

Ranger-Based Data Collection



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Ranger-Based Data Collection

A reference guide and training manual
for protected area staff in Cambodia



All pictures Virachey National Park. Cover page: Ho Chi Minh Trail - David Zeller 2005. This page left: Sun Bear scratches - BPAMP 2005; top right: Tiger snares - Phillip Thomas 2005; bottom right: Veal Yak Yu - Thon Soukhon, 2006.

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Ministry of Environment



Department of Nature
Conservation and Protection



Biodiversity and Protected
Areas Management Project



World Bank



Global Environment Facility

Foreword

The Ministry of Environment has been given the responsibility to manage the protected areas established by Royal Decree in 1993. These protected areas constitute about 18% of Cambodia's land. Ensuring the integrity of these areas and safeguarding their biodiversity is one of the key duties of the Department of Nature Conservation and Protection of the Ministry of Environment. The Ministry needs to know whether and how effectively it fulfils its role, it is therefore essential for the Department of Nature Conservation and Protection to ensure that protected area status and trends are monitored.

To assess and monitor protected area status and trends is also a goal of the Convention on Biological Diversity's Programme of Work on Protected Areas. The target set is: by 2010, national and regional systems are established to enable effective monitoring of protected area coverage, status and trends at national, regional and global scales, and to assist in evaluating progress in meeting global biodiversity targets.

Assessment and monitoring requires accurate and up-to-date data. These data can be provided from different sources, such as scientific monitoring programmes, but the most obvious source are rangers who patrol the protected areas at a regular basis.

The World Bank and Global Environment Facility funded, and Ministry of Environment implemented Biodiversity and Protected Areas Management Project has tested and implemented ranger-based data collection in Virachey National Park. Ranger-based data collection has since been introduced in other protected areas with the support from Flora and Fauna International and the Wildlife Conservation Society. The data collected by rangers on biodiversity and illegal activities are analysed using a computerised management information system (MIST) to provide timely and up-to-date information for decision-making, planning and monitoring.

The Biodiversity and Protected Areas Management Project has compiled the experience made during the implementation of ranger-based data collection in a comprehensive manual. I am please to present you this manual which forms part of the national ranger training curriculum, and which provides managers with clear instructions how to monitor trends in illegal activities and biodiversity.

Mr. Chay Samith

Director, Department of Nature Conservation and Protection
Ministry of Environment

Approval

**This manual and the guidelines therein have been reviewed by the
Department of Nature Conservation and Protection
of the Ministry of Environment
and approved for implementation**

**His Excellency Dr. Mok Mareth
Senior Minister
Minister of Environment
June 2006**

Table of contents

| | |
|---|------|
| Foreword | .i |
| Approval | ii |
| Table of contents | .iii |
| List of figures | .iii |
| List of tables | .iii |
| Acknowledgements | .iv |
| Acronyms | .v |
| 1. Introduction | .6 |
| 2. Background | .7 |
| 3. Ranger-based data collection as part of protected area management | .9 |
| 4. Standardised data collection | .11 |
| 4.1 Standardised nomenclature | .11 |
| 5. Steps required before starting RBDC | .14 |
| 5.1 Information needs assessment | .14 |
| 5.2 Design of the patrol data sheet | .15 |
| 5.3 Prepare instructions for filling in the patrol data sheet | .17 |
| 5.4 Prepare instructions for the set-up of GPS units | .17 |
| 5.5 Delineate management sectors | .17 |
| 5.6 Agree on standard monthly MIST outputs | .17 |
| 5.7 Set-up of MIST computer and software | .18 |
| 6. Field instructions | .19 |
| 7. Data entry in MIST | .21 |
| 8. RBDC training schedule | .22 |
| 9. References | .24 |
| Appendices | .26 |
| Appendix 1: Monitoring of wildlife population trends and trends in illegal activities | .27 |
| Appendix 2: Flow diagram - data to be recorded about illegal activities in Virachey National Park | .32 |
| Appendix 3: List of observation codes | .35 |
| Appendix 4: Example patrol data sheets | .36 |
| Appendix 5: Instructions for filling in the patrol data sheet | .41 |
| Appendix 6: RBDC field instructions | .44 |
| Appendix 7: GPS set up | .45 |
| Appendix 8: Glossary | .47 |

List of figures

| | |
|--|-----|
| Fig. 1: Adaptive management cycle | .9 |
| Fig. 2: The role of ranger-based data collection in the protected area management cycle | .10 |
| Fig. 3: Chart which illustrates a downwards trend in illegal activities using indices | .23 |
| Fig. 4: Comparison of actual and calculated patrol distance | .28 |
| Fig. 5: Extent of areas patrolled in the hypothetical protected area between 2000 and 2002 | .30 |
| Fig. 6: Data and information flow and database replication at protected area and national/regional level | .31 |

List of tables

| | |
|---|-----|
| Tab. 1: Data hierarchy and standards used in ranger-based data collection | .13 |
|---|-----|

Acknowledgements

The concept of ranger-based data collection (RBDC) was introduced in Cambodia in 2003 by Dr. Robbie Robinson. The RBDC concept was then adapted to the specific situation of Virachey National Park and field tested by rangers with support from Mr. Koy Sokha, Mr. Robert Howard and Mr. Tep Borin - I would like to thank them all.

During the last three years rangers and staff of the Biodiversity and Protected Areas Management Project (BPAMP) have been implementing ranger-based data collection in Virachey National Park and their experience has made a significant contribution to this manual. I would like to thank them all, even if I cannot mention them all by name here. In particular, I would like to thank those BPAMP staff who were directly involved in carrying out RBDC training, field testing and data processing: Mr. Oliver Mannion, Mr. Pot Sin, Mr. Johan Robinson, Mr. Stephan De Greef, Mr. Chhun Praseth, Mr. David Murphy, Mr. Sun Vuthy, Mr. David Zeller and Mr. Ung Sokhakun. I also would like to thank senior park protection staff and in particular the director of Virachey National Park, Mr. Chou Sophark, for their support.

Ranger-based data collection has also been implemented in Bokor National Park and in Kulen-Promtep Wildlife Sanctuary. Experience in these protected areas contributed to the development of this manual and thanks goes to all staff and rangers involved in RBDC, in particular to staff of the Wildlife Conservation Society (WCS) who implemented RBDC in Kulen-Promtep Wildlife Sanctuary.

Special thanks go to Mr. Meas Sophal, the BPAMP project director, for his support, and to Mr. Richard Lloyd for his contributions to the writing of this manual.

The testing, customisation and implementation of ranger-based data collection in Virachey and Bokor National Parks and the production of this manual was made possible with financial support from the World Bank, Global Environment Facility and the Government of Cambodia through BPAMP. I would like to thank all of them and in particular the Ministry of Environment for supporting the Biodiversity and Protected Areas Management Project.

Klaus Schmitt

Senior Project Advisor

Acronyms

| | |
|-------|---|
| BPAMP | Biodiversity and Protected Areas Management Project |
| CBD | Convention on Biological Diversity |
| CITES | Convention on International Trade in Endangered Species of Wild Fauna and Flora |
| DNCP | Department of Nature Conservation and Protection |
| DSA | Daily Subsistence Allowance |
| ESRI | Environmental Systems Research Institute |
| GIS | Geographic Information System |
| GPS | Global Positioning System |
| ISM | Information System Manager |
| MIKE | Monitoring of the Illegal Killing of Elephants |
| MIST | Management Information System |
| MoE | Ministry of Environment |
| PDA | Personal Digital Assistant |
| RBDC | Ranger-based Data Collection |
| SQL | Structured Query Language |
| VNP | Virachey National Park |
| WCS | Wildlife Conservation Society |

1. Introduction

Managers of protected areas require up-to-date information on a wide range of subjects including ecology, park protection, tourism and socio-economics to manage parks effectively. Use of information should form an integral part of protected area management, or in other words: form an integral part of decision-making, monitoring and evaluation, and planning in protected area management. For information to be useful it must be based on the timely analysis of up-to-date data and presented in such a way that managers can understand it.

Relevant and geo-referenced data on wildlife and illegal activities collected by rangers on park protection patrols can easily be processed into information and made available in a timely manner to protected area managers. If this information is to be used for monitoring, data collection and patrol deployment must follow ranger-based data collection (RBDC) procedures.

This reference guide and training manual describes in detail the requirements for RBDC. It is written as a reference guide for senior protected area managers as well as managers at the Department of Nature Conservation and Protection, as a guide for the set-up of ranger-based data collection at protected area level, and as a training manual for rangers.

Chapter 2 provides a general introduction to the principles of ranger-based data collection.

Chapter 3 explains the role of ranger-based data collection in the protected area management cycle.

Chapter 4 introduces the concept of and need for standardised data collection and nomenclature.

Chapter 5 describes the elements of RBDC which must be put in place in a protected area before RBDC can start in the field.

Chapter 6 gives instructions on how to carry out RBDC in the field.

Chapter 7 introduces the steps necessary before data processing.

Chapter 8 gives an outline of the schedule of the RBDC modules to be taught as part of the 'Ranger Basic Training Course' and the 'Park Protection Ranger Training Course'.

Additional information, including a glossary, is contained in the appendices. Appendix 1 is of particular relevance to senior staff, park directors, park protection wardens, information system managers and senior staff at the Department of Nature Conservation and Protection. It describes in detail how data collected by ranger park protection patrols can be used for the monitoring of wildlife population trends and trends in illegal activities.

2. Background

Up-to-date, relevant and timely information is an essential prerequisite which will enable managers of protected areas to make informed decisions, to monitor and evaluate, and to plan. Use of information is an integral part of effective protected area management.

The Convention on Biological Diversity's programme of work on protected areas (CBD Secretariat 2005) lists in decision VII/28, under goal 1.4 - to substantially improve site-based protected area planning and management - several activities which can only be carried out if up-to-date data are available. Furthermore, there is a growing demand to monitor the effectiveness of protected area management and donor countries and organisations increasingly demand accountability and quantifiable achievements in return for their assistance. Again, this can only be achieved if up-to-date data are available.

The need to collect data which are up-to-date and readily available for day-to-day management decision-making, without the need to wait for results from scientific surveys or monitoring programmes, has led to the design of ranger-based data collection procedures.

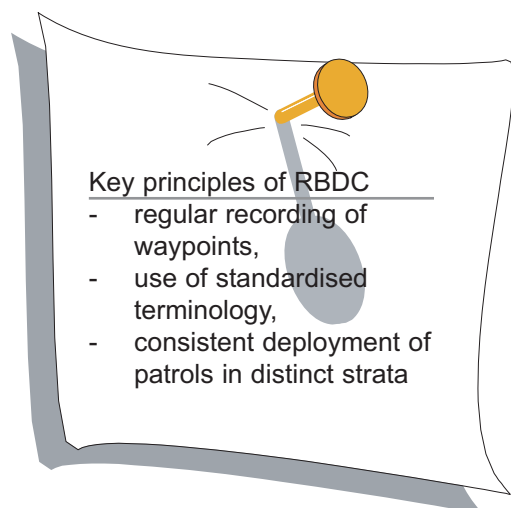
Ranger-based data collection is the opportunistic collection of ecological data and data on illegal activities by rangers on park protection patrols

the data collection procedures have been designed to meet the objective:

to provide timely, reliable and up-to-date information to protected area management for their day to day management decision-making.

park protection patrols need to be deployed based on intelligence information, they need to follow trails of poachers etc. and, therefore cannot carry out systematic surveys or scientific monitoring. park protection patrols can collect opportunistic data on illegal activities and key wildlife species which can be processed in a timely way into information for day-to-day management decision-making. Data collected opportunistically by ranger patrols can be used to calculate indices for monitoring. Indices provide measures of relative density for comparisons in monitoring programmes (Caughly and Sinclair 1994). For opportunistic data to be utilised in monitoring programmes, the following criteria must be met:

- data collection must follow the RBDC principles,
- data collection in distinct strata/management sectors must be consistent from month to month,
- the number of kilometres patrolled per month must be high, and
- the bias in spatial distribution of patrol coverage must be low, i.e. patrols must be more or less evenly distributed.



Ranger-based data collection has the following benefits:

- It requires a minimum of training and education.
- It requires little additional equipment.
- It uses existing patrol systems and no extra patrols or expenses for monitoring are required.
- It provides data for monitoring, using indices, without the need for expensive baseline data.
- It provides timely information for the day-to-day decision-making of protected area managers.

After the successful testing and implementation in Virachey National Park, RBDC became a key competence of the competency profiles for protected area staff which the Biodiversity and Protected Areas Management Project developed for Virachey National Park. These competency profiles, or job descriptions, are based on experiences from South Africa and the competence standards developed for protected area jobs in South East Asia by the ASEAN Regional Centre for Biodiversity Conservation (Appleton *et al.* 2003). The draft competency profiles went through an extensive review process and the Department of Nature Conservation and Protection (DNCP) adopted them as national standards in 2006.

The competency profiles list for all protected area positions:

- role
- key result areas
- competences
- critical outputs and outcomes

Ranger-based data collection is a key competence for all park protection staff, the Information System Manager and the Park Director.

An important competence of the Park Director is the ability to interpret and use results from MIST. MIST is the spatial management information system which is used to analyse the data from ranger-based data collection. The Warden Park Protection must be able to supervise the ranger-based data collection in liaison with Chief of Ranger Station and the Information System Manager. The Chief of Ranger Station's key role, with respect to ranger-based data collection, is to collate and store RBDC data on offences (illegal activities) and observations of key animal species for protected area management in line with MIST procedures. The Patrol Team Leaders are responsible for ranger-based data collection in the field, while Park Protection Rangers must be able to competently complete the RBDC patrol data sheets in the field

This manual has been written for RBDC using hand-held GPS (Global Positioning System) units and patrol data sheets under rough field conditions in the humid tropical climate of Cambodia. When conditions are conducive, the combination of a hand-held GPS with waterproof, rugged housing and paper and pencil can be replaced with a hand-held computer with integrated or attached GPS receiver. This enables field data collection in digital form and fast data processing.

A PDA (Personal Digital Assistant) with an integrated GPS receiver can be used for ranger-based data collection. Data entry forms for PDAs can be easily created to meet the user's needs, alternatively an existing software such as CyberTracker can be used.



Important factors to be considered when using a PDA are battery life (depending on type and length of patrols) and the fact that such an electronic device may be too delicate for use under certain field conditions. A waterproof case can protect a PDA, but it can also cause damage to the electronics of the PDA if moisture is trapped inside the case over longer periods.

3. Ranger-based data collection as part of protected area management

Managers at all levels require up-to-date and timely information to enable them to make informed decisions for planning, implementation and monitoring and evaluation of the activities for which they are responsible. Information is based on the analysis of data¹ and ranger-based data collection provides, in a timely manner, exactly those data which are necessary for effective and timely decision-making in protected area management.

Protected area managers should aim for management by objectives, a proactive and results-oriented approach, emphasising accomplishments and outcomes. The first step of the management cycle is to arrive at a plan based on clearly defined goals and using the best knowledge available. This plan is then implemented with constant monitoring and evaluation. Management which anticipates change, and includes feedback and adjustment loops, and rapid learning for managers, is called adaptive management. It can also be described as a continuous process of actions based on planning, implementing, monitoring, evaluation, and adjustment (see figure 1 and BPAMP 2005).

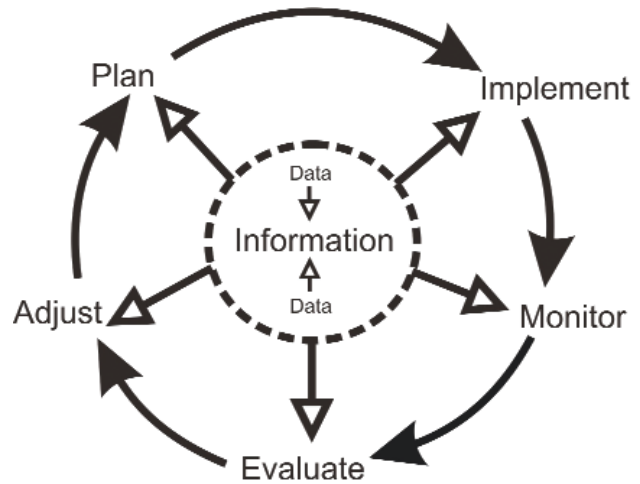
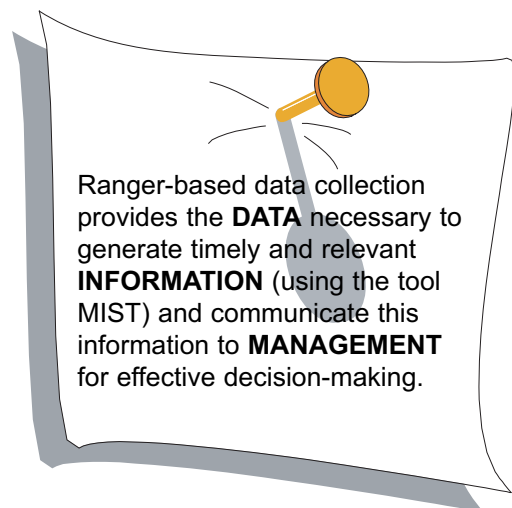


Figure 1: Adaptive management cycle.

An overview of the position of ranger-based data collection in the protected area management cycle and its role in the management cycle is given in figure 2 and summarised in the note below:

Management decision-making has effects on the real world; for example it can lead to a reduction of poaching. Over time such effects/outcomes can be proven through monitoring and evaluation based on the analysis of data from ranger-based data collection. This is illustrated in figure 2 which shows the position of RBDC in the management cycle: a continuous process of data collection, provision of information and decision-making for planning, implementation and controlling (i.e. monitoring and evaluation). The decision-making, based on the information provided, has effects on the real world and the cycle described above starts again. For additional information see appendix 1.

The management information needs determine what data rangers must collect while on patrol. Only data which can be processed into information which is useful to managers is going to be collected by rangers, stored in the MIST database and analysed. The standardised terminology used in RBDC is determined by database and analysis requirements and by the species nomenclature (fig. 2). More details about the data collection standards are given in chapter 4.



¹ The terms data and information are often used interchangeably. In the context of RBDC and analysis of the data for management decision-making, it is important to clearly distinguish between the two terms: data are facts which have been recorded while information is processed data.

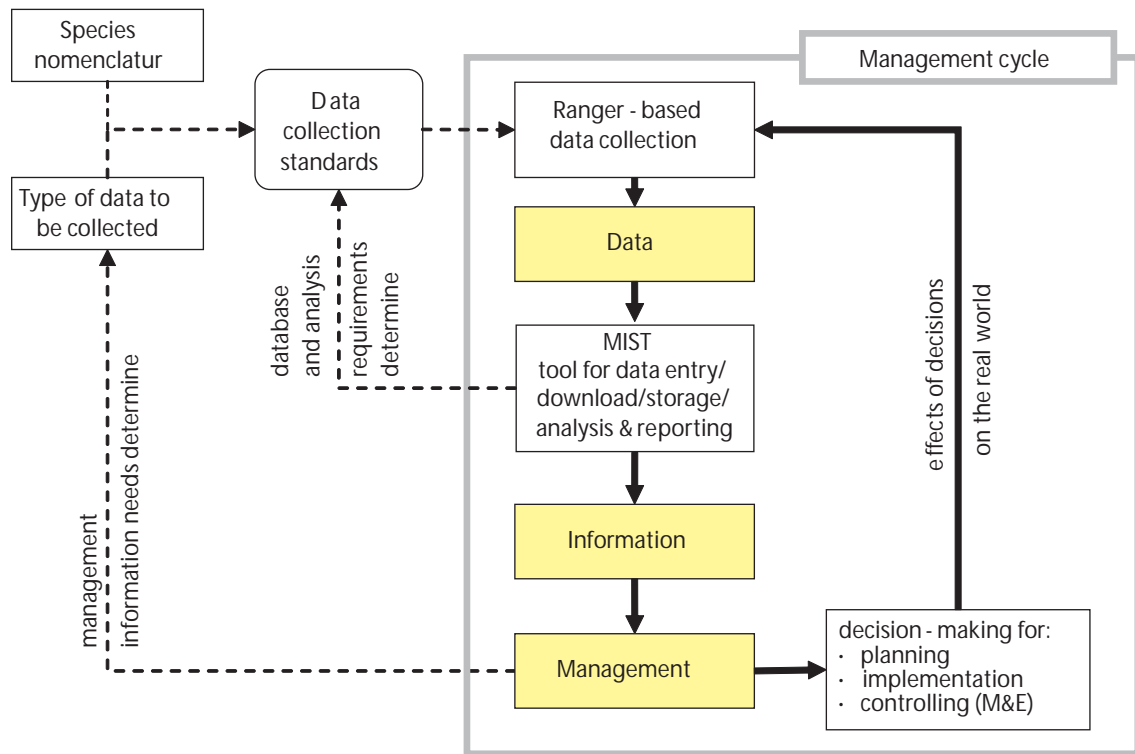


Figure 2: The role of ranger-based data collection in the protected area management cycle.

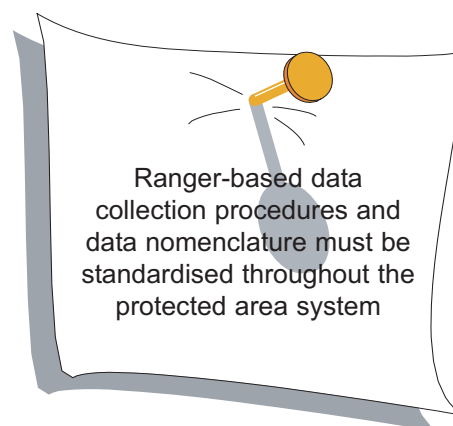
With such standards in place long familiarisation periods and re-training are no longer necessary when staff are transferred. Standardised procedures also lessen the negative effect if individuals leave the organisation, because enough people with knowledge remain to train new staff. Furthermore, standardised data collection and digital data transfer from the protected areas to the Department of Nature Conservation and Protection will enable managers in DNCP to make informed decisions about protected area management in Cambodia. It will also make it easier for DNCP to meet its national and international reporting obligations.

4. Standardised data collection

It is essential that ranger-based data collection procedures and data nomenclature, i.e. the terms used to describe observations, (as well as monitoring, evaluation and reporting) are standardised throughout the protected area system. Only then can DNCP effectively manage a national protected area system. Without such standards in place Cambodia will have a number of individual protected areas managed according to different, and a central authority which has no easy means to control what is going on, has no way to evaluate management effectiveness, and has no ability to report comprehensively on the protected areas under its authority.

Ranger-based data collection requires patrol data sheets² which ensure standardisation and at the same time allow for protected area specific issues to be included if necessary. Such patrol data sheets must be based on the following principles:

- Standardised - data need to be recorded in a consistent and unambiguous way between rangers and over time.
- Simple - the system must have a low learning curve and be easy to use with a minimal amount of formal education. Handling of patrol data sheets in the field must be easy.
- Fast - the primary duty for ranger patrols is park protection. Writing and time spent recording data other than illegal activities must be kept to a minimum.
- Flexible - it must be possible to adapt data collection to meet the needs of different users and for different types of natural resource management, reflecting differences in issues, objectives, and threats in different protected areas and different protected area categories.
- Specific - only data which can be processed into information useful for protected area management decision-making should be recorded by rangers.



After recording/collection, data must be processed into information in a timely manner and be communicated to protected area managers in an easily understandable way. The most effective way to do this is through the use of a computerised management information system³. In addition to the information needs of managers, the design of the database of the information system and data analysis requirements also determines the data collection standards.

The Department of Nature Conservation and Protection has adopted the use of MIST⁴ as a tool to analyse RBDC data. The use of MIST will not be covered in this manual, but the principles of its use are briefly described in chapters 5.6 and 5.7.

4.1 Standardised nomenclature

For RBDC to provide data which can be analysed in a computerised management information system and used at protected area and national level, it is absolutely essential that standardised nomenclature and recording procedures are followed. Recording of observations is made at four hierarchical levels:

² The data sheets can be replaced by a PDA with integrated GPS if the conditions in a protected area are conducive in terms of climate, infrastructure and length and type of patrols.

³ A management information system is a system to convert data from internal and external sources into information and to communicate that information to managers at all levels to enable them to make timely and effective decisions for planning, implementation and monitoring and evaluation of the activities for which they are responsible.

⁴ MIST is an easy to use spatial management information system which provides protected area managers with timely access to information for planning, decision-making and evaluation.

1. Observation groups

Observation groups are related sets of observations such as mammals, birds, reptiles, amphibians, plants and illegal activities. Observation Groups are fixed throughout the protected area system. They are not recorded by rangers, they are assigned by MIST and used for example for aggregated display such as all illegal activities recorded during a specific period.

2. Observations

Observations are the actual recordings made by rangers while on patrol. They can be grouped into animals and illegal activities. Animal observations: Standardised mammal and bird lists produced by the Wildlife Conservation Society (WCS) for Cambodia are used in RBDC. Examples of animal observations are Douc Langur, King Cobra and Saurus Crane. Observations of illegal activities: The following nomenclature is used to record illegal activities: *Poaching, Plant harvesting, Encroachment, and Fire*. For each of these four observations a distinction between *direct evidence* and sign must be made. NB. the nomenclature for illegal activities cannot be modified at protected area level⁵.

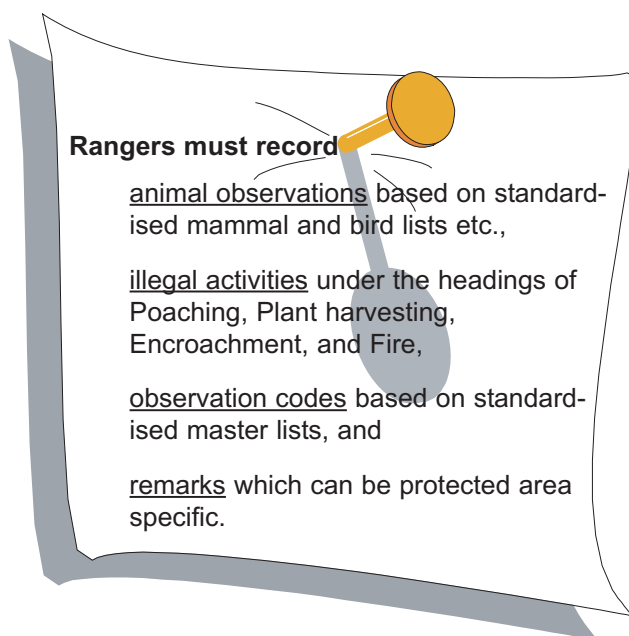
3. Observation codes

Observation codes are a further specification of the observation. They can be grouped into codes for animals and for illegal activities. Examples of animal observation codes are sighting, call, footprint, nest etc. The observation codes are observation specific (e.g. Elephant footprint; nest for example does not apply to Elephant) and must also be standardised throughout the protected area system. Examples of observation codes for illegal activities are *hunting, logging, mining gold* etc. (for more details see appendix 2). Observation code master lists, based on the situation in Virachey National Park, have been developed (see appendix 3). These list can be amended to reflect different situations found in other protected areas.

4. Remarks

Remarks are further details for specific observation codes (see appendix 2), they are often protected area specific.

A tabular overview of the four levels of data used in ranger-based data collection is given in table 1.



⁵ Following this standard is essential for national level data analysis and reporting. Imagine a situation where – for example Poaching direct sign hunting – is reported without using a standardised nomenclature. What DNCP might get from the parks could include: wildlife poaching, forest crime poaching, hunting, hunters arrested, suspected found in forest, hunting crime, and so on. Such data cannot be processed in a database, neither can DNCP evaluate such data easily or report using these data and a computer-based tool for data analysis.

Table 1: Data hierarchy and standards used in ranger-based data collection.

| Observation Groups | Observations | Observation Codes | Observation Remarks |
|---|--|--|---|
| <p>A related set of observations:</p> <ul style="list-style-type: none"> - Mammals - Birds - Reptiles - Illegal Activities <p><u>Observation Groups</u> are not recorded by rangers, they are assigned by MIST for aggregated display, e.g. all illegal activities encountered during a specified period.</p> | <p>Individual species or illegal activity recordings</p> <ul style="list-style-type: none"> - King Cobra - Tiger - Saurus Crane - Poaching sign* - etc. <p>* Observations under illegal activities are:</p> <ul style="list-style-type: none"> - Poaching - Plant harvesting - Encroachment - Fire <p>A distinction between direct evidence and sign must be made for all recordings of illegal activities.</p> | <p>Further specification of the observation:</p> <p>Animals</p> <ul style="list-style-type: none"> - Sighting - Call - Footprint - etc. <p>Illegal activities</p> <ul style="list-style-type: none"> - Hunting - Logging - etc. <p>The <u>Observation Codes</u> are observation specific.</p> | <p>Further details for specific observation codes:</p> <p>Examples are:</p> <ul style="list-style-type: none"> - number of poachers arrested, weapons confiscated; under <i>poaching direct evidence hunting</i> - length and width in cm under <i>Tiger footprint</i> <p><u>Remarks</u> are often protected area specific.</p> |
| | <p>Must be recorded for each observation</p> | | <p>Only recorded for specific observation codes</p> |

The terminology for observations of illegal activities must follow the standards given in table 1. The observation codes and details recorded under remarks (e.g. nationality, tribe, village names, items confiscated etc.) may be protected area specific, but the same term must be used in all protected areas for the same kind of activity; i.e. poaching must always be called poaching and not forest crime etc.

All observation codes and remarks which should be recorded by rangers are included in master lists which are used for the development of the patrol data sheets, and to create protected area specific lookup lists for data entry in MIST.

The terminology included in the master lists in MIST is shown in appendices 2 and 3, and the boxes at the bottom of the patrol data sheet shown in appendix 4. Protected area specific additions can be made providing they follow the same hierarchical logic as shown in table 1. These additions will then be included in the master lists of MIST.

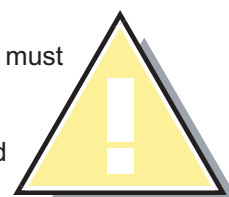
Changes to the master lists cannot be made by an individual protected area. They must be communicated to DNCP and, if justified, be included in the master lists by the database manager of the Department of Nature Conservation and Protection.

5.2 Design of the patrol data sheet

The results from the first step of the information needs assessment are used to design the protected area specific patrol data sheet (see appendix 4). The patrol data sheet is not a static document, it can be adjusted any time once adaptive management, as illustrated in figures 1 and 2, provides the feed back from patrols which makes additions to, or modifications of, the patrol data sheets necessary.

In order for the patrol data sheet to be suitable for ranger-based data collection the following criteria must be considered:

1. Only data which can be processed into information which is useful to managers must be collected.
2. Data recording needs to be easy and fast.
3. Patrol data sheets need to meet RBDC requirements and their use in the field needs to be easy without sacrificing details required by managers.



1. Only data which can be processed into useful information is to be collected

The patrol data sheet must as a minimum provide space to record (1) the names of patrol members, (2) the date of the patrol, (3) co-ordinates and time of waypoints based on GPS readings, (4) the observation, and (5) remarks. All observations and remarks which rangers should record should be clearly listed on the patrol data sheet or on a separate sheet which needs to be carried by patrols to ensure that only data which can be processed into information which is useful to managers are collected.

2. Data recording needs to be easy and fast

For each observation a three-letter code has been assigned, and for each observation code a one or two-letter abbreviation (code) has been assigned as shown in the boxes at the bottom of the patrol data sheet in appendix 4. These abbreviations/codes must be listed either on the patrol data sheet itself or on a separate sheet which needs to be carried by patrols. The codes are used to complete the field 'Observation Code' in the patrol data sheet in order to minimise writing in the field and at the same time to ensure that only observations chosen by management are recorded (see example in appendix 4).

3. Patrol data sheets need to meet RBDC requirements and must be easy to use

For RBDC data to be used for monitoring it is essential that waypoints are recorded at least every 30 minutes while a patrol is moving – even if no observation is made. If waypoints are taken at regular intervals, the distance covered by patrols can be calculated at reasonable accuracy. Distance is required to calculate indices for monitoring which take effort into account. Regular recording of waypoints also ensures that the routes covered by patrols can be recorded. The more waypoints are taken, the greater the accuracy of the route and distance covered.

The amount of time a GPS receiver can be used by rangers on foot patrols in remote areas is constrained by battery life and so using a track log⁶ or taking waypoints every few minutes is not possible – the latter is also very time consuming. The number of waypoints to take depends on how fast the patrol is moving. The slower the patrol the less frequent waypoints need be taken. As a guideline, rangers should take waypoints at least every 30 minutes.

The need for regular recording of waypoints (for a detailed explanation see appendix 1) has implications on the design of the patrol data sheet. Patrol data sheets can provide fields and tick-box for every possible observation which needs to be recorded. This makes filling in of the patrol data sheet easy, but may result in a multi page patrol data sheet which is not very easy to handle by patrols under field conditions. Almost all of the fields and tick-boxes in such a patrol data sheet would remain empty for most RBDC recordings because of the need to take a waypoint recording at least every 30 minutes. In Virachey National Park (VNP) for example ranger patrols recorded more than 19,000 waypoints in 2005, most of which were just waypoints without any observations. Only 142 incidences (i.e. waypoints) of illegal activities were recorded in 2005 – this is the only time when tick-boxes and a lot of data entry fields would help to ensure that observations are recorded completely. If a multi-page patrol data sheet with a lot of tick-boxes and data entry fields would be used in VNP, in more than 99% of all recordings these fields would remain empty.

The need for (1) easy handling of patrol data sheets in the field, (2) accurate and complete recording of all the details required by management and (3) recording of a waypoint at least every 30 minutes, can be met using 2 different design concepts for patrol data sheets. Regardless of the design concept, the patrol data sheets should provide space for the same information in their respective headers (date, ranger station, type of patrol, GPS number, patrol day, patrol or team number or code, names of team members, page number), while the actual data entry fields should be designed as described below:

- One patrol data sheet: A single page patrol data sheet (A4 size) with one row for each observation/recording. The fields of the patrol data sheet must include as a minimum: running number, waypoint number, UTM coordinates, time, observation code, and total. Remarks are written in a 'free-hand' field where patrols need to describe the details of illegal activities based on the structure given in the flow diagram developed during the information needs assessment. The flow diagrams must be carried by patrols to ensure that recording is complete. Brief reminders about what to record about illegal activities can be listed in boxes on the patrol data sheet itself.
- Two different patrol data sheets: The same as above, but instead of providing space for the written recording of observations under remarks on the back page of the patrol data sheet, this option uses front and back page for fields listed above. If an illegal activity is encountered patrols will use a separate patrol data sheet⁷ for the recording of details of illegal activities with the appropriate number of fields and tick-boxes (see example in appendix 4). The main patrol data sheet must have the option to refer to the detailed patrol data sheet on illegal activities, and this in turn must have a field to link it to the respective waypoint on the main patrol data sheet.

Depending on protected area management information needs, more columns (fields) may be needed on the main patrol data sheet in addition to those listed above. Examples are: direction and distance to observation⁸, and for mammals number of adult males and females and number of young. In a protected area which is mainly covered by dense forest, such as Virachey National Park, no separate columns for direction and distance and number of adult males and females are required in the patrol data sheet. If there is the need to record direction and distance or number of adult males and females and number of young this can be done in the remarks column.

⁶ Track logs and RBDC principles can be used during mobile (car or boat) and air patrols when the GPS unit can be easily connected to an external battery. In such situations data can either easily be stored directly onto a portable computer/PDA or a PDA with integrated GPS can be used.

⁷ Further additional data sheets may be used for specific recording requirements such as MIKE (Monitoring of the Illegal Killing of Elephants – a CITES initiative).

⁸ This may only be required in protected areas with open vegetation where wildlife observations can be made over large distances. For further explanation see chapter 6 (additional principles).

5.3 Prepare instructions for filling in the patrol data sheet

The next step of the information needs assessment is to adjust the 3-page instruction for filling in the patrol data sheet, which is shown in appendix 5, to the specific situation of the protected area. It is important to note that only minor modifications can be made to the instructions sheet, and that no modifications can be made to the RBDC rules and principles listed in chapter 6.1. Modifications to the instruction for filling in the patrol data sheet can only be made to section 1 (to be filled in before the start of each patrol or each day of a multi-day patrol) and section 3 (remarks). The field instructions which are shown in appendix 6 should be modified accordingly.

5.4 Prepare instructions for the set-up of GPS units

Clear instructions for the set-up of the specific GPS (Global Positioning System) model(s) used in the protected area must be developed before the start of ranger-based data collection following the instructions shown in appendix 7.

All recordings made as part of ranger-based data collection must be geo-referenced using a hand-held GPS receiver. This will provide sufficiently accurate position information to record where patrols have been and to geo-reference (i.e. provide a co-ordinate reference for) ecological and illegal activity data collected.

All GPS receivers used in protected areas must be set up in the same way for at least the time and unit set up (position format, map datum, and distance). An example for the set-up of Garmin Map 60C is shown in appendix 7.

5.5 Delineate management sectors

The protected area must be divided in strata (management sectors) which are similar in terms of patrol intensity. See appendix 1 for a detailed explanation.

5.6 Agree on standard monthly MIST outputs

A set of standard monthly report, chart, and map outputs can be produced by MIST on button click:

Maps showing:

- patrol coverage (areas patrolled shown in 1 km² grid cells, or any other size required by managers)
- distribution and number of illegal activities
- distribution and numbers of key wildlife species

Reports containing information about:

- patrols (performance indicators such as time and distance patrolled per ranger, costs per km patrolled, arrests per patrol day etc.)
- illegal activities (indices and numbers)
- key wildlife species (indices, numbers and population structure)

These outputs should be sufficient for all routine monthly information requirements of protected area managers. Additional reports can easily be added but care must be taken not to include one-off information request in the list of standard monthly outputs.

Standardised outputs are produced in MIST by clicking on map items, page tabs, list entries, and buttons. Specific, or one-off, information requests can easily be met by using the MIST query wizards and a visual SQL Query Builder which provide advanced functions for production of maps, graphics, charts and diagrams from any kind of database request in an easily understandable way. There is therefore no need to add all possible information requests in the list of standard outputs, because any kind of information request can easily be processed in MIST using advanced functions.

5.7 Set-up of MIST computer and software

A computer and appropriate software is needed to store and analyse the data. A spatial **Management Information System** software programme (MIST) has been designed to support storing and processing of RBDC data (Schmitt and Salle 2002) and has been adopted by DNCP for use in the protected area system of Cambodia.

MIST is a custom-made tool which provides managers with easy and timely access to information for planning, decision-making and evaluation. MIST is easy to customise and can be set-up to meet the needs of different users and for different types of natural resource management, reflecting differences in issues, objectives, and threats at local level and different protected area categories. MIST has been developed as a programme which is not dependent on a highly trained GIS (Geographic Information System) expert, which is easy to use, maintain and customise, and which provides different levels of access for users – depending on their knowledge of database management and GIS. MIST can be used on stand alone computers, a client/server network and at site level as well as national level after data replication from the protected areas.

Entering data into a database without mistakes is very time-consuming and risks creating a bottle-neck which makes it impossible to provide up-to-date information. MIST avoids this problem through data download from GPS units and the use of look-up lists for data entry. This not only avoids data entry errors, it also makes the process of data entry easy and fast. Protected area specific look-up lists need to be created from master lists in MIST before data entry can start.

MIST uses ESRI (Environmental Systems Research Institute) shape file format for the display of spatial data. Protected area specific shape files need to be provided by the GIS unit of the Ministry of Environment and set-up in MIST prior to its use.

Ranger-based data collection and data processing can only start after all the elements described above are in place:

- a list of species (mammals, birds, reptiles, amphibians) to be recorded by ranger patrols together with their related observation codes,
- flow diagrams for all aspects of illegal activities to be recorded by ranger patrols,
- a data sheet (or two) designed based on the species lists and flow diagrams,
- a 3-page instruction for filling in the data sheet,
- RBDC field instructions,
- clear instructions for the set-up of the specific GPS model(s) used,
- a sub-division of the protected area in strata (management sectors) which are similar in terms of patrol intensity,
- a set of standard monthly report, chart, map outputs to be produced by MIST on a single button click, and
- a MIST computer and database with protected area specific look-up tables and shape files.

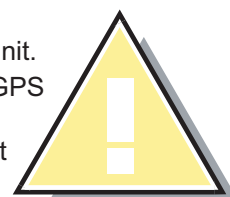
6. Field instructions

The field instructions given below form the basic contents of the RBDC training for rangers. A protected area specific training can only be carried out after an information needs assessment and the development of a patrol data sheet. If this is not the case the training must use the patrol data sheet and terminology from a protected area where RBDC procedures are already in place as an example.

The brief field instructions (an example is given in appendix 6) should be laminated and carried by rangers for reference in the field.

General rules

- Before starting a new patrol, make sure all waypoints from previous patrols have already been downloaded to the computer and deleted from the GPS unit.
- Do not change the settings of the GPS unit.
- Read the WAYPOINT number, LOCATION (48P-UTM) and TIME off the GPS unit.
 - o Do NOT change the Waypoint number. Use the number generated by the GPS unit.
 - o Do NOT change the symbol of a Waypoint. The symbol must be the default symbol.
 - o Record the time in 24 hour format.
 - o Waypoints stored in the GPS and written down on the patrol data sheet must match.
- Each waypoint must be stored in the GPS and recorded on the patrol data sheet.
- Follow the instructions *recording of patrol observations* (see appendix 5) when recording an observation.
- Take a waypoint whenever recording an observation. If you encounter more than one observation at the same location, take a separate waypoint for each observation.
- Use only the OBSERVATION CODES listed in the boxes in the boxes at the bottom of the patrol data sheet.
- Only record those observations of which you are 100% sure.
- For wildlife observations enter the number of individuals under TOTAL.
- For all other observations (illegal activities, physical features and degraded areas) and for 'position' enter 1 under TOTAL.
- Take a waypoint at the start and end of each patrol day.
- Take a waypoint at the start and end of each stopping period such as ambush, lunch etc. (do not take waypoints while stopped).
- Write detailed descriptions under REMARKS following the instructions given in the REMARKS box at the bottom of the back page the patrol data sheet.
- Make a patrol data sheet entry (waypoint) at least once every 30 minutes while moving on patrol. For an explanation of this key rule see appendix 1.
- If you cannot get a GPS reading due to poor satellite cover or dense canopy record the observation and time only, continue the patrol and take a GPS reading as soon as the openness of the canopy allows it and enter this waypoint as 'position'.
- Data from a GPS unit which is not set according to the GPS rules will be considered invalid, and the rangers of that patrol will not be entitled to DSA.
- If waypoints are not taken every 30 minutes during the patrol rangers of that patrol will not be entitled to DSA.



Additional principles

- Only record what is specified in the patrol data sheet and on the remarks chart. NB. there is one exception: if you do encounter something in the field that you consider important to management, describe it in detail under remarks and write 'position' for observation.

- Record observations about animals and birds only if 100% certain. For example, if, due to its size, rangers cannot tell the difference between a tiger and a leopard footprint, they need to record "big cat footprint" (providing it is in the list of observations identified during the information needs assessment).
- Quality, not quantity, is important. A recorded observation is only useful if it is accurate. Only record those observations of which you are 100% sure.

Example: You see a large mammal about 200 metres away for a glimpse in dense vegetation. You cannot accurately identify it but villagers have told you lately that they have seen Gaur around. Do you record a sighting of 1 Gaur? In this case you cannot accurately identify the animal, therefore do not record it.

- Record species observations only if they fulfil the criteria listed below:
 - The species is listed on the patrol data sheet, and can be correctly identified.
 - The observation is a recent sign which clearly indicates the presence of the species.

If you cannot identify the species without any doubt from a sighting, sign, or dead body, either:

- do not record it, or
 - record it in general terms such as cat sp., deer sp. etc.
- There are 4 types of species observations:
 - direct sightings -- an observation is recorded as a sighting if an animal species is directly sighted and positively identified
 - calls -- some animals, such as Elephants for example, can be positively identified by their distinct call, while others can be identified to genus level, for example Hornbill.
 - **fresh signs** -- some animal species leave distinct signs that can only be of that particular animal species, e.g. elephant footprint. An observation should be recorded only if the sign is fresh, i.e. less than one day old, and thus indicates a recent presence of the species.
 - **carcasses** -- the cause of the death should be recorded as natural death or cause of death unknown. NB. if the animal has been poached (e.g. died caught in snare) record it as illegal activity and describe the method of poaching used, e.g. gunshot, snare, spear etc. in remarks.
To avoid the recording of the same carcass twice or more times, only carcasses less than 4 days old should be recorded. As easy indicator for a 4-day old death is whether the carcass smells. If it smells, do not record it, if it still has skin and meat attached and does not smell, record this as an observation.
 - When encountering a herd of animals do not record "1 group". Either count all individuals if the herd is relative small, or estimate the number of species using the following technique. Count five (or ten) animals, look at space they occupy, estimate how many times the 'space of five' fits within the size of the entire herd, and multiply this number by five (or ten) to get the estimated total number. In such a case write 'number estimated' in remarks.
 - Recording of direction and distance to an animal observation may be required in protected areas with open vegetation. In such areas wildlife observations can be made over large distances, but the actual waypoint will be taken at the position of the observer and not at the position of the wildlife specie(s). In such cases rangers should record direction (compass) and estimate the distance to the wildlife. MIST will then calculate the actual position of the observation. Recording of direction and distance is only required if the observation is more than 100 m away from the GPS. If the patrol data sheet provides columns for direction and distance fill these in, otherwise write direction and distance in the remarks column.
 - When recording mammals the number of adult males and females and number of young should be recorded if possible. Do this only if you are 100% certain. Young mammals are those which fit under the belly of their mother. If the patrol data sheet provides columns for number of adult males and females and number of young fill these in, otherwise write the numbers in the remarks column.

7. Data entry in MIST

As soon as possible after the end of the patrol the completed patrol data sheets and GPS unit should be handed to the staff member responsible for data entry – the Information System Manager (ISM). The competencies and responsibilities of the Information System Manager are described in the DNCP staff competency profiles for protected area staff in Cambodia.

Quality control

Once the ISM has received the patrol data sheets and GPS unit s/he must carry out a quality control, i.e. check whether the patrol data sheets have been filled in correctly and whether the GPS unit has been used according to the instructions:

- all waypoint, 48P, UTM, Time, Observation Code and Total fields are filled in
- all GPS readings have the correct number of digits
- long time gaps between recordings are explained
- start times of rest periods and ambushes are recorded and the times when the patrol resumed
- co-ordinates etc. for 'start and end of patrol' are recorded
- direction and distance are filled in (only if observation is more than 100 m away)
- distinction between sexes is possible, given the species and distance to the animal observed
- page numbering is correct
- remarks are clear and complete
- waypoints were taken at least every 30 minutes
- the GPS unit used was set according to GPS rules

MIST data entry

After the quality control the ISM needs to download the waypoints from the GPS into the MIST database and enter the observation records following the instructions given in a separate MIST manual. The ISM must also fill in 4 fields on the patrol data sheet:

- Date received: this is the date when the patrol data sheets and GPS unit have been received by the ISM
- Received by/entered by: here the name of the person who received the patrol data sheets and GPS unit and, once data entry has been completed for a patrol day, the name of the person entering the data into the MIST computer has to be recorded
- Date entered into MIST: this is the date when the data have been entered into the MIST computer
- Patrol ID: to be filled at the beginning of data entry in the MIST computer (this number is assigned by MIST)

NB a supervisor has to initial the patrol data sheet once the entered data have been checked against the original patrol data sheet. The supervisor also needs to confirm by signature (1) that the GPS unit used was set according to GPS rules, and (2) that waypoints were taken at least every 30 minutes.

8. RBDC training schedule

Ranger-based data collection is a key competence of protected area staff and is therefore taught as part of the Basic Ranger Training Course and Park Protection Ranger Training Course of the national ranger training curriculum for Cambodia.

A brief outline of the RBDC training module for both training courses is given below:

RBDC module basic ranger training (1 day)

Introduction to ranger-based data collection: what is RBDC, objective and principles (chapter 2)

The role of RBDC in protected area management (chapter 3 and section on RBDC and MIST on the next page)

Standardised nomenclature used in RBDC (chapter 4.1 and appendices 2 and 3)

In addition to the information provided in chapter 4.1 explain the need for standards using examples such as time, calendar and language. Without everybody using the same concept (i.e. standard) of time and date (e.g. the next meeting will be on Monday 24th at 15:00 hours) communication would be basically impossible. Without using consistent data collection, analysis, evaluation and reporting standards in the protected area system of Cambodia, effective management will not be possible.

How to record observations and fill in the RBDC patrol data sheet (chapter 6 and appendices 4 and 5)

This is the key lesson and a lot of emphasis must be placed on the correct use of the flow diagrams (either park specific if an information needs assessment has been carried out, or 'generic' using the VNP flow diagram in appendix 2) and going through a lot of different examples how to fill in the patrol data sheet (see appendix 4). Emphasis must also be placed on the '30 minutes rule' as explained in detail in appendix 1.

Please note: the RBDC training module must be taught after the introduction of the use of GPS. The instructions for the set-up of GPS units (appendix 7) should be repeated as part of the RBDC training.

RBDC field exercise 1

Break into groups. Each group should take a GPS unit and 2 patrol data sheets and take regular way-points and record a selection of different types of [pretend] observations including:

- o species observations (direct sighting and sign)
- o observation of illegal activity with remarks
- o observation with poor satellite coverage (no GPS reading)
- o start and end of patrol day observations
- o rest period

Review of patrol data sheets from field exercise 1

RBDC field exercise 2

Same as field exercise 1 – but with the input from the review of the first field exercise.

Review of patrol data sheets from field exercise 2 and round up

RBDC module park protection ranger training (1 day)

This is a refresher training because all park protection rangers should have gone through the basic training before doing the park protection training. The one-day training should follow the same principles as the basic training but with more focus on field exercises and review.

Emphasis must be put on the '30 minutes rule' and the monitoring related patrol deployment issues described in appendix 1. At the end of the training module a test should be carried out which shows whether rangers have understood the principles explained in appendix 1.

RBDC and MIST

During the training rangers should be shown how the data they collect in the field are used in management decision-making.

A short computer presentation should be given which demonstrates:

- waypoint download from GPS units,
- data entry using look up lists, and
- data analysis and report production in form of tables, graphs and maps on a single button click.

Alternatively the steps listed above can be presented in a power point presentation. A set of maps and reports from MIST should be used to illustrate the role of RBDC in the management of protected areas.

Distribution maps

Distribution maps can be used for monitoring and planning. Examples are species distribution maps compiled from data collected over long periods will provide information about seasonal movement patterns and trends in distribution.

A time series of indices as shown in figure 3 should be used to explain the monitoring of trends without a base-line. Appendix 1 provides additional information on the use of indices.

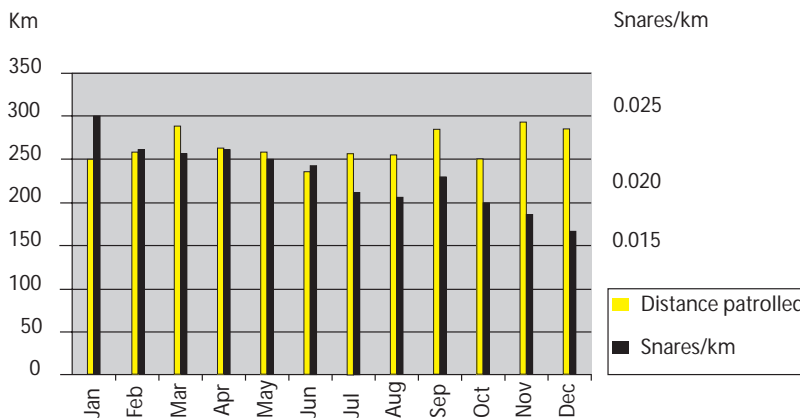


Figure 3 shows that the patrolled distance remained fairly similar from month to month: 232 to 290 km with an average of 267 km.

At the same time the index for snares collected per month shows a clear downwards trend from 0.025 in January to 0.017 in December.

Fig. 3: Chart which illustrates a downwards trend in illegal activities using indices.

Maps showing the distribution of illegal activities should be used for pro-active deployment of patrols. If, when looking at aggregated data over long periods, patterns become evident (e.g. increased fishing activities in a certain area at the beginning of the dry season) this information can be used to deploy patrols pro-actively.

Patrol Deployment Planning

Deployment of patrols is done based on park protection requirements and intelligence information. In addition, maps showing areas recently patrolled should be used to prepare a two week (or one month) patrol operation plan.

Performance Indicators

Performance indicators - such as number of patrol days per month, kilometres patrolled per day and costs per kilometre patrolled - are calculated as part of routine outputs and should be used for monitoring and evaluation of the implementation of the annual operations and monthly patrol operation plans (BPAMP 2006). This will show whether or not the patrol targets set in the plans have been achieved. Rangers should be encouraged to use RBDC because it not only provides the data for effective protected area management it also proves to anybody the amount of hard work done by rangers while on patrols.

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APPENDICES

APPENDIX 1: Monitoring of wildlife population trends and trends in illegal activities

A standard text book on monitoring such as Goldsmith (1991) already stated one year before the Rio Declaration “The recording of changes in the abundance of plants and animals is vital for decision-making in conservation. It has become of increasing interest particularly in view of concern over projected global environmental change which is likely to profoundly affect the diversity of species on earth.” This text book emphasises the distinction between monitoring and surveys. A survey “... is an inventory, it is static in its background philosophy and it is usually done once only.” Monitoring on the other hand “... is purpose oriented; it tells us how something(s) is/are changing; it is repeated at regular intervals and it often provides the baseline for recording possible changes in the future. Thus it is dynamic in philosophy, purpose oriented and needs to be critically examined prior to implementation.”

Goldsmith (1991) provides the following definition for monitoring: “Intermittent (regular or irregular) surveillance carried out in order to ascertain the extent of compliance with a predetermined standard or the degree of deviation from the expected norm.” Surveillance is “an extended programme of surveys, undertaken in order to provide a time series, to ascertain the variability and/or range of states or values which might be encountered over time.” A survey is “an exercise in which a set of qualitative or quantitative observations are made, usually by means of a standardised procedure ...”. (Goldsmith 1991, p. 2).

When planning a monitoring programme issues such as purpose, intensity and frequency of monitoring, method (e.g. total count, random or stratified random sampling, use of plots or transects etc.), analysis and interpretation must be taken into consideration. It may be possible to count every species of a rare plant in a small protected area, but for most species populations an estimate of the mean number per unit area, together with a standard error of that mean, is commonly used in scientific monitoring. Sampling, rather than total counts, is widely used to get the data required for monitoring because it can be done faster and is less expensive, both in terms of finances and human resources. Simple monitoring schemes are likely to be the most effective and have a chance to succeed over a longer period which will inevitably involve many different people. Ranger patrols do not systematically cover the entire park area, neither do patrols follow random patterns. All these issues were considered when designing the concept of ranger-based data collection with the aim to provide managers of protected areas with relevant, up-to-date and readily available information on wildlife populations (biodiversity) and illegal activities for monitoring and evaluation.

Systematic transect counts are widely used to collect data for the monitoring of population trends of large mammals (Lamprey 1964, Eberhardt 1978, Norton-Griffiths 1978). A number of studies comparing sample and total counts have shown that sample counts provide reliable results (e.g. Lamprey 1964, Eltringham *et al.* 1999, Ottichilo 1999). Sample counts require dedicated staff and adequate financial resources to be carried out.

Ranger patrols do not follow systematic transects - they are deployed based on park protection requirements, areas patrolled recently, and intelligence information. Patrols do not follow straight lines (transects) but follow paths of least resistance (e.g. around rather than through a swamp) or, for example, footprints of poachers. The question therefore is: how can data collected opportunistically by rangers on park protection patrols be used for the monitoring of illegal activities, wildlife populations and biodiversity? This can be done through the use of indices which provide measures of relative density for comparisons in monitoring programmes.

A study over a 5-year period by Allen and Sargeant (1975) has shown that indices can be compared with census data. They found a positive correlation ($r = 0.958$) between the index (number of red foxes per 1,000 miles driven by rural mail carriers in North Dakota) and township aerial census data (red fox families per township). A pilot study carried out in Murchison Falls Conservation Area in Uganda (1998 - 2001) compared population estimates from 21 aerial counts (systematic reconnaissance flights, Norton-Griffiths 1978) with monthly indices from ranger park protection patrols. A direct comparison of population estimates from the first 6 of the 21 systematic reconnaissance flights with indices from ranger patrols was carried out for a presentation at the 2nd International Wildlife Management Congress and gave a poor correlation, $R^2=0.5$ (Schmitt *et al.* 1999). When comparing all 21 population estimates from aerial counts in Murchison Falls Conservation Area with indices from ranger patrols, and particularly when looking at the spatial distribution of patrols and the distance patrolled per month, it becomes apparent that there is a relationship between effort and precision.

Based on these findings one can conclude that:

Data collected opportunistically by routine ranger park protection patrols can be used to obtain precise indices for monitoring trends in wildlife populations and illegal activities if the bias in spatial distribution is low and the number of kilometres patrolled high. This can be achieved in discrete and relatively small areas which are similar in terms of patrol intensity.

The importance of distance recording

Rangers on park protection patrols often collect geo-referenced data whenever encountering illegal activities or wildlife species using a GPS and a patrol data sheet (fig. 4A). Such data are useful for the production of species/illegal activity distribution maps and reports on the numbers of illegal activities, but they can not be used for monitoring because they do not take sampling intensity into consideration.

The most appropriate way to account for sampling intensity of ranger patrols is distance patrolled. Distance recording can be done using the track log function of the GPS unit providing the GPS is turned on during the entire duration of the patrol. This is not an option for multi-day foot patrols in remote areas due to limitations with the internal memory of the GPS and the high costs for batteries. A practical alternative for ranger patrols is to take waypoints at regular intervals. The distance patrolled can then be calculated with reasonable accuracy using MIST (fig. 4B). The shorter the time interval between waypoint recording the more accurate will be the distance calculation. Rangers must therefore take a GPS reading at least every 30 minutes while moving on patrol.

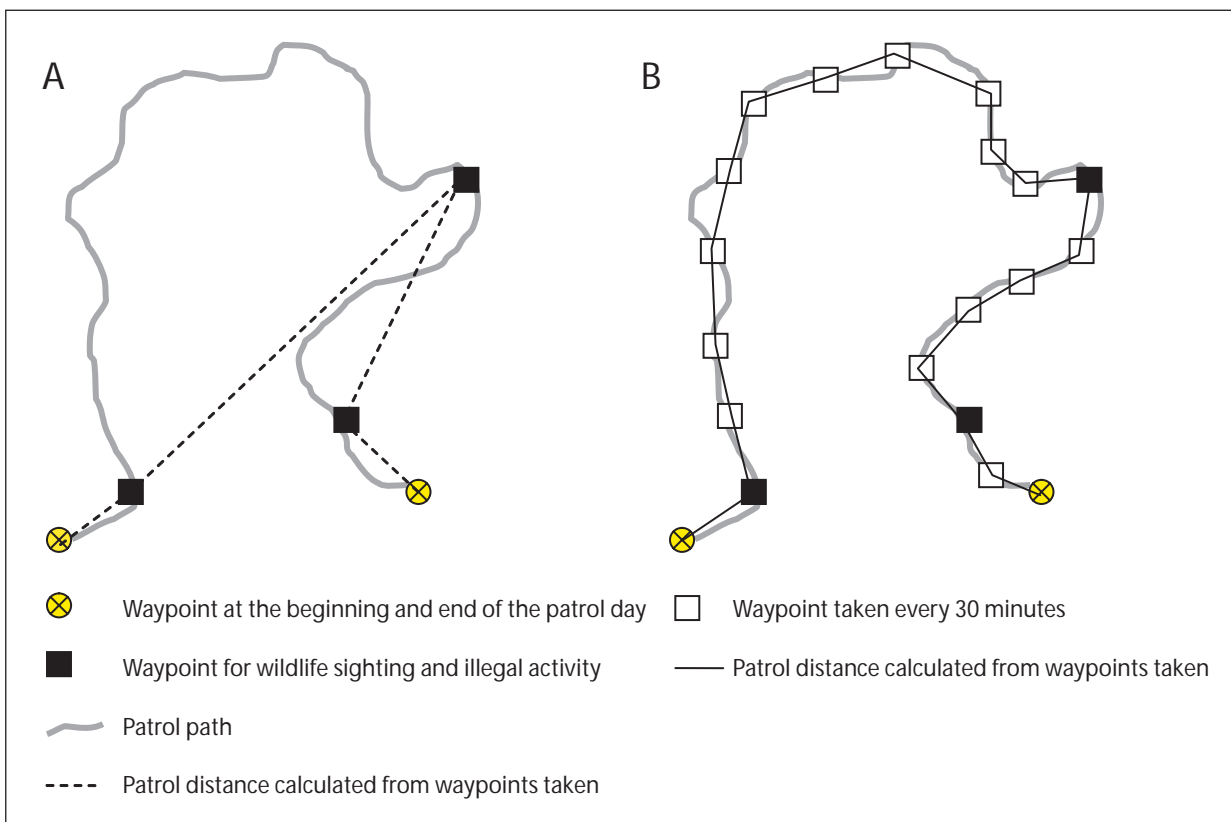


Figure 4: Comparison of actual and calculated patrol distance. A: based on waypoints taken when recording an observation, and B: based on RBDC principles.

The example shown in figure 4 illustrates the importance of taking regular waypoints for the accuracy of the patrol distance calculation. Figure 4A shows a patrol where rangers only take waypoints when actually encountering an illegal activity or a sighting/sign of wildlife. The patrol distance calculated from the waypoints, using Euclidean Distance, is much less than the actual distance patrolled. The same patrol is used in figure 4B with additional waypoints taken every 30 minutes. The calculated patrol distance is fairly similar to the actual distance patrolled. Please note that the calculated distance will always be slightly less than the actual distance patrolled.

The use of indices for monitoring

If the distance patrolled has been calculated with reasonable accuracy, distance related indices can be calculated. Examples are: elephants seen per kilometre patrolled, snares collected per kilometre patrolled, costs per kilometre patrolled (per month, per arrest etc.). An index such as snares collected per kilometre patrolled can show changes in relative hunting pressure over time without knowing the actual number of poachers or number of animals killed. It can be used to indicate the success or failure of anti-poaching measures.

Without the distance information monitoring cannot be done. Lets look at a hypothetical example to illustrate this:

In a protected area ranger patrols have recorded data on snares collected during a 3 period:

| Year | No. of snares collected |
|------|-------------------------|
| 2000 | 200 |
| 2001 | 100 |
| 2002 | 50 |

Based on these figures the protected area management reports that they have been successful at significantly reducing illegal activities between 2000 and 2002. This statement cannot be made with certainty and may be wrong. Based only on the numbers of snares confiscated no conclusion about changes in the extent of illegal activities can be made because the effort (intensity) put in the collection of the data has not been taken into consideration.

An effort measure which can be added easily is the number of patrols carried out:

| Year | No. of snares collected | No. of patrols |
|------|-------------------------|----------------|
| 2000 | 200 | 20 |
| 2001 | 100 | 20 |
| 2002 | 50 | 20 |

One could conclude that, because the sampling intensity (or patrol effort) has been the same during the monitoring period, there has been a significant reduction in illegal activities. Again, this statement cannot be made with certainty and may be wrong. Number of patrols is not a good measure of intensity because patrols for example can be of different duration.

Another effort measure which can be added easily is the number of patrol days:

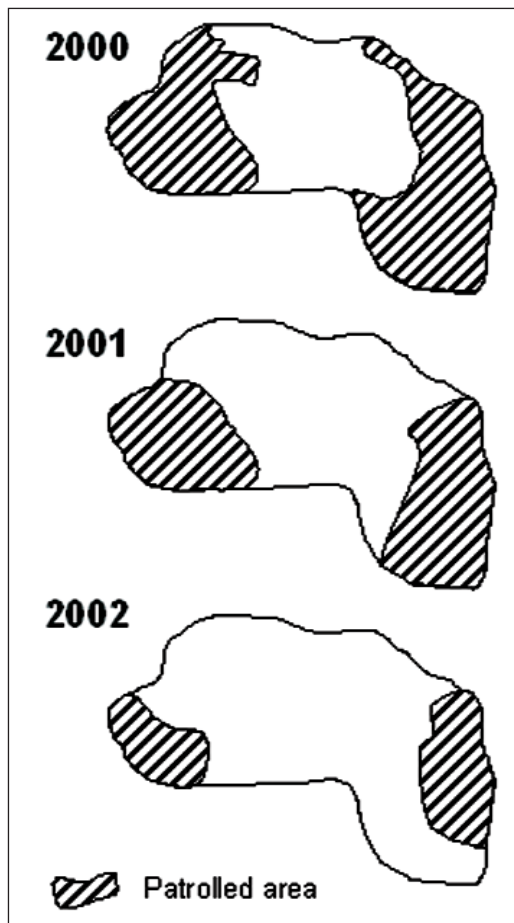
| Year | No. of snares collected | No. of patrols | No. of patrol days |
|------|-------------------------|----------------|--------------------|
| 2000 | 200 | 20 | 40 |
| 2001 | 100 | 20 | 34 |
| 2002 | 50 | 20 | 38 |

The number of patrol days, as a measure of effort, are similar and one could conclude that there has been a significant reduction in illegal activities. Again, this statement cannot be made with certainty and may be wrong. The number of patrol days is not a good measure of intensity because the distances covered during patrol days may vary.

It is therefore essential to record the actual distance patrolled as a measure of effort, only then can indices per kilometre patrolled be calculated:

| Year | No. of snares collected | No. of patrols | No. of patrol days | Distance patrolled (km) | Snares collected/km |
|------|-------------------------|----------------|--------------------|-------------------------|---------------------|
| 2000 | 200 | 20 | 40 | 800 | 0.25 |
| 2001 | 100 | 20 | 34 | 740 | 0.14 |
| 2002 | 50 | 20 | 38 | 770 | 0.06 |

The distances patrolled per year are similar and the indices show a significant decrease in snares collected per kilometre patrolled. Based on this, one could conclude that there has been a significant reduction in illegal activities. Again, this statement cannot be made with certainty and may be wrong



because the spatial distribution has not been taken into consideration as an important measure of intensity. Figure 5 illustrates the importance of the spatial deployment if data collected by patrols are to be used for monitoring.

Figure 5 shows the areas which were patrolled during the period 2000 – 2002. Although the actual distance patrolled per year remained similar (740 – 800 km), the area covered by patrols decreased steadily from year to year due to a higher patrolling intensity in smaller areas. Therefore, again, no statement about trends can be made with certainty because the spatial distribution was not without bias, was not more or less even.

Only if the distance patrolled has been recorded with reasonable accuracy (and if the distance is high and fairly similar over time) and if the spatial deployment is without bias can indices be used for monitoring of trends in illegal activities and wildlife populations.

Figure 5: Extent of areas patrolled in the hypothetical protected area between 2000 and 2002.

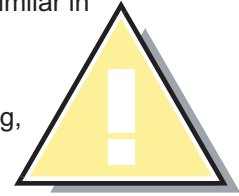
Management sectors

The delineation of management sectors can best be done based on the documented patrol deployment and on the location of patrol infrastructure, such as ranger outposts, roads and trails. The park shown in the hypothetical example in figure 5 should be divided into three management sectors which will be similar in shape to the areas patrolled in the year 2000. The borders of the management sectors should follow natural or man-made features. The Warden Park Protection must then ensure that patrol deployment within the management sectors is done without spatial bias (i.e. more or less evenly distributed) and that the number of kilometres patrolled is high and fairly similar from month to month. The latter may be different for the dry and rainy season.

Implications for protected area management

The quality and usefulness of a monitoring system depends on the quality of its data. The protected area management must therefore ensure that:

- the protected area is sub-divided into strata (management sectors) which are similar in terms of patrol intensity,
- patrols are deployed effectively in terms of spatial distribution and distance,
- GPS readings are taken at least every 30 minutes while the patrols are moving, and
- the quality and consistency of RDBC is high.



If all this is done, the opportunistic nature of the RDBC data collection will resemble random sampling over time, and thus can be used for monitoring in distinct strata such as management sectors.

The way data from RDBC are used in decision-making at protected area level, and the link to the national/regional level through database replication and the information flow at national/regional level is shown in figure 6. 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 the central MIST database.

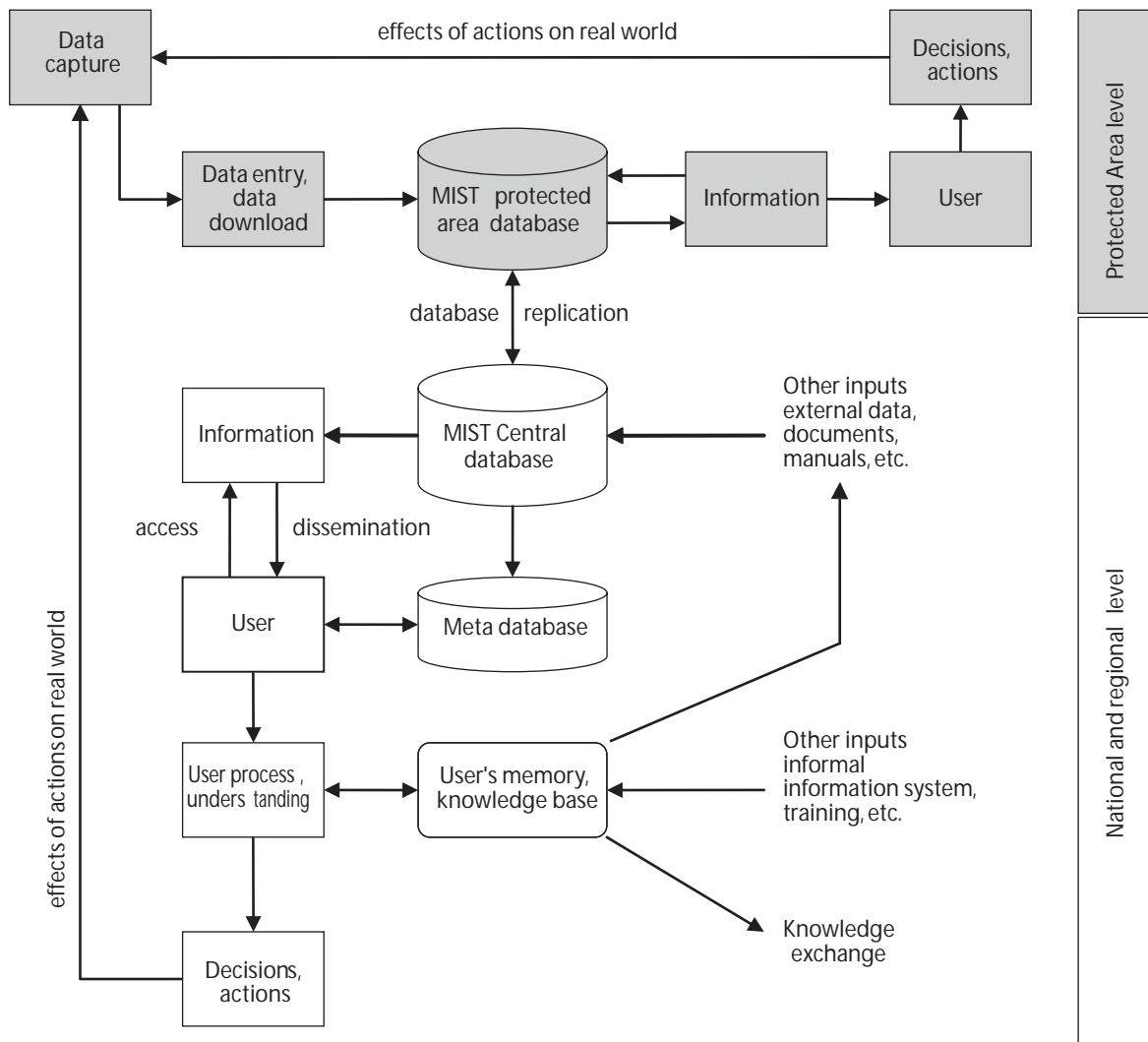
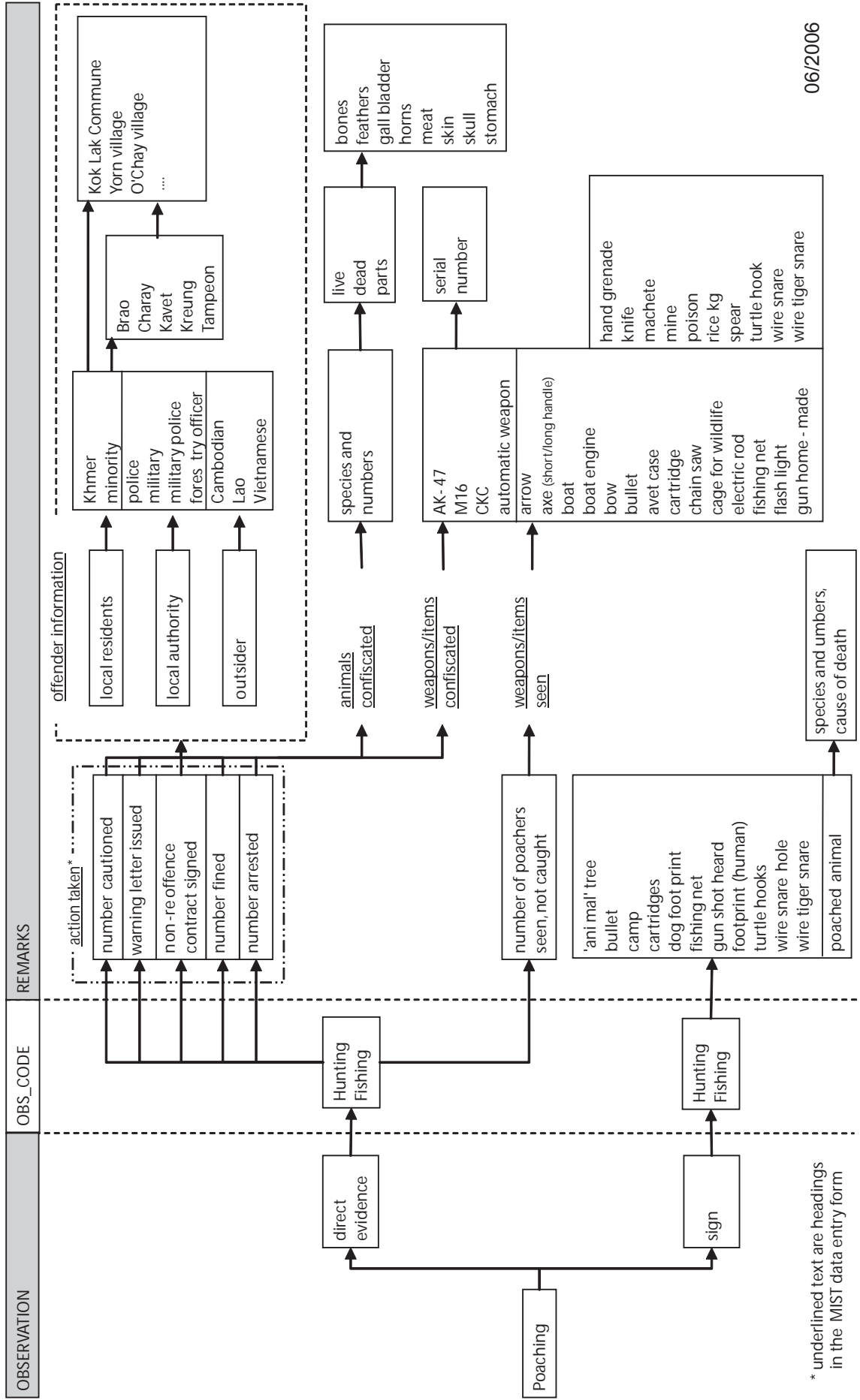


Figure 6: Data and information flow and database replication at protected area and national/regional level.

APPENDIX 2: Flow diagram - data to be recorded about illegal actives in Virachey National Park

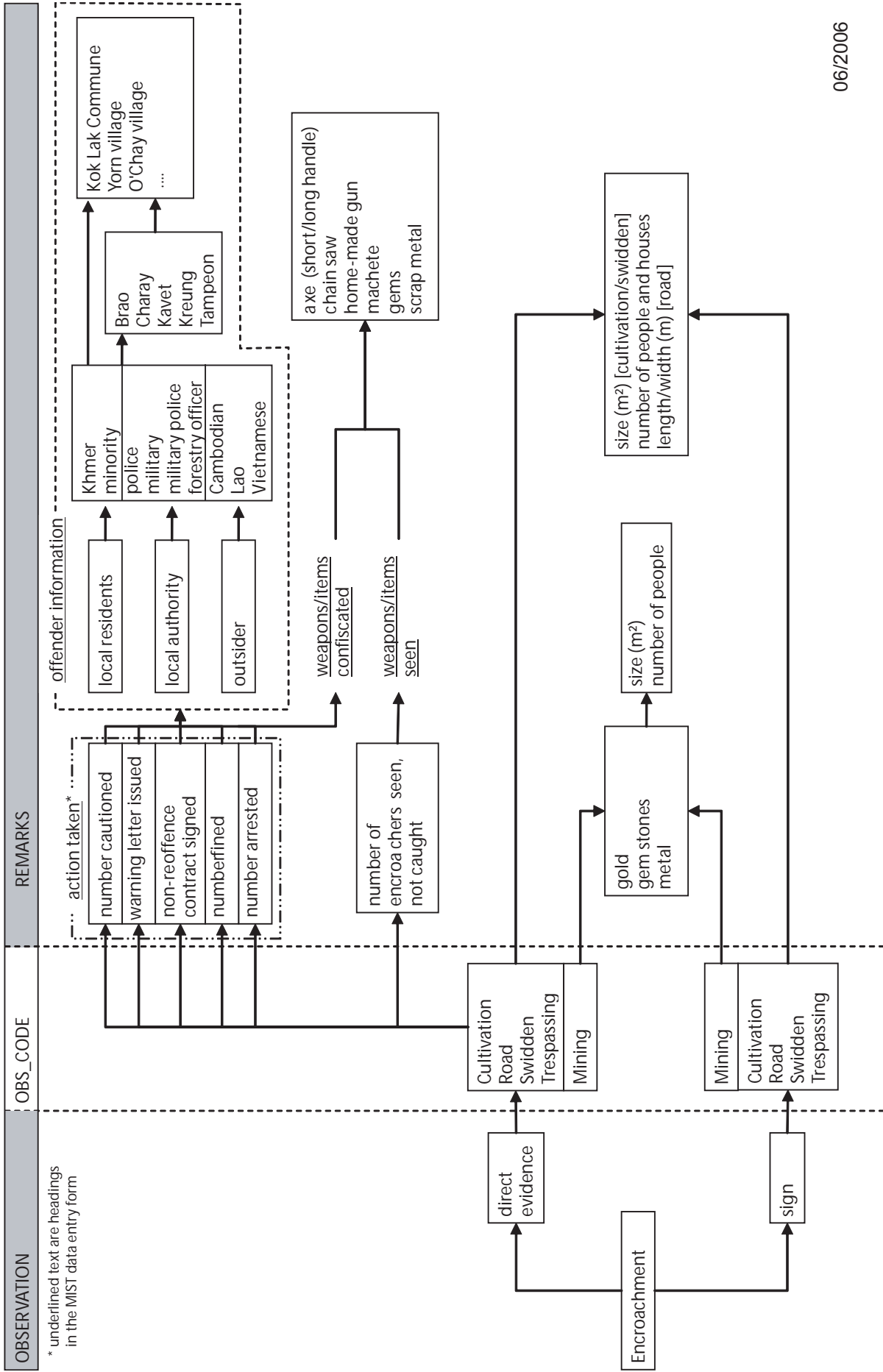


* underlined text are headings in the MIST data entry form

| OBSERVATION | OBS_CODE | REMARKS |
|--|--|--|
| <p>* underlined text are headings in the MIST data entry form</p> | | |
| <p>Plant harvesting</p> <p>direct evidence</p> <p>sign</p> <p>Logging road Sawmill</p> | <p>Eaglewood Fruit tree Malva tree Raisin tree Rattan</p> <p>Log ponds Logging</p> <p>Log ponds Eaglewood Fruit tree Malva tree Raisin tree Rattan</p> <p>Log ponds Logging road Sawmill</p> | <p>number of harvester seen, not caught</p> <p>number of trees felled</p> <p>luxury logs logs class 1 & 2 construction timber</p> <p>weapons/items seen</p> <p>weapons/items confiscated</p> <p>axe (short/long handle) chain saw Eaglewood home-made gun Malva nuts (ripe/unripe) kg machete</p> <p>offender information</p> <p>local residents local authority outsider</p> <p>Khmer minority police military military police forestry officer Cambodian Lao Vietnamese</p> <p>number of harvester seen, not caught</p> <p>warning letter issued</p> <p>non-reeffiere contract signed</p> <p>number arrested</p> <p>number of trees felled</p> <p>number of logs</p> <p>number of stumps + diameter</p> <p>number of shoots</p> <p>size of pond (m²)</p> <p>species and numbers size (length, diameter at base, at top)</p> <p>Bravo Charay Kavet Kreung Tampeon</p> <p>Kok Lak Commune Yorn village O'Chay village ...</p> |

** Logging roads and sawmills can be recorded in the same way under direct evidence, if the offenders are present

06/2006



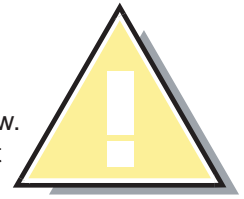
06/2006

APPENDIX 3: List of observations codes

All observations must be further qualified by a specific observation code.

Further details are recoded under remarks.

New protected area specific codes can be added to those shown in the table below. But care must be taken not to add details which should be recorded as remarks at the level of the observation codes. The existing codes cannot be changed.



All codes currently included in the MIST master lists of observation codes for illegal activities and animals are shown in the table below. These codes are based on the situation in Virachey National Park. Other codes can be added to cover specific situations found in other protected areas. Please note that under animal observations the actual name of the species will be recorded by ranger patrols.

| Illegal Activities | | Animals | |
|---------------------------|--------------|-------------------------------|-----------------------|
| Observation | Code | Observation | Code |
| Encroachment | Cultivation | <i>Bird species name</i> | Call |
| | Mining | | Egg |
| | Road | | Nest |
| | Swidden | | Photo |
| | Trespassing | | Poached |
| Fire | Position | <i>Mammal species name</i> | Sighting |
| | | | Call |
| Plant harvesting | Eaglewood | <i>Reptile species name</i> | Dead-carnivore eating |
| | Fruit tree | | Dead-cause unknown |
| | Malva tree | | Dig |
| | Raisin tree | | Dropping |
| | Rattan | | Footprint |
| | Sawmill | | Natural death |
| | Logging | | Photo |
| | Logs | | Scratch |
| | Log ponds | | Sighting |
| | Logging road | | Trail |
| Poaching | Fishing | <i>Amphibian species name</i> | Dead-cause unknown |
| | Hunting | | Footprint |
| | | | Photo |
| | | | Sighting |

APPENDIX 4: Example patrol data sheets

GROUND PATROL DATA SHEET VIRACHEY NATIONAL PARK

Way - point Date Ranger Station patrol days of Day of Day of Day of Day

GPS no

| run. Nos | LOCATION | TIME | OBSERVATION CODE | TOTAL | REMARKS |
|----------|----------|------|------------------|-------|---------|
| | 48P | UTM | | | |
| | 48P | UTM | | | |
| | 48P | UTM | | | |
| | 48P | UTM | | | |
| | 48P | UTM | | | |
| | 48P | UTM | | | |
| | 48P | UTM | | | |
| | 48P | UTM | | | |
| | 48P | UTM | BAN_S | 2 | |
| | 48P | UTM | | | |
| | 48P | UTM | POD_H | 1 | |
| | 48P | UTM | | | |
| | 48P | UTM | | | |
| | 48P | UTM | | | |
| | 48P | UTM | | | |
| | 48P | UTM | | | |

from GPS display

Observation recordings of mammals based on species listed (3 or 4-letter codes*) and on additional information (1 - or 2 letter code)
The example show is the sighting of 2 Banteng
* 4 letter codes are assigned by MIST

Recording of illegal activities based on 3 or 4-letter codes and a further specification (1- or 2-letter code*)
The example show is one incidence of poaching direct evidence hunting
* bold letters in box below

OBSERVATIONS - Mammals:
BAN (Banteng), **BSP** (Bear sp.), **BBR** (Black Bear), **BSR** (Sun Bear), **CAT** (Cat sp.), **CFC** (Fishing Cat), **GGC** (Golden Cat), **CMC** (Marbled Cat), **CVT** (Civet sp.), **CUJ** (Large Indian Civet), **CLS** (Large-spotted Civet), **CPC** (Common Palm Civet), **CSI** (Small Indian Civet), **CSP** (Small-toothed Palm Civet), **DLE** (Dhole), **DLR** (Dour Languar), **ELE** (Elephant), **GAU** (Gaur), **GVC** (Yellow-cheeked Gibbon), **HBR** (Hog Badger), **LPD** (Leopard), **LPC** (Clouded Leopard), **LMD** (Lesser Mongoose), **MSP** (Macaque sp.), **MLT** (Long-tailed Macaque), **MPT** (Pig-tailed Macaque), **MST** (Stump-tailed Macaque), **MSR** (Sumatran Rhinoceros), **MUS** (Muntjac sp.), **MUM** (Red Muntjac), **OSP** (Other sp.), **POR** (Asian Porcupine), **SAW** (Sambur), **SLR** (Silvered Langur), **SSW** (Southern Serow), **SPG** (Sunda Pangolin), **TIG** (Tiger), **WPG** (Wild Pig)
 Add codes for: seen, call, fresh footprint, fresh droppings, fresh scratch, natural death, cause of death unknown

OBSERVATIONS - Illegal activities:
POACHING direct observation: **POD** - Hunting, Fishing; **POACHING** sign: **POS** - Hunting, Fishing
PLANT HARVESTING direct observation: **PHD** - Eaglewood cutting, Fruit tree cutting, Logging, Malva tree cutting, Resin tree cutting, Rattan cutting, Sawmill sign: **PHS** - Eaglewood cut, Fruit tree cut, Logs, Log ponds, Logging road, Malva tree cut, Resin tree cut, Rattan cut, Sawmill sign: **END** - Cultivation, Mining gold, Mining gem stones, Mining metal, Road, Swidden, Trespassing sign: **ENS** - Cultivation, Mining gold, Mining gem stones, Mining metal, Road, Swidden, Trespassing sign: **FID** - FIRE sign: **FIS** - FIRE direct observation

04/2006 Patrol ID: ID number from MIST Date received: Date entered into MIST: Received/entered by:

This is and example of a filled in patrol data sheet

**GROUND PATROL DATA SHEET
VIRACHEY NATIONAL PARK**

Date 12.12.2005
Ranger Station Veunsa

GPS no 119
Day 1 of patrol days

| run. Nos | Way - point | LOCATION | TIME | OBSERVATION CODE | TOTAL | REMARKS |
|----------|-------------|-----------------------|--------|------------------|-------|---|
| 1 | 45 | ^{48P} 701420 | 07:55 | POS | 1 | start of patrol |
| 2 | | ^{48P} - | 08:22 | MPT_s | 2 | No GPS signal |
| 3 | 46 | ^{48P} 701197 | 08:28 | POS | 1 | |
| 4 | 47 | ^{48P} 700845 | 09:00 | POS | 1 | |
| 5 | 48 | ^{48P} 700473 | 09:35 | POS | 1 | |
| 6 | 49 | ^{48P} 700073 | 10:02 | HSP_c | 1 | |
| 7 | 50 | ^{48P} 699821 | 10:28 | POS_H | 1 | 2 wire snares collected |
| 8 | 51 | ^{48P} 699669 | 11:03 | POD_H | 1 | 2 poachers carrying one AK-47 and one dead pangolin escaped-> |
| 9 | 52 | ^{48P} 699458 | 11:42 | POS | 1 | Start of lunch break |
| 10 | 53 | ^{48P} 699451 | 13:18 | POS | 1 | End of break |
| 11 | 54 | ^{48P} 699172 | 13:36 | BSB_s | 1 | |
| 12 | 55 | ^{48P} 699172 | 13:36 | WPG_s | 2 | About 200 m north |
| 13 | 56 | ^{48P} 698915 | 14:00 | POS | 1 | |
| 14 | 57 | ^{48P} 698605 | 14:181 | POS | 1 | Start of ambush we heard some noise and decided to hide and-> |
| 15 | 58 | ^{48P} 698614 | 15:55 | POS | 1 | End of ambush |
| 16 | 59 | ^{48P} 698496 | 16:10 | POS | 1 | |
| 17 | 60 | ^{48P} 698401 | 16:35 | POS | 1 | End of patrol day |

Run No. 2: Sighting of 2 Pig-tailed macaques, no waypoint because the canopy was so dense that the patrol did not get enough satellite fixes for a GPS position recording

Run No. 3: Position waypoint which will be used in MIST to calculate the coordinates of the MPT_s observation

Run No. 6: Hornbill call

Run No. 7: Sign of poaching hunting; 2 wire snares

Run No. 8: Direct evidence of poaching hunting: 2 poachers carrying one AK-47 and one dead pangolin escaped [text continues on back page] because they were on the other side of the river when we saw them. We charged them after crossing the river, but they got away because the river crossing took too long.

Run No. 11, 12: 2 observations made from the same position: Sun Bear scratches at the position of the GPS user, and two Wild Pigs were seen about 200 metres to the north

Run No. 14: [text continues on back page] wait in case the noise was from people poaching nearby.

Example of front and back page of a detailed data sheet for the recording of illegal activities

Detailed Illegal Activity Data Sheet Virachey National Park

direct evidence

From patrol data sheet

| | | | | | | | |
|------|-------------|---------|-----------------|-----|-----|------|------------------|
| Date | Team Number | Run No. | Waypoint number | 48P | UTM | Time | Observation Code |
|------|-------------|---------|-----------------|-----|-----|------|------------------|

| | | | | | | | | | | | |
|------------------|--------------------------|--------------------------|------------------|-------------------|--------------------------|---------|--------------------------|--------------|--------------------------|-----------------|--------------------------|
| Number of people | cautioned | <input type="checkbox"/> | local resident | → Khmer | <input type="checkbox"/> | Brao | <input type="checkbox"/> | * Cambodian | <input type="checkbox"/> | Name of village | <input type="checkbox"/> |
| | warning letter issued to | <input type="checkbox"/> | local auth ority | → police | <input type="checkbox"/> | Charay | <input type="checkbox"/> | * Lao | <input type="checkbox"/> | | <input type="checkbox"/> |
| | non-reoffence contract | <input type="checkbox"/> | outsider* | → military | <input type="checkbox"/> | Kavet | <input type="checkbox"/> | * Vietnamese | <input type="checkbox"/> | | <input type="checkbox"/> |
| | fined | <input type="checkbox"/> | forestry officer | → military police | <input type="checkbox"/> | Kreung | <input type="checkbox"/> | | | | <input type="checkbox"/> |
| | arrested | <input type="checkbox"/> | seen, not caught | | <input type="checkbox"/> | Tampeon | <input type="checkbox"/> | | | | <input type="checkbox"/> |
| | local resident | <input type="checkbox"/> | minority | → Khmer | <input type="checkbox"/> | | <input type="checkbox"/> | | | | <input type="checkbox"/> |
| | local auth ority | <input type="checkbox"/> | police | → military | <input type="checkbox"/> | | <input type="checkbox"/> | | | | <input type="checkbox"/> |
| | outsider* | <input type="checkbox"/> | military police | → military police | <input type="checkbox"/> | | <input type="checkbox"/> | | | | <input type="checkbox"/> |
| | forestry officer | <input type="checkbox"/> | Tampeon | | <input type="checkbox"/> | | <input type="checkbox"/> | | | | <input type="checkbox"/> |
| | Taken to police | <input type="checkbox"/> | | | | | | | | | <input type="checkbox"/> |

this may apply to all recordings on this page

| | | | | | | | | | | |
|----------|----------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|-------------------------------------|--------------------------|--------------------------|--------------------------|
| Poaching | <input type="checkbox"/> Hunting | species code | No | Live | Dead | Part | number of weapons/items confiscated | <input type="checkbox"/> | seen | <input type="checkbox"/> |
| | <input type="checkbox"/> Fishing | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | | | <input type="checkbox"/> | <input type="checkbox"/> |
| | animals confiscated | <input type="checkbox"/> | | | | | | | | |

| | | | | | | | | |
|------------------|---------------------------------------|--------------------------------|--------------------------|---------|----|--------|----|----|
| Plant harvesting | <input type="checkbox"/> Eaglewood | number of shoots | <input type="checkbox"/> | Species | No | length | D1 | D2 |
| | <input type="checkbox"/> Fruit tree | number of trees felled | <input type="checkbox"/> | | | | | |
| | <input type="checkbox"/> Malva tree | number of logs | <input type="checkbox"/> | | | | | |
| | <input type="checkbox"/> Rasin tree | number of sawmills | <input type="checkbox"/> | | | | | |
| | <input type="checkbox"/> Rattan | number of stumps | <input type="checkbox"/> | | | | | |
| | <input type="checkbox"/> Logging | Kg of harvest | <input type="checkbox"/> | | | | | |
| | <input type="checkbox"/> Logging pond | length/width of road | <input type="checkbox"/> | | | | | |
| | <input type="checkbox"/> Logging road | size of pond (m ²) | <input type="checkbox"/> | | | | | |
| | <input type="checkbox"/> Sawmill | | | | | | | |
| | | Stumps no. | <input type="checkbox"/> | ∅ | | | | |

D1 = diameter at base D2 = diameter at top of log

| | | | | |
|--------------------------------------|--------------------------------------|--------------------------|--------------------------|--|
| Encroachment | <input type="checkbox"/> Cultivation | number of people | <input type="checkbox"/> | For mining, list type (gold, gem stone, metal) and notes here: |
| | <input type="checkbox"/> Mining | number of houses | <input type="checkbox"/> | |
| | <input type="checkbox"/> Road | length/width (m) | <input type="checkbox"/> | |
| <input type="checkbox"/> Swidden | size (m ²) | <input type="checkbox"/> | | |
| <input type="checkbox"/> Trespassing | | | | |

DETAILED ILLEGAL ACTIVITY DATA SHEET VIRACHEY NATIONAL PARK

From patrol data sheet

sign

| | | | | | | | |
|------|-------------|---------|-----------------|-----|-----|------|------------------|
| Date | Team Number | Run No. | Waypoint number | 48P | UTM | Time | Observation Code |
|------|-------------|---------|-----------------|-----|-----|------|------------------|

Poaching

- Hunting
- Fishing

| | | | | |
|--------------------------|---------------|--------------------------|-------------------|--------------------------|
| <input type="checkbox"/> | 'animal' tree | <input type="checkbox"/> | gun shot heard | <input type="checkbox"/> |
| <input type="checkbox"/> | bullet | <input type="checkbox"/> | footprint (human) | <input type="checkbox"/> |
| <input type="checkbox"/> | camp | <input type="checkbox"/> | turtle hooks | <input type="checkbox"/> |
| <input type="checkbox"/> | cartridges | <input type="checkbox"/> | wire snare | <input type="checkbox"/> |
| <input type="checkbox"/> | dog footprint | <input type="checkbox"/> | hole | <input type="checkbox"/> |
| <input type="checkbox"/> | fishing net | <input type="checkbox"/> | wire tiger snare | <input type="checkbox"/> |

| | | |
|--------------|--------------------------|----------------|
| species code | No | cause of death |
| _____ | <input type="checkbox"/> | _____ |
| _____ | <input type="checkbox"/> | _____ |
| _____ | <input type="checkbox"/> | _____ |
| _____ | <input type="checkbox"/> | _____ |

Plant harvesting

- Eaglewood
- Fruit tree
- Malva tree
- Raisin tree
- Rattan
- Logs
- Log ponds
- Logging road
- Sawmill

| | | |
|--------------------------|--------------------------------|--------------------------|
| <input type="checkbox"/> | number of shoots | <input type="checkbox"/> |
| <input type="checkbox"/> | number of trees felled | <input type="checkbox"/> |
| <input type="checkbox"/> | number of logs | <input type="checkbox"/> |
| <input type="checkbox"/> | number of sawmills | <input type="checkbox"/> |
| <input type="checkbox"/> | number of stumps | <input type="checkbox"/> |
| <input type="checkbox"/> | Kg of harvest | <input type="checkbox"/> |
| _____ | length/width of road | _____ |
| _____ | size of pond (m ²) | _____ |

| | | | | |
|------------|--------------------------|--------|-------|-------|
| Species | No | length | D1 | D2 |
| _____ | <input type="checkbox"/> | _____ | _____ | _____ |
| _____ | <input type="checkbox"/> | _____ | _____ | _____ |
| _____ | <input type="checkbox"/> | _____ | _____ | _____ |
| _____ | <input type="checkbox"/> | _____ | _____ | _____ |
| _____ | <input type="checkbox"/> | _____ | _____ | _____ |
| _____ | <input type="checkbox"/> | _____ | _____ | _____ |
| Stumps no. | <input type="checkbox"/> | Ø | _____ | _____ |

D1 = diameter at base D2 = diameter at top of log

Encroachment

- Cultivation
- Mining
- Road
- Swidden
- Trespassing

| | |
|--------------------------|------------------------|
| <input type="checkbox"/> | number of people |
| <input type="checkbox"/> | number of houses |
| _____ | length/width (m) |
| _____ | size (m ²) |

For mining, list type (gold, gem stone, metal) and notes here:

notes:

Mark circles with a tick write numbers in square boxes

VIRACHEY NATIONAL PARK

Ranger-Based Data Collection (RBDC) Instructions for Filling in the Patrol Data Sheet



Before the start of a patrol

- Take enough patrol data sheets (twice the number of planned patrol days).
- Keep patrol data sheets (and maps and other important documents) in a “Clear Plastic Bag”.
- Always carry spare pens, pencils and batteries when on patrol.
- Ensure that the GPS unit is correctly setup and that all previous waypoints and tracks have been saved to a computer and have been deleted from the GPS, according to the VNP GPS instructions.

Filling in the patrol data sheet

1. To be filled in before the start of each patrol or each day of a multi-day patrol:

A new patrol data sheet must be used for each day of patrol. More than one sheet can be used in one day. Before the start of each day's patrol, fill in the patrol data sheet header information:

| | |
|---------------------------------|--|
| Date | day/month/year |
| Ranger Station | Siem Pang, Veunsai, Taveng, Dragon Tail |
| Type of patrol | Foot patrol, Vehicle patrol, Water patrol |
| GPS no | BPAMP inventory number |
| Day .. of patrol .. days | More than one sheet might be filled in per day |
| Page no | Sequential page number, starting with page 1 for the first day of the patrol |
| Names | Team number, Team Leader, GPS User, Team members (data sheet back side) |

2. Recording of observations (patrol data sheet entries):

When the patrol starts fill in the first row of the patrol data sheet (see instructions below) and write 'position' under OBSERVATION CODE and 'start' under REMARKS.

NB: The vehicle drive or boat ride to the drop-off point (and back to the base) is not part of a foot patrol, and must not be recorded on the patrol data sheets as part of the patrol. If you encounter an observation on the way to the start of the patrol, e.g. an illegal activity, record this on the patrol data sheet but do not give it a running number [RUN No].

For each observation (illegal activities, wildlife, physical features or degraded areas) a waypoint must be taken, and a running number [RUN No], WAYPOINT number, LOCATION, TIME, OBSERVATION CODE, and TOTAL must be entered onto the patrol data sheet. For specific observation REMARKS must be entered as well. Each line on the patrol data sheet represents one data entry:

| | |
|------------------------------------|---|
| Run. Nos: | Each observation (=row) gets its own number starting from 1. For each patrol day of a multi-day patrol the 'run. Nos' starts with 1. If several observations are made from one point (e.g. elephants ahead of patrol and gibbons to the right), each gets its own number and waypoint. NB a waypoint has to be recorded for each observation (row)! |
| Waypoint - Location - Time: | all data are to be copied from the GPS display. TIME must be in 24 hour format. |
| Observation Code: | A list of observations and additional codes which should be recorded is shown in the boxes at the bottom of the data sheet. NB use only the codes listed on the data sheet. |
| Total: | For mammals, birds and reptiles this is the number of individuals seen or the number of individuals deduced from signs. For illegal activities always enter 1 under total; each illegal activity is recorded as one encounter or incident. Details such as number of poachers etc. are written under REMARKS. NB there must be a total for every observation; the total for illegal activities is always 1. |
| Remarks: | See detailed description below. |

Specific instructions for recording - POSITION:

All patrols must make at least one data entry with a GPS reading every 30 minutes. If a patrol does not make any observation for about 30 minutes take a waypoint, record location (run. Nos, waypoint, UTM and time only) and write 'position' under observation. TOTAL is 1 for all 'position' entries.

NB: Frequent recording of positions is very important in order to get a good idea of the course and length of the path followed by the patrol because: (1) calculation and display of the areas covered by the patrols will be more accurate and (2) calculation of indices such as elephants per kilometre or snares per kilometre can only be made if the distances covered by the patrols can be calculated as accurately as possible.

Specific instructions for recording - NO GPS READING:

If you want to record an observation but cannot get a GPS reading due to poor satellite cover or dense canopy do the following:

- (1) record the observation and time only – fill in 'Run. No', Time, Observation Code, Total and - if required - Remarks
- (2) continue the patrol and take a GPS reading as soon as the openness of the canopy allows it and enter this waypoint as a position

Specific instructions for recording - START:

- Start of a patrol Running number [RUN No] is 1. Record waypoint, time and UTM co-ordinates in the first row of the patrol data sheet, write 'position' under observation code, and 'start of patrol' under remarks.
- Start of a new day of a multi-day patrol Use a new patrol data sheet. RUN No is 1. Record waypoint, time and UTM co-ordinates in the first row of the new patrol data sheet, write 'position' under observation code, and 'start day #' under remarks.
- Start of an activity such as ambush, observation post or listening post. Record waypoint, time and UTM co-ordinates, write 'position' in the observation code, and describe the activity under remarks.
- Start of a rest period or meal break Record waypoint, time and UTM co-ordinates, write 'position' in the observation code, and describe the type of break (e.g. lunch or rest) under remarks.

Specific instructions for recording - END:

- End of a patrol Record waypoint, time and UTM co-ordinates in the row after the last observation, write 'position' in the observation code, and 'end of patrol' under remarks.
- End of a day of a multi-day patrol, going into night camp or outpost Record waypoint, time and UTM co-ordinates, write 'position' in the observation code, and 'end day #' under remarks.
- End of an activity such as ambush, observation post or listening post. Record waypoint, time and UTM co-ordinates, write 'position' in the observation code, and 'end of activity' under remarks.
- End of a rest period or meal break Record waypoint, time and UTM co-ordinates, write 'position' in the observation code, and type of break (e.g. 'lunch' or 'rest') under remarks.
NB at the start and end of each patrol day a GPS reading must be taken, and entered on the patrol data sheet.

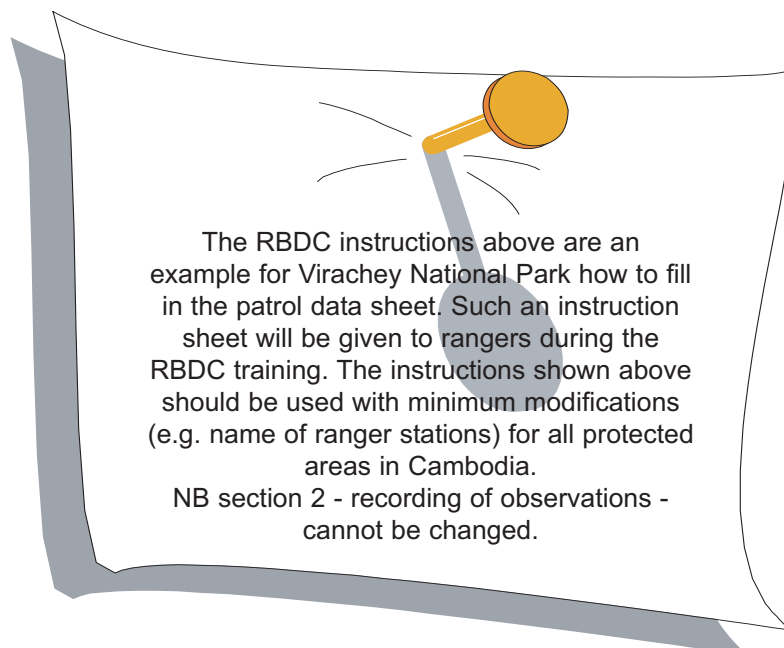
3. Remarks:

Any additional information to complement the observation code must be written under remarks. Remarks should be very detailed and should follow the instructions given in the REMARKS box at the bottom of the back page of the patrol data sheet. Write remarks about:

- **direct evidence of illegal activities (poaching, plant harvesting, encroachment, fire)**
- **signs of illegal activities** (poaching, plant harvesting, encroachment, fire)
- **degraded areas**, giving the length and width of the area, and description of disturbances. Take a track log around the area and write the name the track log is saved as in the remarks column.
- **salient physical features**
- any **other remarks** of relevance to park management

REMEMBER

- Read the WAYPOINT number, LOCATION (UTM) and TIME using the GPS.
 - Do NOT change the Waypoint number. Use the number generated by the GPS.
 - Do NOT change the symbol of a Waypoint. The Waypoint symbol must be the default symbol.
 - Do NOT change the GPS settings.
 - Waypoints stored in the GPS must match the UTM locations entered onto the patrol data sheet.
- Follow the instructions recording of patrol observations when recording an observation.
- Use only the OBSERVATION CODES listed in the boxes at the bottom of the patrol data sheet.
- For wildlife observations enter the number of individuals under TOTAL.
- For all other observations (illegal activities, physical features and degraded areas) and for 'position' enter 1 under TOTAL.
- Take a waypoint at the start and end of each patrol day.
- Take a waypoint at the start and end of each stopping period such as ambush, lunch etc. (do not take waypoints while stopped).
- Write detailed descriptions under REMARKS following the instructions given in the REMARKS box at the bottom of the back page the patrol data sheet.
- Make a patrol data sheet entry at least once every 30 minutes while moving on patrol.
- If you cannot get a GPS reading due to poor satellite cover or dense canopy record the observation and time only, continue the patrol and take a GPS reading as soon as the openness of the canopy allows it and enter this waypoint as 'position'.
- Data from a GPS which is not set according to VNP GPS rules will be considered invalid, and the rangers of that patrol will not be entitled to DSA.
- If waypoints are not taken every 30 minutes during the patrol rangers of that patrol will not be entitled to DSA.



APPENDIX 6: RBDC field instructions

BRIEF INSTRUCTIONS FOR FILLING IN THE VIRACHEY NATIONAL PARK PATROL DATA SHEET

Before starting a patrol

- Ensure that the GPS unit is set up correctly and that waypoints and tracks have been downloaded to a computer and deleted from the GPS.
- Take spare batteries and enough patrol data sheets for the intended duration of the patrol.

At the beginning of each patrol day

- Fill in **DATE, RANGER STATION, TYPE OF PATROL, GPS NO, DAY ... OF PATROL, PAGE NUMBER and NAMES** of patrol members on back page
- Take GPS reading (waypoint) **LOCATION** and **TIME** at start of patrol (write position under **OBSERVATION** code and start under **REMARKS**; first line; run. Nos = 1)

When recording an observation

- allocate a **RUNNING NUMBER** and take a **WAY-POINT** for each observation - even if several are made at the same point !
- use GPS to get **WAY-POINT, LOCATION** and **TIME**
- use only codes listed on the patrol data sheet
- there must be a total (number) for each observation. For animals record the total number seen or number of individuals deducted from signs. For illegal activities always enter 1 under total. The number of trees felled, of poachers, of snares etc. will be recorded under **REMARKS**. For Position always enter 1 under total.
- add a 1- or 2-letter code (as shown on the data sheet) when recording illegal activities, animal calls, footprints, droppings, etc. – record only fresh footprints, droppings and scratches (from today)
- if a data sheet is full, use a new sheet, fill in **DATE** of patrol and **PAGE NUMBER** (bottom right)

At the end of the patrol or at night camp

- take a GPS reading and record **LOCATION** and **TIME** (write **position** under **OBSERVATION** and **end** or **night camp** under **REMARKS**)

Important

- if you cannot get a GPS reading record observation and time only (fill in run Nos, Total and Remarks) – continue patrol and take a GPS reading as soon as the openness of the canopy allows it
- **if you have not recorded any observation for about 30 minutes, take a GPS reading, fill in run. Nos, LOCATION and write position under OBSERVATION**
- at the beginning of any period when the patrol stops, take a waypoint and write **position** under **OBSERVATION** and write start of ambush, rest, lunch break etc. under **REMARKS**. When resuming the patrol again take a waypoint, write **position** under **OBSERVATION**, and end of ambush etc. under **REMARKS**.

Remarks

write remarks about

- direct evidence of illegal activities (i.e. when you arrest somebody)
 - signs of illegal activities
 - carcasses of poached animals found
 - degraded areas
 - salient physical features
 - anything else of relevance you observe
- follow instructions at the bottom of the back page
- for more remarks use back of sheet; copy the related running number (run. Nos)
- animals more than 100 m away:
- if you see animals which are more than 100 metres away record **DIRECTION** (compass) and **DISTANCE** (estimate) and number of young (Only very young offspring are considered as **YOUNG**) under remarks

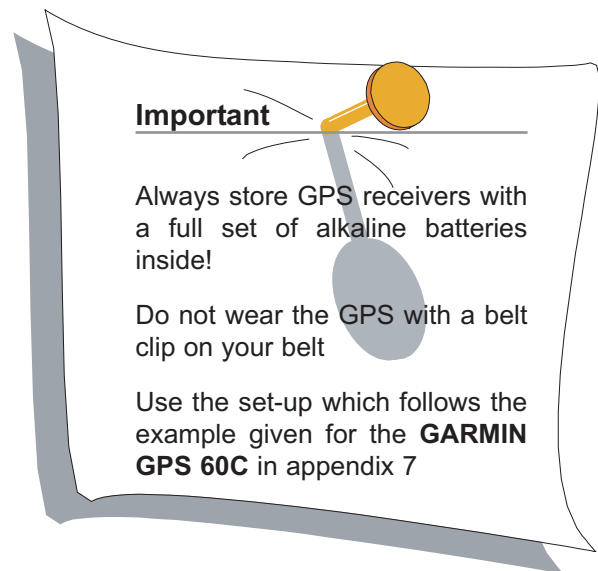
05/2006

The brief field instructions shown above should be laminated and carried by each patrol.

Please note that the month and year when the last changes were made must be shown on the brief field instructions, and on the flow charts and patrol data sheet(s). This ensures that only the most recent patrol data sheet(s) and instructions are used.

APPENDIX 7: GPS set up

- 1) Batteries in
- 2) Satellite page:
 - USE WITH GPS OFF
- 3) Track Log Set-up page:
 - RECORDING METHOD = AUTO
 - INTERVAL = NORMAL
- 4) System Set-up page:
 - GPS = NORMAL
 - WAAS = DISABLED
 - BATTERY TYPE = ALKALINE
 - TEXT LANGUAGE = ENGLISH
 - EXTERNAL POWER LOST = TURN OFF
- 5) Time Set-up page:
 - TIME FORMAT = 24 HOUR
 - TIME ZONE = BANGKOK




Topographic maps in Cambodia use two different map datums: INDIAN 1954 and INDIAN 1960. The old 1:50,000 scale topographic maps are based on the INDIAN 1960, the newer 1:100,000 scale maps on the INDIAN 1954 datum.

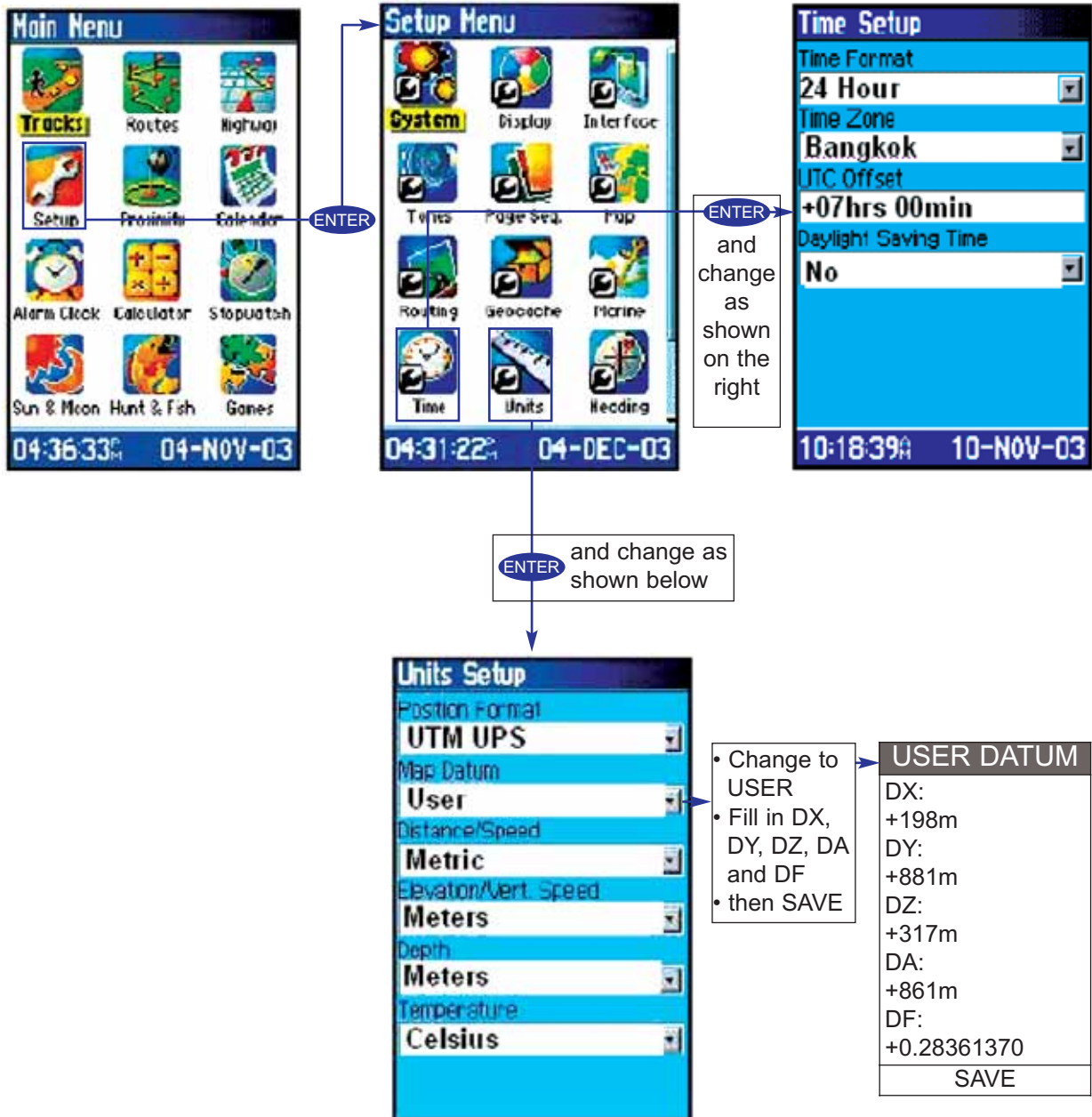
By default, each Garmin GPS unit is set to WGS84 datum, which is about 500m different to the Indian datums. The GPS units map datum setting must therefore be changed to accurately show positions in Cambodia. Garmin supports the INDIAN THAILAND datum which is close to, but not exactly the same as INDIAN 1954 or 1960. For the most accurate setting use a USER datum as described below.

- 6) Units Set-up page:
 - POSITION FORMAT = UTM UPS
 - MAP DATUM = USER
 - DX: +198m
 - DY: +881m
 - DZ: +317m
 - DA: +861m
 - DF: +0.28361370
 - DISTANCE SPEED = METRIC
 - ELEVATION VS = METRIC
 - DEPTH = METRIC
 - TEMPERATURE = CELCIUS
- 7) Interface Set-up page:
 - USB (GARMIN DATA F) = NOT CONNECTED
 - SERIAL DATA FORMAT = GARMIN
- 8) Waypoint symbol:
 - Waypoint symbol must be set to ■
 - Do not change the waypoint symbol

NB: all other settings are the Garmin default setting

Set up of Garmin GPSMAP 60C for use in Cambodia

1. Press **MENU** twice to view the MAIN MENU.
2. Navigate the MAIN MENU  using highlight SETUP MENU and press **ENTER**



APPENDIX 8: Glossary

Bias: Inaccuracies or irregularities in the collection, analysis, or interpretation of data which may cause distortion of the research results; can be caused by intended or unintended subjective choices or perceptions.

Data: Data are facts which have been recorded.

Database query: A database query is the process of requesting data from the database and receiving the results.

Geographic information system (GIS): A computerised database management system used for the capture, conversion, storage, retrieval, analysis, and display of spatial data.

Geo-referenced: Data which are connected to a specific location on the earth's surface.

Index (plural Indices): Indices are statistical measures of change.

Information: Information is processed data.

Map datum: A datum is used to describe the actual shape of the earth in mathematical terms. Datums were developed to accurately map topographic differences in the earth's surface based on an ellipsoid (because the earth's surface is not perfectly round). A datum is a set of parameters defining a coordinate system, and a set of control points whose geometric relationships are known, either through measurement or calculation.

Meta database: A database containing meta-data. Meta-data are data about data. They describe characteristics such as the content, quality and condition of the data.

Monitoring: Intermittent (regular or irregular) surveillance carried out in order to ascertain the extent of compliance with a predetermined standard or the degree of deviation from the expected norm. Monitoring tells us how something(s) is/are changing, it is repeated at regular intervals, it is dynamic in philosophy and purpose oriented.

Nomenclature: Nomenclature is a system of assigning (unique) names.

Objectives: Objectives describe expected results of implementing a plan. They are described in measurable terms and indicate a specific period of time during which these results will be achieved.

Opportunistic: Opportunistic refers to the recording of incidents/observations as and when encountered in contrast to systematic sampling.

Random: A sample is a subset of a larger population. A random sample is one chosen by a method involving a random (i.e. unpredictable) component.

SQL: Structured Query Language is a standard interactive and programming language for getting information from and updating a database.

Stratum (plural strata): A sub-division of a (sample) area defined by a characteristic.

Surveillance: Surveillance is an extended programme of surveys, undertaken in order to provide a time series, to ascertain the variability and/or range of states or values which might be encountered over time.

Survey: A survey is an exercise in which a set of qualitative or quantitative observations are made, usually by means of a standardised procedure; it is an inventory, it is static in its background philosophy and it is usually done once only.

Systematic: Systematic sciences follow logical, consistent and ordered methods.



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