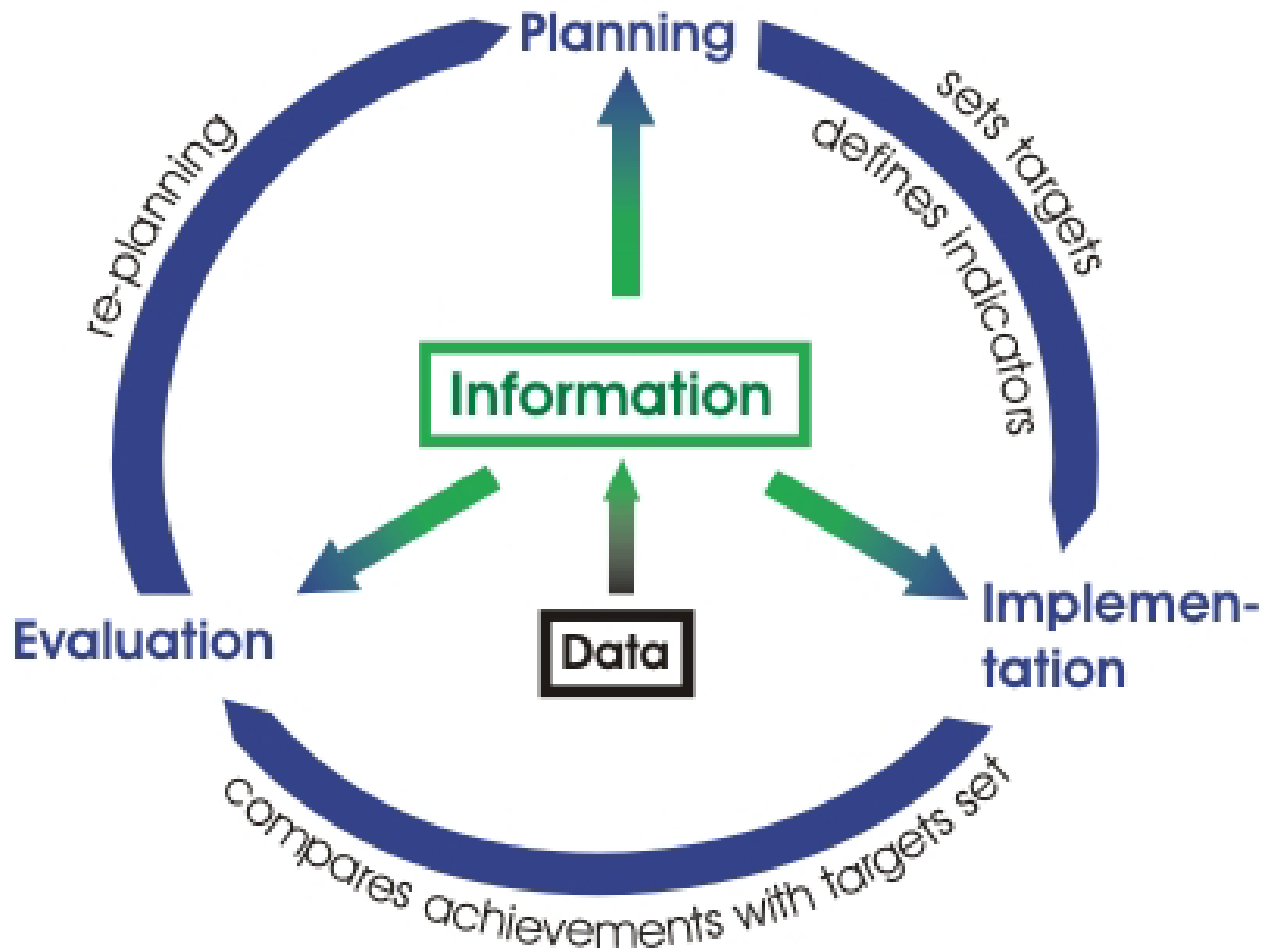 Experiences in quantitative management effectiveness assessment using the Management Information System MIST in Bwindi Impenetrable National Park, Uganda

John Makombo and Klaus Schmitt

November 2003

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1. SUMMARY

This report presents an example of how quantitative assessment of management effectiveness is performed in Uganda using a spatial **M**anagement **I**nformation **S**ystem (MIST).

MIST was developed as part of the GTZ project 'Advisory Services to Uganda Wildlife Authority' (1997-2002) and is currently used in Uganda and Cambodia. It is a tool which converts data from internal and external sources into information and communicates this information, in an appropriate form, to managers at all levels to enable them to make timely and effective decisions for planning, directing/implementing and evaluating the activities for which they are responsible. The information enables managers to assess the effectiveness of their management.

MIST comprises a user-friendly computer programme and associated data collection procedures. It consists of a Structured Query Language (SQL) database (InterBase), application processing libraries, a graphical user-interface programmed in Delphi and spatial display (ArcObjects).

Important aspects taken into consideration during the development of MIST were technical factors (data collection procedures, programming, database design, easy use and easy maintenance and customisability of MIST), the organisational set-up of Uganda Wildlife Authority (UWA) and behavioural principles (the human dimension of information management). The technical aspects have been addressed successfully and MIST has been used in Bwindi Impenetrable National Park since November 1999.

The data collection component of MIST, which has been designed to be simple and fast, and to provide data which can be processed into information which is relevant and useful for managers, focuses on protected areas. MIST can be tailor-made to reflect differences in issues, objectives, and threats at local level and different protected area categories due to the easy customisability of the programme. Because of the design of the database and the database replication module MIST becomes a tool for use at national or regional (trans boundary) level once data from the protected areas are replicated to a central MIST database.

The key issue for the successful and sustainable introduction of efficient quantitative information management is the human dimension. Opposition to new developments such as the use of MIST and quantitative information to plan, make decisions and to evaluate is inevitable, but will be overcome once managers realise that by using MIST they can do their work more efficiently and effectively. A quantitative system can only succeed if all users, particularly senior management, accept such a system and want the transparency that comes with it.

2. INTRODUCTION

Effective management means producing planned results. Assessment of management effectiveness is about evaluating how well Protected Area Management carries out actions necessary to fulfil the protected area's objectives.

Hockings (2000) gives a comprehensive review of 31 methodologies for the assessment of management effectiveness. Most of them use subjective scoring by individuals and are thus qualitative in nature, depending on the knowledge base and integrity of the people who carry out the assessment.

This report presents an example of how quantitative assessment of management effectiveness is performed in Uganda.

Requirements for a quantitative assessment of management effectiveness are:

- **data**[1] which can be processed into information which is relevant and useful for managers
- **information** which can be used to plan, make informed decisions and to evaluate to what extent the planned results have been achieved
- **plans** which set quantitative targets and define indicators
- a **tool** to provide information for planning, decision-making (implementation) and evaluation

A tool which can do this is an information system which converts data from internal and external sources into information and communicates this information, in an appropriate form, to managers at all levels to enable them to make timely and effective decisions for planning, directing/ implementing and evaluating the activities for which they are responsible.

A spatial **M**anagement **I**nformation **S**ys**t**em (MIST) was developed as part of the GTZ[2] project 'Advisory Services to Uganda Wildlife Authority' (1997-2002). MIST is currently used in nine protected areas in Uganda, in Uganda Wildlife Authority Headquarters and also in one protected area in Cambodia.

The following text gives an introduction to MIST and describes experiences with the use of MIST and the assessment of management effectiveness in Bwindi Impenetrable National Park in Uganda.

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[1] The terms data and information are often used interchangeably. However, in the context of information management they have clearly distinct meanings: data are facts which have been recorded and information is processed data.

[2] German Technical Cooperation (Deutsche Gesellschaft für Technische Zusammenarbeit).

3. A BRIEF OVERVIEW OF MIST

MIST is an easy to use, flexible and powerful tool which gives managers access to information for protected area management. It comprises a user-friendly client/server application programme and associated data collection procedures. MIST provides managers at all levels (Protected Areas, Headquarters, Ministry) with easy access to information for adaptive management: planning, decision-making (implementation), monitoring, evaluation and re-planning (fig. 1).

MIST has been designed to provide information based on the analysis of quantitative data for:

- individual protected areas (both for managers and local communities),
- national protected area systems and
- trans-boundary protected areas.

This information can be used for the assessment of management effectiveness in terms of planning, input planning, processes, outputs and outcomes according to the World Commission on Protected Areas framework for assessing the management effectiveness of protected areas and protected area systems (Hockings et al. 2000).

Fig. 1: The management cycle.

3.1. The MIST programme and database

MIST consists of a Structured Query Language (SQL) database (InterBase), application processing libraries, a graphical user-interface programmed in Delphi and spatial display (ArcObjects). MIST has been developed as a client/server application and for use on stand alone PCs. Databases from stand alone PCs in protected areas are synchronised with the central MIST database through database replication.

MIST is easy to use. It can be completely controlled by clicking on map items, page tabs, list entries and buttons of the MIST query wizards. Additional visual tools enable advanced users to create any kind of query not included in the custom-made wizards. Help files can be accessed from anywhere within the programme. Fast and accurate data entry is guaranteed through data download from GPS units (Global Positioning System) and the use of look-up tables and wizards for data entry.

Maintenance and customisation of the MIST database is done with visual Database Administrator Tools. Reports for example can be designed by the users to meet their specific needs. These reports can then be included in the MIST interface using the Database Administrator Tool without the need for any programming.

Much of the code to run database queries has been placed directly into the database as SQL procedures and triggers. This allows the user to customise MIST or make changes to MIST without having to re-code the MIST user interface or the Windows libraries. The MIST programme libraries, each dealing with a single logical task, can be updated and re-developed at any time on an as-needed basis without affecting the system as a whole. This provides a simple and cost-effective way to update MIST without having to rewrite and adapt the MIST Windows programme.

3.2. Design of data collection

The information needs of protected area managers determine what data are collected, the methods of analysis and the types of outputs. Only data which can be processed into information which is relevant and useful for managers are collected, stored and processed in MIST. Data collection has been designed to be simple and fast, to minimise data collection mistakes and to provide raw data for a wide range of outputs. All spatial data collected are geo-referenced using GPS units.

Data processed in MIST include:
- spatial data on patrols, ecology and illegal activities
- resource use and visitor data
- staff and salary data
- data from annual operations planning (activities, budget, expenses and the evaluation of the implementation status of activities)

3.3. Monitoring

MIST processes systematically and opportunistically collected data for monitoring. An example of a systematic monitoring programme are wildlife counts from the air using systematic reconnaissance flights (Norton-Griffiths 1978). Opportunistically collected data by rangers and local communities are also analysed in MIST.

Indices are used for monitoring based on the analysis of opportunistically collected data. Indices provide measures of relative density and are calculated in MIST for monitoring of wildlife populations, illegal activities and resource harvest by local communities without the need for expensive baseline data (Caughley and Sinclair 1994).

Ranger patrols record opportunistic observations on key wildlife species and on illegal activities. All data collected is geo-referenced using GPS units and recordings are taken at least every 30 minutes. This enables calculation of the distance covered by each patrol with reasonable accuracy[3]. In time, the opportunistic nature of ranger-based data collection will resemble random sampling, and thus can be used for monitoring, if the bias in spatial distribution is low and the number of kilometres patrolled high. To achieve this each protected area needs to be stratified into management sectors which are similar in terms of patrol intensity. Indices such as elephants seen per kilometre patrolled and snares collected per kilometre patrolled are then calculated for these management sectors and can be used to monitor trends.

Non-geo-referenced data collected by local communities are used to monitor resource use. Two indices are required to monitor the impact of the harvest on the resource base. (1) the amount of resources harvested (e.g. headloads/month, handful/week) and (2) the effort required for the harvest of a defined quantity (e.g. hours/headload). If the amount harvested per month remains more or less constant over time one might conclude that the harvest has no negative impact on the resource and that there is enough regeneration to sustainably support the current harvest volume. This is only the case if the effort required for the harvest of a defined quantity remains the same.

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[3] Under dense canopy patrols may not get a GPS waypoint reading for each observation. In such a case patrols need to record the time at the observation and take a waypoint afterwards as soon as the openness of canopy allows it. After downloading the waypoints, MIST will calculate the position for observations without GPS readings based on the time elapsed between two waypoints.

3.4. MIST programme design and sustainability

Important issues for the design of the MIST database were:

- data integrity (which refers to maintaining the correctness and consistency of the data),
- data independence (the data stored in a database are independent of the programme which uses them) and
- flexibility (it must be possible to access data in many different ways and for many different purposes).

Flexibility and sustainability were also key issues for the design of the MIST programme. The development of MIST as a programme which is not dependent on a highly trained GIS expert, which is easy to use, maintain and customise, and which provides different levels of access for users, contributes to the sustainability of MIST.

3.5. Institutional set-up and knowledge management

In Uganda Wildlife Authority, MIST has been placed in an Information Management Unit (IMU) which reports directly to the Executive Director. This guarantees access for all users, horizontal information flow, and data integrity.

The IMU's function is to create an information network linking the departments of UWA Headquarters and the protected areas. The role of MIST is: (1) to serve as an UWA in-house decision-support tool, (2) to provide information for planning and evaluation, (3) to act as a central data depository for incoming multi-sectoral data, and (4) to provide data and information to other institutions.

Knowledge management is the broad process of locating, organising, transferring and using the information and expertise within an organisation. It is about (1) capturing and storing knowledge in an accessible way and about (2) joining up people to enable knowledge flow/exchange across the organisation. The latter can only be achieved if a culture of knowledge exchange is established as a core value of the organisation; only then can personal knowledge be communicated.

MIST contributes to institutionalising information and knowledge management in Uganda Wildlife Authority through capturing and storing information and knowledge in an accessible way (MIST database, meta-database, and documents and manuals kept in the digital archives), and by joining up people to enable knowledge to exchange across the organisation.

Summary

- The information needs of protected area managers determine what data are collected, the methods of analysis and the types of outputs;
- Data collection must be simple, fast and provide data which can be processed into information which is relevant and useful for managers;
- Indices are used for monitoring when analysing opportunistically collected data;
- Easy use, maintenance and customisability contribute to the sustainability of MIST;
- MIST contributes to institutionalising information and knowledge management;
- MIST has been designed for use in protected areas, at national and trans-boundary levels.

4. THE BWINDI EXPERIENCE WITH MANAGEMENT EFFECTIVENESS ASSESSMENT

Bwindi Impenetrable National Park (BINP) is located in south west Uganda, (fig. 2) covering an area of 327 km² of tropical rain forest with an altitudinal range of 1,160 - 2,600 m. Bwindi has high floral and faunal biodiversity. More than half of the world's total population of about 670 mountain gorillas is found in BINP. Bwindi Impenetrable National Park was declared a World Heritage Site in 1994.

Fig. 2: Location of Bwindi Impenetrable National Park.
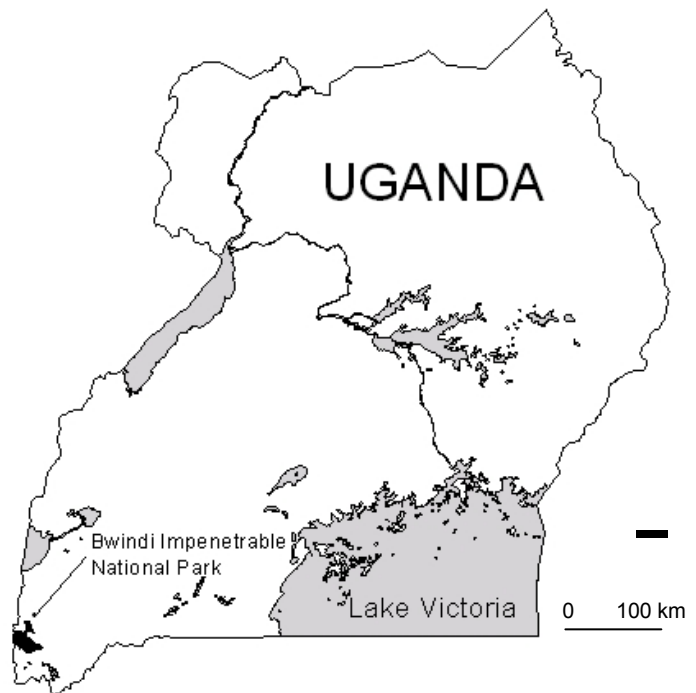
4.1. Planning

Protected Area Management Plans and Annual Operations Plans (AOPs) are written within the framework set by the Uganda Wildlife Authority Strategic Plan. The relationship between the different levels of planning is shown in figure 3.

Based on the Protected Area General Management Plan, detailed Annual Operations Plans are developed. These plans describe activities and who is responsible for their implementation, set targets, define indicators, and elaborate the budget.

An Annual Operations Planning module for MIST has been developed to assist PA managers with their annual planning and evaluation[4]. The MIST AOP module provides data entry fields and wizards for detailed descriptions of activities, budgets, milestones and indicators and for evaluation.
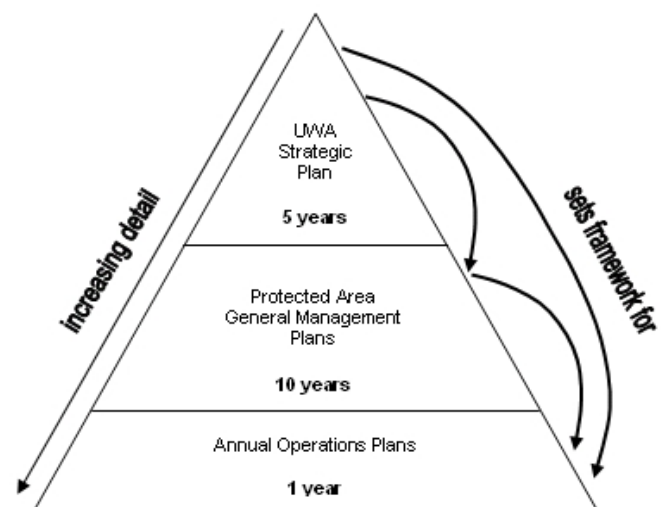

Fig. 3: Hierarchy of planning in Uganda Wildlife Authority.

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[4] There is little point in planning if progress after implementation is not monitored and evaluated. Evaluation examines implementation of the plan. Evaluation must be based on clearly defined performance measures (indicators) which describe quality, quantity, place and time, and not just on intuition, impressions or casual observations.

Figure 4 shows a screen shot from the MIST AOP module which shows details of the activity 'carry out law-enforcement patrols', the indicators and means of verification. Different windows are used to enter the budget and the evaluation codes. For more details see Schmitt and Sallee (2002).

Fig. 4: Screen shot from the MIST Annual Operations Planning module.

4.2. Assessments of management effectiveness in BINP using the activity 'carry out law-enforcement patrols' as an example

Data on ecology and illegal activities collected by ranger patrols are downloaded from the GPS units and entered regularly into the MIST database at Bwindi Impenetrable National Park headquarters. Cost for food rations and fuel used for patrol deployment are also entered at Bwindi. Salary data are part of the staff database in MIST which is synchronised through database replication with the payroll database in UWA Headquarters.

At the beginning of every month the warden responsible for MIST can then produce reports and maps on mouse click. An example of a report wizard for mammal reports where the user only needs to select the time period[5], whether or not a map should be included in the report and click on the Report button, is shown in figure 5.

Standard reports and maps produced monthly from data collected by ranger patrols:

- **Patrol and ranger performance report**: This report was designed to provide the information necessary to assess two of the indicators shown in figure 4: number of patrol days and costs/km patrolled. Other information contained in this report can be used for staff performance assessments, planning etc. An example of a patrol and ranger performance report is shown in the annex.

- **Patrol coverage map**: This map shows areas patrolled in grid cells and percentage park area patrolled. The grid cell size can be defined by the user. The standard size used in UWA is 1 km². An example of a patrol coverage map is shown in the annex.

Fig. 5: Report generator for mammal reports and maps

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[5] Other sources of data for reports which can be selected from the report generator are: air patrols, research data and occasional observations.

- **Illegal activities report and distribution map**: The report provides indices and numbers and the map shows the spatial distribution of illegal activities. The example shown in the annex provides the information necessary to assess the indicator shown in figure 4 (decrease in pitsaws/km).

- **Key wildlife species report and distribution map**: The report provides indices and numbers[6] and the map shows the spatial distribution of key wildlife species.

The regular (monthly) dissemination of quantitative information and indices shows managers the effects of their decision-making and enables them to carry out adaptive management. The information enables managers to show whether the inputs provided in terms of man-power, equipment and finances are adequate to achieve the targets set. Managers can then adapt the targets set for, or inputs to, specific activities. Reports, charts and maps produced with MIST help managers to meet their reporting requirements. They show what has been done, and document achievements and outcomes.

Information provided by MIST can be used for short-term planning. An example is the patrol deployment planning[7] based on areas patrolled, information about spatial and temporal patterns in the distribution of illegal activities and key wildlife species and on intelligence information.

4.3. Information provided by MIST not covered in the above example

Monitoring of behaviour and health of habituated gorilla groups is carried out in Bwindi Impenetrable National Park in a programme developed by the International Gorilla Conservation Programme. A gorilla database with data about individual gorillas has been added to MIST in BINP and the behaviour and health monitoring data are entered as part of the patrol data download/entry.

MIST has the option to enter data collected as part of the MIKE[8] programme and produce the reporting required by MIKE on button click.

MIST provides a module to monitor the sustainability of resource use by local communities at parish level and for the entire protected area. The data collected by local communities can also be used to assess whether harvesting is being done according to harvest quota set in the Memorandum of Understanding between the communities and the park, and to calculate the monetary value of the resources harvested by local communities.

The visitor statistics module in MIST stores data for a wide range of analyses. The data include numbers, nationality and resident status of visitors, length and type of visit, and entrance fees collected.

The AOP module is used for planning as described in section 4.1 above and also for budget control (comparison of expenses with budget planned per budget line) on mouse click. This module also provides managers with a comprehensive report which shows for each activity the implementation status and budget and expenses (activity based costing) for each quarter of the financial year. An example is given in the annex.

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[6] In protected areas with open vegetation, whenever possible, patrols also record the number of young and adult male and female. These data are used to get information about population status – sex ratio, percentage of young and group size.
[7] In Murchison Falls Conservation Area (Uganda) MIST is used to develop 2-weekly patrol operation plans.
[8] MIKE (Monitoring Illegal Killing of Elephants) is a programme under CITES, the Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Spatial data from external sources which are stored in MIST as shape files and their attribute data (socio-economy, vegetation, elevation etc.) together with the above listed data stored in the MIST database provide base-line data for future park management planning.

Summary

- The MIST AOP module is used to plan annual activities, indicators and budgets and to evaluate implementation of activities, for budget control and activity based costing.

- Regular data download and data entry into the various modules of MIST provides managers with a wide range of quantitative information (1) to assess whether the targets set have been achieved, (2) for adaptive management, (3) for reporting on achievements and outcomes, (4) for input planning and (5) for the development of management plans.

- The information provided by MIST on mouse click includes:
  - patrol and ranger performance indicators and patrol coverage maps,
  - wildlife distribution maps, indices on species abundance, information on population structure, information about systematic monitoring programmes such as gorilla behaviour and health,
  - distribution maps of illegal activities and indices to monitor trends in illegal activities,
  - indices on resource use by local communities and monetary value of resources harvested,
  - visitor statistics,
  - activities planned and their implementation status,
  - budget control, and activity based costing.

4.4. Problems with the effective use of MIST in Bwindi Impenetrable National Park

Important aspects taken into consideration during the development of MIST were technical factors, the organisational set-up of UWA and behavioural principles (the human dimension of information management). The technical aspects (data collection procedures, programming, easy use and easy maintenance and customisability of MIST) have been addressed successfully and MIST has been used for planning and decision-making in Bwindi Impenetrable National Park since November 1999. Procedures for data collection, entry and analysis and training manuals are in place and staff in BINP have been trained in data collection and the use and maintenance of MIST.

Despite this there are still problems which need to be addressed to ensure the effective use of the information system. Unreliable power supply at BINP Park Headquarters severely impacts on the effective use of the computers. BINP will address this problem through the installation of solar panels and sufficient backup power capacity. Furthermore UWA will install a back-up generator for its headquarters in Kampala to avoid future computer problems caused by fluctuations in power supply.

MIST has been set up in an Information Management Unit (IMU) to enable efficient and effective information and knowledge management and to enable knowledge exchange across the organisation. IMU staff has been trained to maintain the central database and to provide technical support to protected areas. However, technical support to MIST users in BINP is still insufficient. UWA senior management must ensure that the Information Management Unit provides timely and appropriate technical support to field staff and that IMU carries out regular maintenance of all databases.

The efficient use of MIST in BINP is further hampered by gaps in data collection and entry. This, and the insufficient technical support, are related to the human dimension of information management. To address the problems with data collection and entry, management of BINP will put in place incentives to ensure consistent data collection, and timely data entry and processing. Refresher training in data collection and the use and maintenance of MIST will be provided by UWA Headquarters. Regular feed-back to rangers on how the data they collect are being used for park management will contribute to improving staff motivation.

Opposition to new developments and institutional changes are inevitable. An example of this is the introduction of GPS units for use by ranger patrols in UWA in 1997. The initial opposition was overcome once staff realised that the GPS was not just there to control them, but to get useful information for protected area management, and once the usefulness of spatial data became obvious to managers. Nowadays GPS units are standard patrol equipment. The same will happen to initial opposition to the efficient use of MIST in BINP.

Summary

- Technical issues concerning the development and sustainable use of MIST have been addressed successfully.
- The role of UWA's Information Management Unit is to provide timely, appropriate and consistent support to all MIST users.
- Field staff need to be motivated and incentives put in place to ensure consistent data collection, timely data entry and processing.
- Opposition to new developments such as the use of MIST and quantitative information to plan, make decisions and to evaluate is inevitable, but will be overcome once managers realise that by using MIST they can do their work more efficiently and effectively.

5. CONCLUSION

The technical aspects and organisational set-up for information management have been addressed successfully during the development of MIST. The key issue for the successful and sustainable introduction of efficient information management is the human dimension. MIST uses quantitative information for planning, decision-making, monitoring, evaluation and the assessment of management effectiveness and can only succeed if all users, particularly senior management, accept such a system and want the transparency that comes with it.

Activity-based evaluation based on quantitative information, rather than qualitative perception by individuals, using an Information System such as MIST, should be used whenever possible. However, establishment of an Information System and the collection of data requires time and resources. It is therefore important to choose the appropriate assessment tool/methodology depending on objectives, the time frame and the situation on the ground in terms of availability of data, finances etc.

MIST is a tool for managers for planning, decision-making, monitoring and evaluation at local, national and regional levels. The data collection component of MIST focuses on protected areas. MIST can be tailor-made to reflect differences in issues, objectives, and threats at local level and different protected area categories due to the easy customisability of the programme[9]. Because of the design of the database and the database replication module MIST becomes a tool for use

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[9] MIST has been modified according to the needs of the management of Virachey National Park in Cambodia and successfully introduced in the park.

at national/regional (trans boundary) level once data from the protected areas are replicated to the central MIST database. The data and information flow at protected area level, the link to the national/regional level through database replication and the information flow at national/regional level is shown in figure 6.
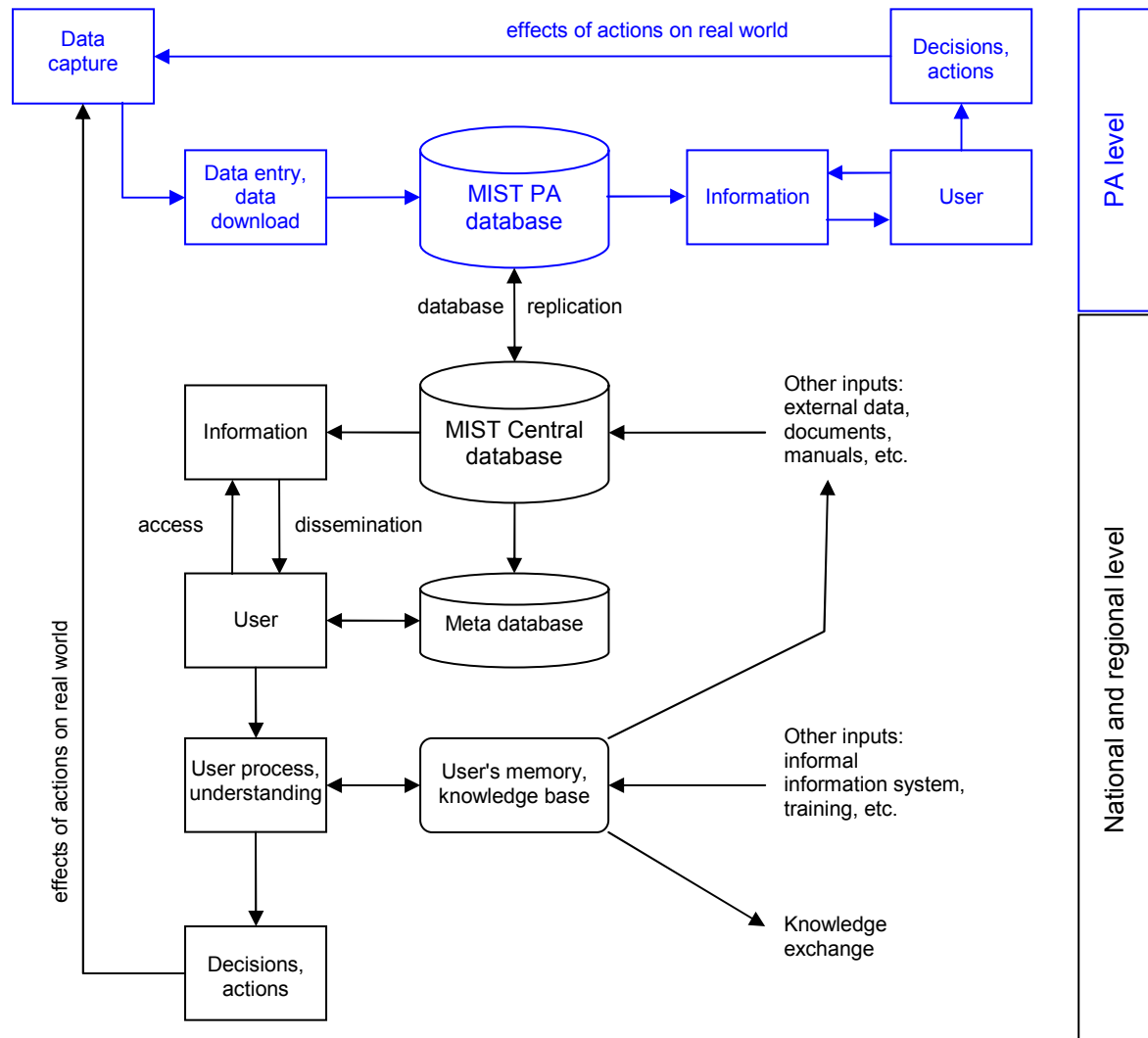

Fig. 6: Data and information flow and database replication at protected area and national/ regional level.

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Norton-Griffiths, M. 1978: Counting animals. - 2nd revised edition. African Wildlife Foundation, Nairobi, Kenya.

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Information

MIST is an open source programme, distributed free of charge for non-commercial use.

Further information can be obtained from:

GTZ, Karin von Loebenstein, Postfach 5180, 65726 Eschborn, Germany
E-mail: Karin.Loebenstein-von@gtz.de

A demo version of the MIST programme and an interactive demo about the use of MIST can be ordered, and a report about MIST in pdf format and MIST files can be downloaded from:
http://www.ecostats.com/software/mist/mist.htm

Programme development: Ecological Software Solutions (mail@ecostats.com) and Klaus Schmitt (klaus@brinkschmitt.com).

Patrol and ranger performance report BINP, May 2001.

Uganda Wildlife Authority
BINP: Ranger Reports
Ground Patrols
Inclusive Dates: 01/05/2001 to 01/06/2001
Report Date: 23/08/2003

Number of Patrols	50	Average Days on Patrol	1.64
Patrol Days	82	Average Nights on Patrol	0.64
Patrol Nights	32	Average Patrol Size	2
Total Distance(km) Patrolled	127	Average Patrol Distance(km)	2.54
Costs / km Patrolled	14000		

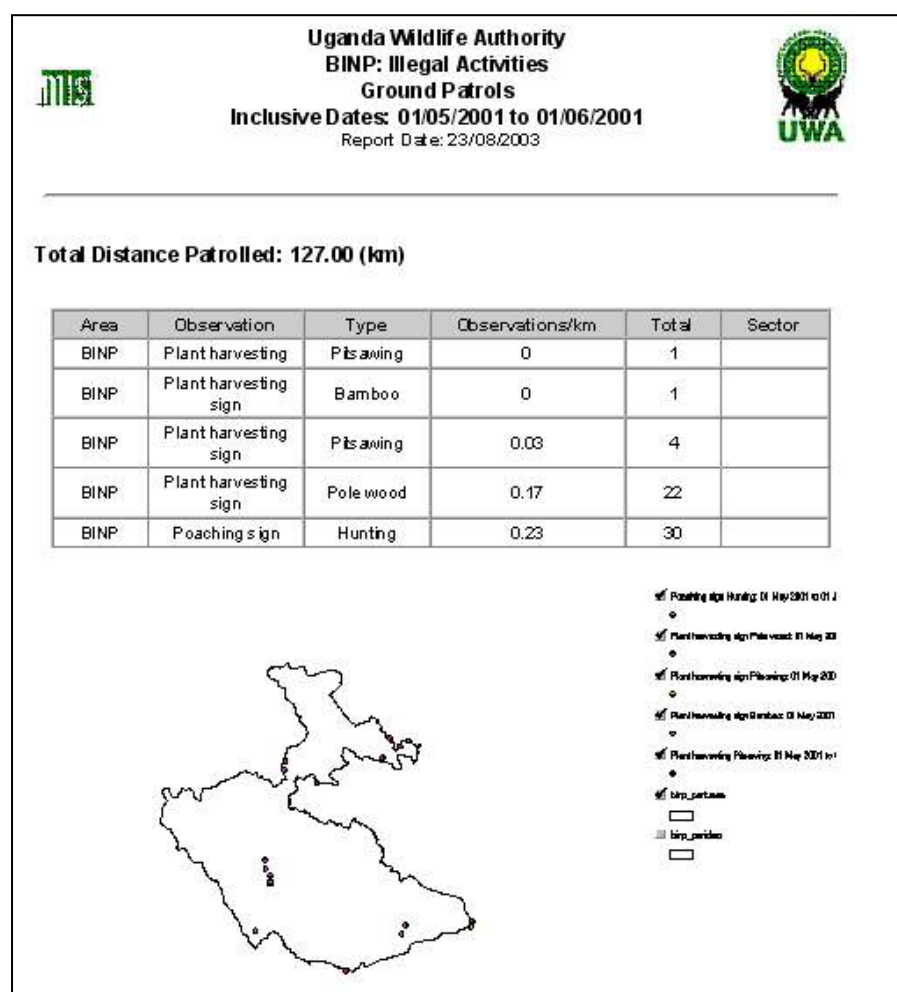| Id	Name	Patrols	Days	Nights	Distance (km)
480	MIGYISHA,STEPHEN	1	1	0	0.27
482	TUMUGABIRWE,CHRISTOPHER	2	2	0	1.52
484	MUHWEZI,ABEL	1	1	0	1.62
491	BAGAMUHUNDA,MATAYO	1	1	0	1.97
492	MBONIGABA,SILVER	2	11	9	8.15
493	KANYAMANZA,GASTON	4	4	0	16.78
495	TIBEMANYA,JAMES	2	2	0	1.15
496	BAREBERAHO,JOTHAM	3	3	0	1.98

Map showing patrol paths and patrolled areas in 1km² grid cells, BINP, May 2001.
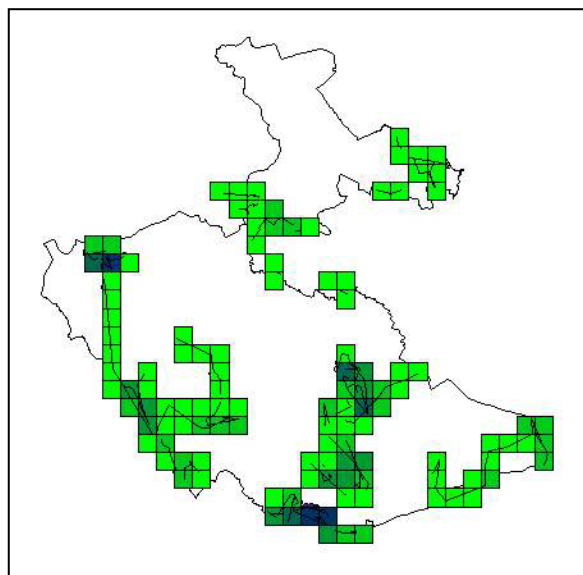
Map showing all gorilla sightings between November 1999 and June 2001, BINP.
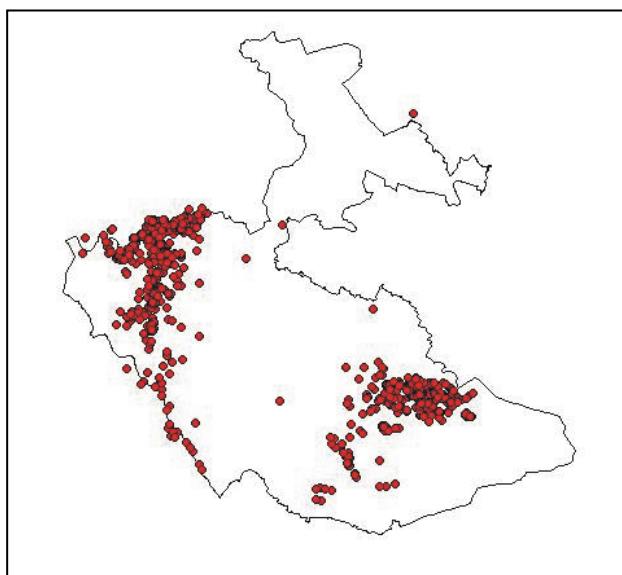
Report about number and indices of illegal activities and distribution map, BINP, May 2001.

Uganda Wildlife Authority
BINP: Illegal Activities
Ground Patrols
Inclusive Dates: 01/05/2001 to 01/06/2001
Report Date: 23/08/2003

Total Distance Patrolled: 127.00 (km)

Area	Observation	Type	Observations/km	Total	Sector
BINP	Plant harvesting	Pitsawing	0	1	
BINP	Plant harvesting sign	Bamboo	0	1	
BINP	Plant harvesting sign	Pitsawing	0.03	4	
BINP	Plant harvesting sign	Pole wood	0.17	22	
BINP	Poaching sign	Hunting	0.23	30	

Quarterly report showing for each activity: the budget, expense (current quarter and cumulative), percentage of budget spent, implementation status for each quarter and explanatory remarks.

The codes used for the implementation status are: A - no deviation from the plan, B - deviation from plan but no need for corrective action, and C - deviation from plan and need for corrective action.

UGANDA WILDLIFE AUTHORITY
AOP Quarterly/Annual Report

Cost Centre: Bwindi Impenetrable National Park   FY: 2002/2003   Quarter: 1-4

Pr	Activity	Budget	Actually Spent this quarter	Actually Spent up to this quarter	% of budget spent	Status Code Q1 Q2 Q3 Q4	Remarks (indicate if extra pages has been attached) Deviation	Remarks Corrective Action
1	Annual Operations Planning	400,000	10,000	26,000	6.5	C	enter explanation	elaborate corrective actions
1	Ranger Based Data Collection	460,000	110,000	440,000	95.65	A A A A		
1	Construct HQ	251,150,000	50,000	200,560,000	79.86	B B B A		
2	Carry out law enforcement patrols	2,900,000	660,000	2,640,000	91.03	B B B A		
	Total	254,910,000	830,000	203,666,000				