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An Evaluation of Wildlife Monitoring and Anti-Poaching Activities

By

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A report submitted in partial fulfilment of the requirements for the MSc.

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ABSTRACT

Monitoring and evaluation of community based wildlife management projects is essential for assessing both effectiveness and efficiency of project activities, thus enabling the identification of potential improvements and providing feedback information to stakeholders, policy-makers and the conservation community itself. This evaluation addresses two aspects of two community wildlife management projects, wildlife monitoring and anti-poaching activities, using two projects based in Tanzania as case studies. A theoretical framework of the costs and benefits of these activities is used as a basis for identifying relevant data within the project records, followed by an analysis of the data in order to evaluate the impact and effectiveness of the projects. Additionally, an estimation of the monetary value of anti-poaching activities is made, based upon results of questionnaires administered to game scouts. Finally, recommendations are made for the improvement of the wildlife monitoring and anti-poaching operations of the two projects. Cullman and Hurt Community Wildlife Project (CHCWP) is shown to be effective in some aspects of their anti-poaching activities, illustrated by a decline in the rate of firearms confiscated, bows and arrows confiscated and snares destroyed, and they have a high value of anti-poaching activities relative to cost and hunting offtake value. Analysis of MBOMIPA anti-poaching data is inconclusive as to whether anti-poaching patrols are effective, and value of anti-poaching activities is low relative to costs. Ground surveys using live animal sightings have shown to be useful for assessing changes in populations in both direction and magnitude. Recommendations for improvement of anti-poaching activities include improving resources and data consistency and focusing on high value enforcement activities, whilst wildlife monitoring can be improved by utilising trophy quality and hunting effort data, using line transect techniques and pursuance of the use of the data for quota setting.

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TABLE OF CONTENTS

1. INTRODUCTION

With the growing interest in community-based natural resource management (CBNRM) there is increasing pressure to show if such projects are achieving their goals. Therefore monitoring and evaluation has taken on increasing importance (Stem *et al.* 2005) as it can provide public and internal accountability and help reveal the impact of a project (Hockings *et al.* 2000). Demonstrating such impacts can be vital in the conservation field, for receiving approval from government officials, raising project funds and influencing decisions of other CBNRM projects, and requires 'the quick accessibility of appropriately analysed data to a wide audience, particularly policy-makers' (Gibbs *et al.* 1999).

Lack of complete and reliable data is a problem for many community schemes, and results in a limited availability of feedback information (Jachmann and Billiouw 1997), yet with reliable and meaningful measures of success, CBNRM projects can assess their own effectiveness, providing a means by which strong and weak aspects of the project can be identified, and decisions can be made on whether management should be continued or changed (Gibbs *et al.* 1999). Indeed, there is now realisation in the conservation community that collaborative initiatives are needed in order to improve effectiveness and efficiency of community based conservation by improving monitoring and evaluation, as well as establishing clear definitions of commonly used terms, clarifying monitoring system components and applying available approaches appropriately (Stem *et al.* 2005). For example, The Conservation Measures Partnership has developed a set of adaptive management open standards, providing steps, principles, tasks and guidance for the successful implementation of conservation projects (Conservation Measures Partnership 2004). Collaborative approaches such as these aim to utilise the experience and knowledge of practitioners in the conservation field, with the intention of discouraging organisations from building a system from scratch and overlooking the long history of lessons learned (Stem *et al.* 2005). Thus conservation projects

should be able to undertake activities more efficiently and effectively, and generate the necessary data required by stakeholders and policy-makers.

The success of a community based wildlife management project depends on a range of factors, including sufficient incentives for residents to stop poaching (Gibson and Marks 1995) as well as sufficient incentives for them to continue monitoring (Mesterton-Gibbons and Milner-Gulland 1998), which is discussed further in *Chapter 2*. Indeed, if such criteria are in place, community wildlife projects are potentially powerful tools in the conservation of wildlife in areas where people are both living and hunting (Mesterton-Gibbons and Milner-Gulland 1998), reflected by the shift towards community conservation programmes in both Africa and around the world, following the failure of conventional wildlife management in halting poaching and protecting the wildlife resources (Gibson and Marks 1995). However, without comprehensive monitoring and evaluation of project activities, not only will such projects have difficulties in assessing their own impact and identifying potential improvements, but they will also limit availability of information to the conservation community as a whole, thus slowing the progress of wildlife protection. With this in mind, this evaluation addresses two key aspects of community based wildlife management projects: wildlife monitoring and anti-poaching activities. It seeks to identify measures of success for these activities and determine what data can be useful for expressing project impact and efficiency, by assessing and analysing data sets of two such projects in Tanzania. By addressing these aspects of the projects, this evaluation seeks to potentially improve their wildlife monitoring and anti-poaching activities operations by making recommendations regarding the form of the data and the methods by which it is collected and utilised. These recommendations can have implications beyond the projects directly involved in this evaluation, if applied appropriately to similar community wildlife projects undertaking wildlife monitoring and anti-poaching activities.

This evaluation can be divided into five main components, in which CHCWP and MBOMIPA act as two case studies (described in more detail in *Chapter 2*). Firstly, the construction of a theoretical framework that identifies the costs and benefits of wildlife monitoring and anti-poaching activities. The costs and benefits are then linked with the relevant information and data that is

required to produce feedback information on the effectiveness and efficiency of the activities (see *Chapter 3*). Secondly, the project records are examined in order to identify the data that are obtain according to the theoretical framework, with a brief review of the quality and consistency of these data sets (*Chapter 4*). Thirdly, the available data are analysed to determine where the projects are succeeding or otherwise (*Chapter 5*). Fourthly, an estimation of a monetary value of anti-poaching activities is made, based up questionnaires administered to game scouts, as a method of assessing the benefits of this aspect of the projects (*Chapter 6*). And finally, recommendations are made based upon the evaluation in the previous chapters and by making comparisons of the strengths and weaknesses of the two projects *(Chapter 7).*

2. BACKGROUND

2.1 Theory

2.1.1 Anti-poaching activities

2.1.1.1 Poacher and game scout incentives

Community based wildlife management projects often provide employment to local residents as game scouts for the protection or monitoring of wildlife resources, with the aspiration of turning potential poachers into 'individuals with a sense of proprietorship over wildlife' (Gibson and Marks 1995). Thus a poacher can be considered as a potential scout, and similarly a scout can also be considered as a potential poacher. Therefore, in order to establish an effective anti-poaching project, it is critical to understand the incentives behind the decision of an individual whether to poach or not to poach, and whether to monitor or not to monitor.

There are two main types of poachers, local poachers and organised gangs. It is the local poachers that may have the opportunity to be involved in anti-poaching patrols, therefore the focus here will be on these local poachers. They mainly hunt for meat, although may occasionally opportunistically kill other animals such as large carnivores for their skins and other body parts, and elephants or rhinos for both meat and for trophies to be sold on to a dealer (Leader-Williams and Milner-Gulland 1993). The decision of an individual whether to poach or not, or how long to spend poaching, depends upon the benefits and costs of poaching to that individual; in order to eliminate poaching, the marginal costs need to be consistently greater than the marginal benefits (Messer 2000). An increase in marginal costs may be achieved by increasing opportunity costs, such as providing alternative means for generating income. Increasing the penalty also increases the costs to the individual, and since local hunters are marginal hunters they may be more likely to be deterred from crime by the threat of higher penalties (Thurow 1980, cited in Leader Williams and Milner Gulland 1993). Indeed, the common feature of many of the successes in

wildlife protection in Africa is 'the willingness to use lethal force to enforce anti-poaching laws, combined with some type of Integrated Conservation and Development Program that tries to raise the non-poaching wage rate' (Messer 2000). However, a local poacher may be converted into a more serious hunter (e.g. of elephants and rhinos) if the penalty is too severe, since it pays to hunt for more profitable species if the penalty does not differentiate between low scale and high scale poaching (Stigler 1970, cited in Leader Williams and Milner Gulland 1993). However, theory suggests that increasing detection rate has a greater deterrence effect than increasing the severity of the penalty (Leader Williams and Milner Gulland 1993). Therefore the potential of anti-poaching patrols in the protection of wildlife is considerable. It is the perceived risk of detection (rather than necessarily the real probability of detection) that will most strongly influence an individual's decision whether or not to poach. Effective anti-poaching patrols will therefore succeed in decreasing poaching if they create the perception of high detection rate.

The incentives of the game scouts are also fundamental in the running of effective anti-poaching patrols. Game scouts incur an opportunity cost while monitoring, therefore the payment to the scouts must exceed these opportunity costs, even if no one is poaching (Mesterton-Gibbons and Milner-Gulland 1998), otherwise there is considerable likeliness of corruption. The costs to scouts for participating in monitoring can be greater than just the opportunity costs. Firstly, there is a risk to scouts when encountering armed poachers. Secondly, in some circumstances, scouts can become estranged from their community, for example in Zambia's Administrative Management Design for Game Management Areas (ADMADE) community wildlife project, in those areas without effective unit leaders, residents accused scouts for their poaching, stealing, fighting, witchcraft and drunkenness (Gibson and Marks 1995). This emphasises not only the need for sufficient wages to offset the costs encountered, but also the involvement of all community members in project implementation.

2.1.1.2 Enforcement indicators

Enforcement indicators i.e. the activities that the game scouts perform in order to deter poaching (such as arresting poachers, confiscating weapons or vehicles, destroying snares and poachers' camps, and discovering poached wildlife) are the most common way of expressing the impact of anti-poaching patrols. However, total number of activities only has limited value, since it does not take into account change in patrol effort, such as number of patrol days/hours, or number of scouts. For example, an increase in the total number of an enforcement indicator may be an artefact of increased effort, rather than as a consequence of an increase in poaching. The point where any further increase in patrol effort no longer causes an increase in the enforcement indicator can be considered as the most efficient level of enforcement (point of diminishing returns). Rates of enforcement indicators provide a more useful analysis for determining trends in poaching. If rates of enforcement indicators are decreasing, this may imply that poaching levels are decreasing, and therefore that patrols are being effective. However, there is the possibility that poacher behaviour may change in reaction to the patrols, becoming more concealed or cautious in order to avoid detection. The poachers may also shift to other areas where patrol presence is less extensive, thus simply shifting the problem to another area. The most likely situation is a combination of the above. Therefore, trends extracted from analysis of rates of enforcement indicators can be used as a signal of the changes in poaching levels, but should not be assumed as the only possible cause of the trends.

2.1.1.3 Rewards/bonuses

Rewards or bonuses, usually in the form of a monetary cash payment, are often offered to game scouts undertaking anti-poaching patrols as an incentive to carry out their duties effectively and with commitment, i.e. fulfilling their duties according to their training, and encouraging them to take initiative in order to achieve the goals of the patrol unit. The value of the reward for each activity may vary depending on the perceived benefit and may take into account the difficulty or risk that the game scout may incur. For example, the reward that was offered

by CHCWP to game scouts for arresting an elephant poacher was approximately 500 times more than for destroying a snare (see *section 2.2.1*), taking into account the protected status of elephants, their internationally charismatic status, and the likeliness that elephant poachers will be armed and dangerous, compared with the limited risk associated with destroying snares.

There is a theoretical positive feedback relationship between rewards and enforcement activities. An increase in the anti-poaching activities results in an increase in the total value of rewards awarded, as each reward is awarded for a particular enforcement activity, presuming that claims for rewards are paid out. Similarly, rewards can be an incentive to increase commitment to anti-poaching activities, and therefore the number of enforcement activities may be expected to increase as a consequent of increased number or value of rewards paid out. Therefore, if the reward system is acting effectively it may be expected that both the total value or number of rewards and total number of anti-poaching activities (or at least those for which rewards are offered) would increase until either anti-poaching activities are at their most effective, so that an increase in patrol effort or game scout commitment would no longer lead to an increase in enforcement activities, or until other factors, such as a decrease in poaching levels, take a greater effect. However it is uncertain what the consequence of a decrease in the number or value of rewards paid out in one year may have on the following year. It may have no significant effect on the subsequent year, as scouts may recall the previous benefits of patrol commitment, i.e. the incentive may remain. Alternatively a fall in rewards could result in cynicism or doubt about the reward scheme and thereby the incentive is weakened. If this leads to a decline in commitment the following year, again resulting in a reduction in rewards, a cascade effect of declining rewards and declining enforcement activities may result.

However, there is evidence that rewards can have a considerable impact on the effectiveness of anti-poaching foot patrols. In a study of elephant poaching and law enforcement in the central Luangwa valley in Zambia, the number of bonuses paid was identified as the most important predictor variable affecting the number of elephants found killed illegally, above scout density, effective investigation days, total law-enforcement budget and the budget related to personal emoluments (Jachmann and Billiouw 1997). Logarithmic analysis in

the same study also indicated a saturation point for the effectiveness of bonuses, whereby the effect of the number of bonuses paid on elephants found killed became insignificantly small after approximately 5000 bonuses (Jachmann and Billiouw 1997). This suggests that if too many rewards or bonuses are paid out then their ability to act as an incentive may be compromised. Nevertheless, the role that reward schemes can play in increasing the effectiveness of anti-poaching activities is apparent, if set at an appropriate level to act as an incentive.

2.1.1.4 Wildlife monitoring

The monitoring of wildlife has been the traditional approach of conservation programmes in the effort to conserve biodiversity, although there is growing realisation of its limitations without the monitoring of social, economic, political and cultural threats to conservation (Stem *et al*. 2005). The objectives of monitoring programmes can usually be classified as either scientific or managerial, both which can play an important role in conservation. Management in particular involves decisions about actions that may result in changes to the population, for example in order to prevent populations from becoming too low or too high (Pollock *et al.* 2002). Effective wildlife monitoring should ideally assess the current trends and threats (base on local and scientific knowledge), the desired status, breeding rates and current exploitation (Olsen *et al.* 2001) in order to obtain a comprehensive understanding of the health of the wildlife population. Such information can be vital for increasing awareness of populations under threat and provide political anchorage with which to influence policies. However, unless the monitoring data are used for such managerial purposes, the monitoring itself does not add to the protection of the wildlife and will not increase its sustainability. It is therefore vital that wildlife monitoring programmes direct their intentions towards influencing policies, for example quota setting, where the data can be used to change the legal offtake of a particular species depending on the trends in the population.

Most monitoring programmes face two potentially problematic variables: spatial variation and detectability (Pollock *et al.* 2002). Spatial variation has an impact when a sample area is used to draw inference about the entire area, due to logistical constraints of monitoring the entire area, whilst detectability affects

most monitoring programmes, referring to the inability of survey methods to detect every animal of concern within the sample area (Pollock *et al.* 2002). Therefore monitoring programmes need to either estimate or remove the effects of these variables in order to determine true trends in the populations (Pollock *et al.* 2002). There is a range of wildlife monitoring techniques, each which face numerous difficulties and are affected by problematic variables, such as those discussed above, to varying degrees. Capture-recapture is a method of estimating absolute abundance, requiring the capture, marking and releasing of animals. Although it can provide accurate population estimates in some cases, it can be subject to problematic variables such as trap response and heterogeneity in capture probabilities (Pollock *et al.* 2002). Furthermore, capture-recapture methods are not suitable for projects that require monitoring of many species over a wide area, as is the case for many African community based wildlife-monitoring programmes. Similarly, tagging methods can provide detailed information on population size and animal behaviour, but they are usually resource intensive and are only suitable for certain species and populations.

Simple animal counts have the benefit that they do not require the capture of individual animals are relatively inexpensive to run, although they do require that the animals have high detectability. They also do not provide estimates of absolute abundance, although may provide information on changes in populations in magnitude and direction. Line transects on the other hand can be used to provide absolute estimates, where the distance from the animal to the point of measurement can be used to estimate detectability (Pollock *et al.* 2002). One such line transect method based upon bicycle counts has been demonstrated to provide high census intensity with efficient animal detection and high levels of precision for the density estimates obtained, as well as being inexpensive to run and being suitable for the participation of local people (Gaidet *et al.* 2003). Aerial surveys are an alternative but very expensive method for estimating wildlife populations, providing useful estimates particularly for large areas where ground surveys for the entire area are unrealistic. However they usually underestimate population density due to animals being missed (Alpízar-Jara and Pollock 1996) and also might not be considered as a sustainable method of monitoring by community based projects. Whichever method or combination of methods of wildlife monitoring is adopted by a project depends on objectives and

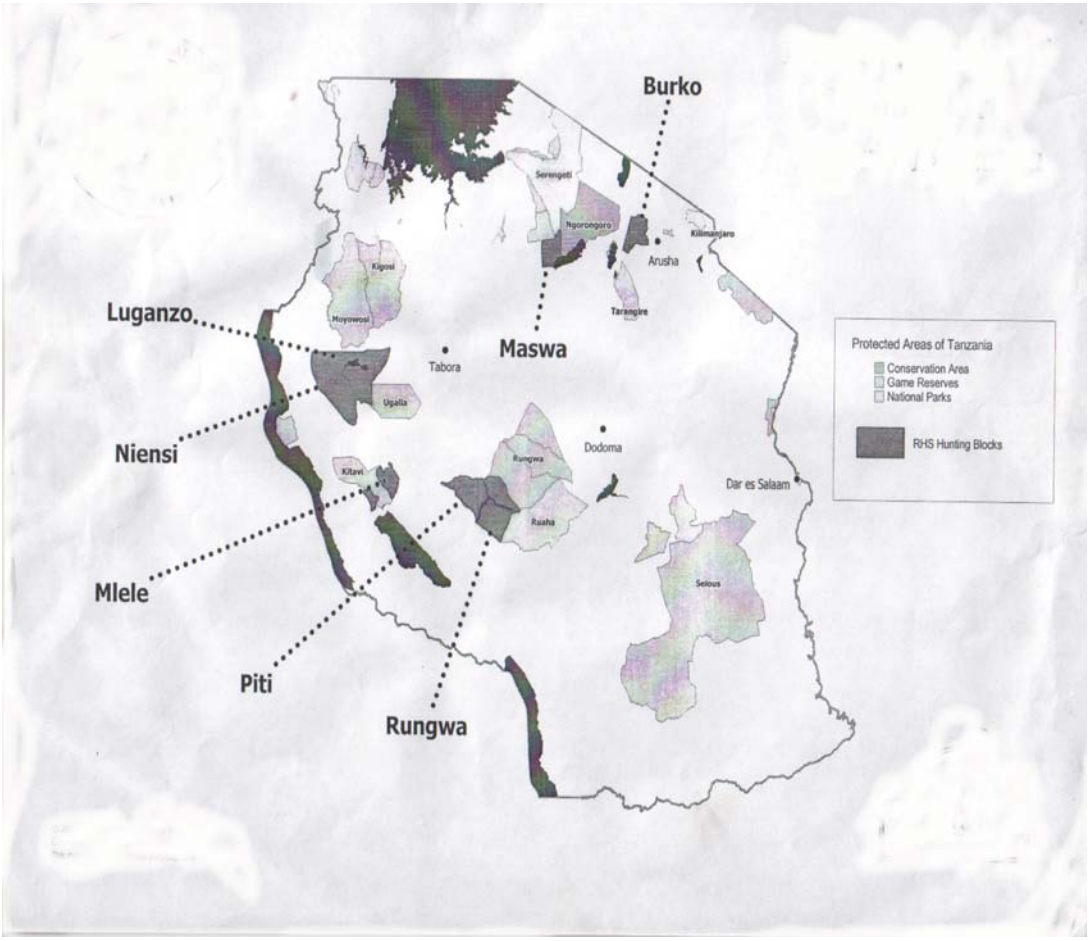
budget and the species under question, but in any case the importance of acknowledging limitations of the method and correcting them where possible is vital for both the understanding of population dynamics and for effective management.

2.2 Case studies

2.2.1 Cullman & Hurt Community Wildlife Project (CHCWP)

CHCWP was founded in 1990 as a division of Robin Hurt Safaris (RHS), a tourism hunting company, and operates in five areas of Tanzania: Burko Maasailand, Makao/Maswa, Niensi-Luganzo, Mlele, and Rungwa/Piti East, covering an approximate total area of 21,300km^2 (see *Map 2.1*). The 33 villages involved all exist within these areas, and benefit from CHCWP in the form of development projects of the villages' choice, such as secondary schools, dispensaries, clinics, hospitals, water pumps and dams. These projects are funded by hunting fees, since RHS clients pay a 20% mandatory Community Conservation Fee above the Government Game Fees. CHCWP also run anti-poaching activities with funds raised through donations. Villagers are trained by experienced Project Field Officers with the assistance of government game scouts, and the units are supplied with camp equipment, uniforms, food, medicine and transport, with the participating villagers receiving a small salary and rewards for their activities. With these actions, CHCWP aims to 'eliminate illegal hunting and harmful hunting practices, as well as provide benefits to the villagers as incentive to protect the environment and promote long-term sustainability of Tanzania's natural resources' (Tanzania Game Trackers Safaris and Robin Hurt Safaris 1995). Until 2004, CHCWP offered reward payments to game scouts for anti-poaching activities as an incentive to carry out patrols effectively according to training, but have since terminated this scheme due to financial constraints and political issues. The rewards that were offered are as follows:

- poachers' camp destroyed US$6
- wire or steel cable snare destroyed US$ 0.3-0.9
- rifle or shotgun recovered and handed over to wildlife department US$75
- muzzle loader recovered and handed over to wildlife department US$40
- poacher arrested and convicted US$25
- elephant or rhino poacher arrested and convicted US$ 300

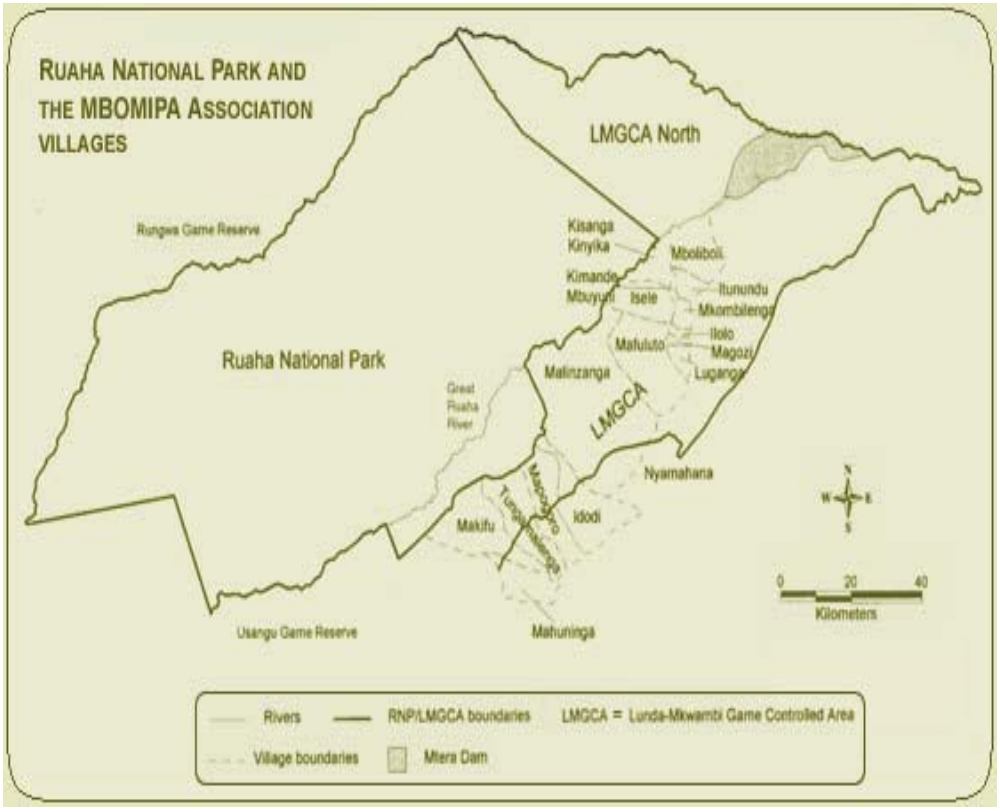


Map 2.1 CHCWP operation areas, Tanzania

2.2.2 MBOMIPA (Matumizi Bora ya Malihai Idodi na Pawaga; Sustinable Use of Wildlife Resources in Idodi and Pawaga)

Founded in 1997, as a development of the Ruaha Ecosystems Wildlife Management Project (1992-1996), MBOMIPA works with 19 villages that

border Ruaha National Park, in the Idodi and Pawaga divisions of the Iringa District (See *Map 2.2*) The MBOMIPA project itself ran until 2002, with support from NGOs such as DFID UK, and is now run by The MBOMIPA Association, having been legally registered under the Societies Ordinance in 2002, the first indigenous wildlife and development project of its kind in Tanzania. Villagers receive benefits, through MBOMIPA, from the sale of the hunting quota in the Lunda-Mkwambi Game Controlled Area (LMGCA), and therefore have an incentive to maintain a sustainable wildlife population. The villages have now pooled their resources, with each village electing two representatives, in order to achieve a more efficient operation. The project runs both wildlife monitoring and anti-poaching activities in LMGCA, funded mostly by the income from hunting. Ground wildlife surveys are conducted by village game scouts alongside anti-poaching activities, based at two main fixed posts in Lunda and Mkupule within LMGCA. Wildlife monitoring, which aims to influence the setting of the hunting quota, has also been in the form aerial surveys.



Map 2.2 MBOMIPA project area and associated villages.

3. METHODOLOGY

3.1 Theoretical framework

3.1.1 Costs

Costs in general are easily identified and can be classed into 'expenditure' and 'effort', as illustrated in *Figure 3.1*. Data on financial expenditure is useful to assess whether the project is being cost-effective i.e. if the benefits outweigh the costs, whether expenditure on patrols is changing over time, and if this is affecting patrol data. Changes in patrol expenditure may not necessarily follow the same trends as overall expenditure, and therefore can be analysed separately. Patrol effort is important because it can have direct impact on patrol data, therefore these data are required in order to calculate rates of change in enforcement and monitoring indicators.

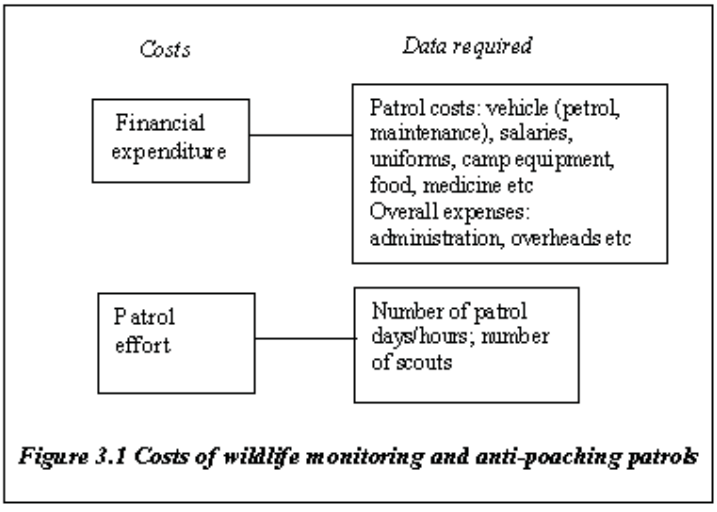


Figure 3.1 Costs of wildlife monitoring and anti-poaching patrols

3.1.2 Benefits

Measurements of benefits (measures of success) are the key to assessing whether the project is achieving its goals, and can be essential in attracting donors or influencing decisions in wildlife management. However, it is often difficult to create a meaningful link between the data that are collected and the benefits that the project is striving to achieve. *Figure 3.2* below depicts the information from which the benefit may be inferred, and the data required to provide this information.

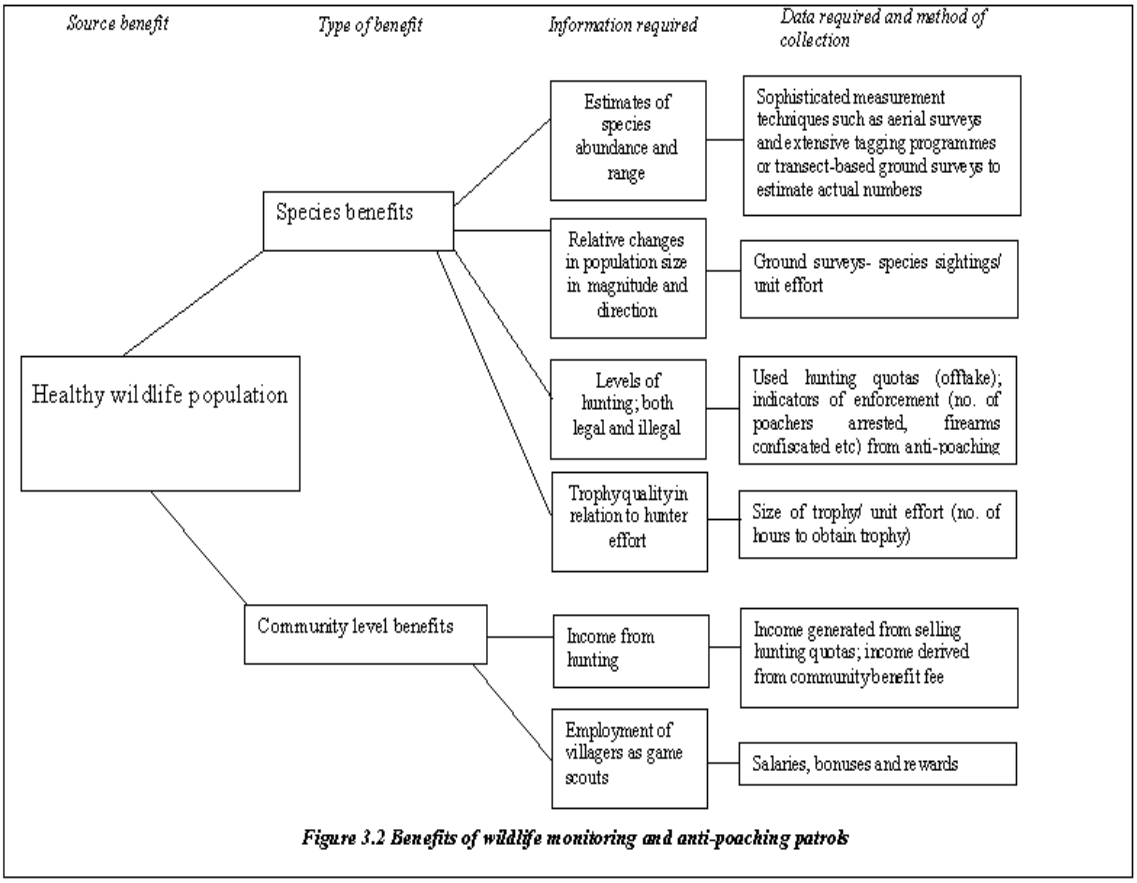


Figure 3.2 Benefits of wildlife monitoring and anti-poaching patrols

A healthy wildlife population may be considered as the baseline populations which are sufficient to ensure rapid population growth for the fast-breeding key bushmeat species (Olsen *et al.* 2001) and allowing recovery of slow-breeding species, such as large carnivores, to a sustainable level. Thus a healthy wildlife population describes both a benefit to the species themselves and to the community, as it can provide an income to the local people in both the current and future generations. The health of the population can be monitored by using ground surveys, aerial surveys and trophy number and quality per unit hunting effort. However, these data will not accomplish sustainability of the populations unless the data is applied in a way that can influence hunting levels, for example quota setting. On the other hand, protecting wildlife through anti-poaching activities can directly improve the health of the wildlife population. Therefore data indicating a decrease in poaching levels suggests improvement to the health of the population. Community level benefits are more easily assessed using data on income to the villages from hunting (either directly from resident hunting, or indirectly from benefit schemes such as that of CHCWP), and records of salaries and rewards paid out to game scouts.

3.2 Cost- benefit analysis

Much of the data required compilation and reformatting before being suitable for analysis, which in itself suggests that much of it has not previously been evaluated. The data was analysed for significant relationships using regression analysis in Excel using a significance level of 0.05.

4. DATA RECORDS

The theoretical framework (described in *Section 3.1*) provides a basis upon which the identification of data that can be useful for assessing the efficiency and the impact of a project can be made. This chapter identifies the data sets that the two case study projects possess according to this framework and briefly describes the availability and consistency of the data. This is necessary in order to both understand the operations of the projects, and to justify the subsequent analysis in Chapter 5.

4.1 CHCWP

4.1.1 Costs and benefits

The costs and the benefits, as depicted by the theoretical framework, that are recorded by CHCWP are summarised in *Table 4.1* and *Table 4.2* respectively, and are described in more detail below:

(i) Patrol costs are recorded monthly and include the following categories: vehicle maintenance; vehicle fuel and oil; night allowances; salaries; rewards, camp food and rations; camp equipment, medication and uniforms; and miscellaneous.
(ii) Overall expenditure is recorded in the annual audit accounts from 1997-2004
(iii) Patrol effort is recorded in the patrol sheets as the number of days of each patrol.
(iv) Village income is recorded in the annual audit accounts as the benefit received by each village, available from 1997-2003
(v) Employment income is not directly recorded, although salaries and rewards are included in monthly costs reports and could be extracted
(vi) Hunting quota and offtake and value of offtake is available for each legally hunted species for each area (from 1998-2004).

(v) Levels of illegal hunting are recorded for each patrol session. The number of each indicator are recorded in the following categories: poachers arrested; meat poaching incidents; timber poaching incidents; firearms confiscated; bows & arrows confiscated; vehicles impounded; snares destroyed; poachers' camps destroyed; skins etc confiscated; and timber confiscated. The patrol sheets also contain categories for the name of poacher and village, case number and outcome of arrests, and GPS coordinates (from 2001)

Table 4.1. Summary of costs records for CHCWP

Data source	**Financial expenditure**		**Patrol effort**	
	Patrol costs	**Overall project expenditure**	**Time spent patrolling**	**Number of scouts**
CHCWP records	Yes (incomplete)	Yes	Yes (incomplete): number of days	No, although should be relatively constant at five scouts/patrol (one field officer, four scouts).

Table 4.2. Summary of benefits records for CHCWP

Data source	**Community level**		**Healthy wildlife population**				
	Income	**Employment**	**Estimates of species abundance and range**	**Relative changes in population size (magnitude, direction)**	**Levels of legal hunting**	**Levels of illegal hunting**	**Trophy quality/unit hunting effort**
CHCWP records	Yes (20% community development fee)	No direct records, although some salaries included in costs	No	No	Yes: hunting quotas and used quota	Yes: Anti-poaching activities (incomplete)	Trophy size data exists but inaccessible; hunting effort not recorded

4.1.2 Data consistency and availability

Data for CHCWP are divided into the five hunting blocks: Burko, Makao, Mlele/Piti, Niensi/ Luganzo, and Rungwa. Records for Makao and Niensi begin in 1994, Mlele/Piti and Rungwa in 1996 and Burko in 2000. Most of the data has previously been inputted into a database, but the format was in the most part disorganised and not suitable for analysis. Therefore all data required reformatting before analysis.

Various data are missing in all aspects of the records. Patrol expenditure in particular has many years with no records available, although recent years show much improvement and consistency. However, overall expenditure is complete from 1997, and village benefits are available for all years except 1996. Patrol effort is also reliable, with the majority of records containing the number of days of each patrol. Records of timber confiscation are the most inconsistent, ranging from zero to several thousand in the same area over the different years. The early data have no records of confiscations of vehicles, which may represent failure to record the data accurately, or different emphasis on patrol activities, rather than necessarily absence of such poaching activities. Recording whether the poaching incidents are meat or timber incidents also shows inconsistency and frequent absence, whereas records on poacher arrests, firearms confiscation and number of snares destroyed are much more reliable. Names of poachers are rarely, if ever, entered in the patrol sheets, and follow up on case numbers and outcomes of arrests are absent in early years and incomplete in more recent years. GPS coordinates have been entered from 2001, although there is no clear consensus on which points these coordinates signify.

4.2 MBOMIPA

4.2.1 Costs and benefits

The costs and the benefits, as depicted by the theoretical framework, that are recorded by MBOMIPA are summarised in *Table 5.1* and *Table 5.2* respectively, and are described in more detail below:

(i) Patrol costs are available in the annual audit accounts from July 2003 for the total of MBOMIPA patrols.

(ii) Overall project expenditure is available in the annual audit accounts from July 2003.

(iii) Patrol effort is recorded in the patrol sheets as number of hours spent patrolling (start time, finish time and rests), and number of scouts on patrol.

(iv) Village income from hunting is available from 1996, and overall income of the MBOMIPA Association is available in the audit accounts from July 2003.

(v) Aerial surveys were conducted bi-annually from April 1999 through to October 2001 using Systematic Reconnaissance Flight (SRF) method over the southern portion of LMGCA (Ecosystems Consultants 2001), providing wildlife population estimates. Ruaha Ecosystems and Wildlife Management Project (the predecessor to MBOMIPA) conducted three wildlife surveys in 1994 and 1995 in a 6250 km^2 survey area comprising the Rift Valley section of Ruaha National Park and the adjacent southern parts of LMGCA, providing an established baseline for MBOMIPA aerial surveys to assess medium term trends (Ecosystems 2001).

(vi) Wildlife monitoring using ground surveys includes data collection on live animal sightings, dead animals found, and animal signs. Live animal sightings include the species, the number of individuals and the number of males, females and juveniles. Dead animals are recorded by species, male/female/juvenile and the method by which it

died. Animal signs are recorded by species, in terms of number of tracks, dung and calls. Problem animal reports are also issued, which record the species involved and the area and type of damage that the animal has caused.

(vii) Levels of illegal hunting are recorded for each patrol. The number of each indicator are recorded in the following categories: poachers arrested; poachers' voices; poachers' footprints; poachers' fires; meat camps; timber camps; snares destroyed; other traps destroyed; animals poached (species and cause of death); trees cut.

(viii) Environmental condition is also recorded for each patrol, requiring a description on rainfall, presence or absence of fire, grazing/grass condition and browsing/tree condition.

Table 4.3. Summary of costs records for MBOMIPA

Data source	**Financial expenditure**		**Patrol effort**	
	Patrol costs	**Overall project expenditure**	**Time spent patrolling**	**Number of scouts**
MBOMIPA records	Yes (some years)	Yes (some years)	Yes: number of hours	Yes

Table 4.4. Summary of benefits records for MBOMIPA

Data source	**Community level**		**Healthy wildlife population**				
	Income	**Employment**	**Estimates of species abundance and range**	**Relative changes in population size (magnitude, direction)**	**Levels of legal hunting**	**Levels of illegal hunting**	**Trophy quality/ unit hunting effort**
MBOMIPA records	Yes	No	Yes: using aerial surveys	Yes: ground surveys	No	Yes: Anti-poaching activities (incomp-lete)	No

4.2.2 Data consistency and availability

Data have been collected throughout the duration of the MBOMIPA project, which ran from 1998-2002, and from the continuation of the MBOMIPA Association since the conclusion of the project. The database from the MBOMIPA project has not been made available for this assessment, although some data on anti-poaching activities from Lunda 2000-2002 were accessible through published reports, as were comparisons of aerial surveys with ground surveys. Data collected after the conclusion of the project were available but had not been inputted into a database. This data comprised of patrol reports from 2003 for Lunda and from 2004 for Mkupule. Therefore the only complete time series was the anti-poaching statistics for Lunda from 2000-2003.

It is therefore difficult to make a fair assessment of the consistency of the data. Judging from the 2003 and 2004 reports, live animal sightings data are the most complete and consistent. As may be expected, the number of individuals and gender were not always recorded. Records of animal signs appear relatively consistent, whilst recording of dead animals was infrequent, but is most likely due to lack of occurrence rather than poor data entry. Description of environmental condition was very inconsistent and mostly absent. The data on illegal activities were few in comparison to live animal sightings, but it is not possible to determine if this is due to bias emphasis of patrols towards wildlife monitoring, poor data entry, low levels of poaching, or a combination of the above. Patrol effort was fairly well recorded, with start, stop and rest times mostly entered, but the calculations of duration from these entries were frequently incorrect. The number of scouts on the patrol was always recorded.

5. DATA ANALYSIS

5.1 CHCWP

5.1.1 Village benefits and financial expenditure

Village benefits are independent of the costs of anti-poaching patrols or overall project costs since they are derived from the 20% community development fee. Instead they are dependent on levels of hunting by clients, which is affected by government quota setting and the buoyancy of the tourism hunting trade. Hence, there is no significant correlation between overall expenditure and village income or patrol costs and village income. However, it can still be useful to examine trends in expenditure, in order to assess efficiency or changing costs. *Figure 5.1* shows overall operation expenditure and anti-poaching expenditure for CHCWP from 1997-2004. Using regression analysis, there has been a significant decline in overall expenditure in the period 1997-2004 (r^2= 0.550, df=7, $p<0.05$), but no significant change in expenditure on anti-poaching patrols from 1999-2004 ($r^2=7.37E^{-5}$, df=5, $p>0.5$), suggesting that the budget for anti-poaching patrols is not being adversely affected by changes in overall project expenditure. However, there has been an overall increase in the number of patrol days from 1994-2003 (see *Figure 5.2*), so although the overall expenditure on anti-poaching activities remains relatively constant, the budget has been spread more thinly, which explains the decline in expenditure per patrol day from 2000-2003 seen in *Figure 5.2*

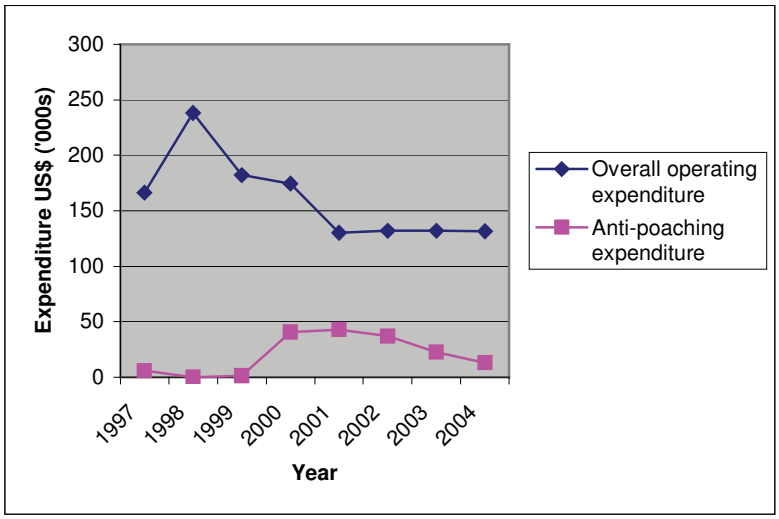


Figure 5.1 Overall expenditure and anti-poaching expenditure of CHCWP from 1997-2004. No data was available for anti-poaching expenditure in 1998.

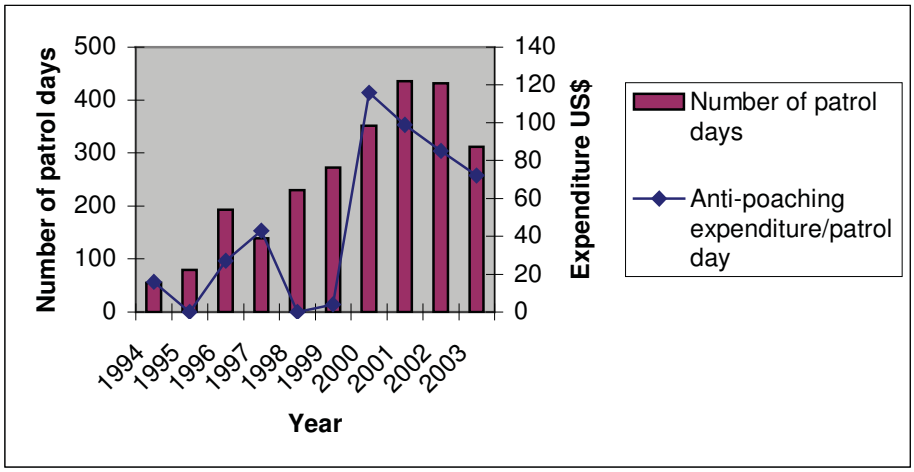


Figure 5.2 Number of patrol days and expenditure on anti-poaching activities for CHCWP from 1994-2003. No data was available for 1995 and 1998 for expenditure.

5.1.2 Used hunting quota (offtake)

The value of used hunting quota (offtake) has greater implications than expenditure for CHCWP since village benefits are derived from these values. There has been a significant decrease in the offtake value over the period 1998-2003 (r^2=0.948, df= 5, p<0.05), see *Figure 5.3,* but no significant change in village benefits. Although the village benefits are in theory directly dependent on the offtake value, the villages also receive independent donations which decouple the direct correlation between the two. Nevertheless, utilising the data on offtake value is important in assessing productivity over time. The decline shown in the period 1997-2003 for RHS may be a result of a decrease in tourism hunting, or may imply a decrease in the health of the wildlife population (which would result in fewer successful hunts). If data on hunting effort, such as number of hunting days, were available it may be possible to establish the cause of the decline in offtake value.

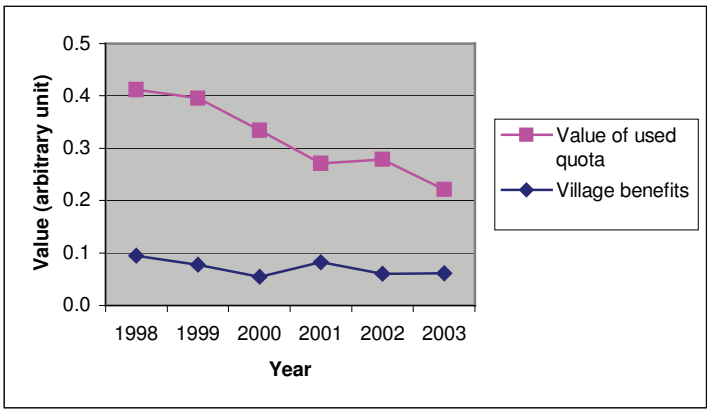


Fig 5.3 Value of used hunting quota (offtake) and village benefits from 1998-2003. Value is portrayed in an arbitrary value due to data confidentiality.

Offtake value can also be used as an indicator of productivity in each hunting block per unit area (see *Figure 5.4).* If these values were to be analysed against hunting effort, it will be possible to determine if differences or changes in value are due to heterogeneous hunting effort or due to wildlife population status. For example, the Makao and Burko blocks have been the most productive blocks throughout the period 1998-2004; this may be simply an artefact of greater

hunting effort in this area, or alternatively may be due to a higher success rate of hunts, which may imply a more healthy wildlife population.

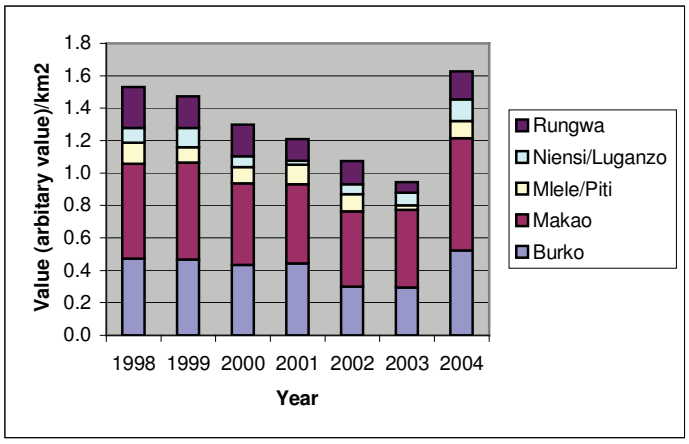


Fig 5.4. Value of used hunting quota per unit area for five hunting blocks of CHCWP from 1998-2004. Value is portrayed in an arbitrary value due to data confidentiality.

5.1.3 Enforcement indicators (anti-poaching activities).

Enforcement indicators are a common way of expressing changes in poaching levels, for example CHCWP record the number of poachers arrested, firearms confiscated, bows & arrows confiscated, vehicles impounded, snares destroyed, poachers' camps destroyed, skins etc confiscated and timber confiscated. These different indicators do not necessarily follow the same trends, and their relative changes can provide an insight into changes in poaching. *Figure 5.5a and Figure 5.5b* show these enforcement activities from 1994-2003, adjusted to a maximum value of one for each anti-poaching activity. This adjustment was made because some activities have over an order of magnitude more occurrences than others, for example, the average number of snares destroyed is 2050, whilst the average number of lorries impounded is 0.4 (see *Appendix I, Table (i)* for actual values). The most noticeable trends, seen in *Figure 5.5b,* are the dramatic increase in the number of lorries impounded and bicycles confiscated from 2000-2003 and timber confiscated from 1999-2003. The increase in vehicle confiscations may be a result of change in poacher

behaviour towards a more efficient and faster operation, perhaps due to knowledge of the presence of anti-poaching patrols. The increase in lorry impoundments may also correspond to the increase in timber poaching. Alternatively, these increases may be a result of changes in patrol activities, in emphasis, awareness and data recording.

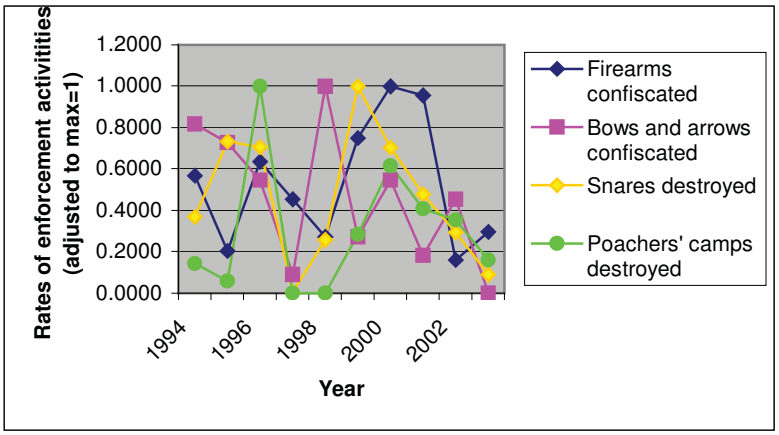


Figure 5.5a Anti-poaching activities for CHCWP from 1994-2003: firearms confiscated, bows and arrows confiscated, snares destroyed and poachers' camps destroyed. Values adjusted to maximum =1 for each activity.

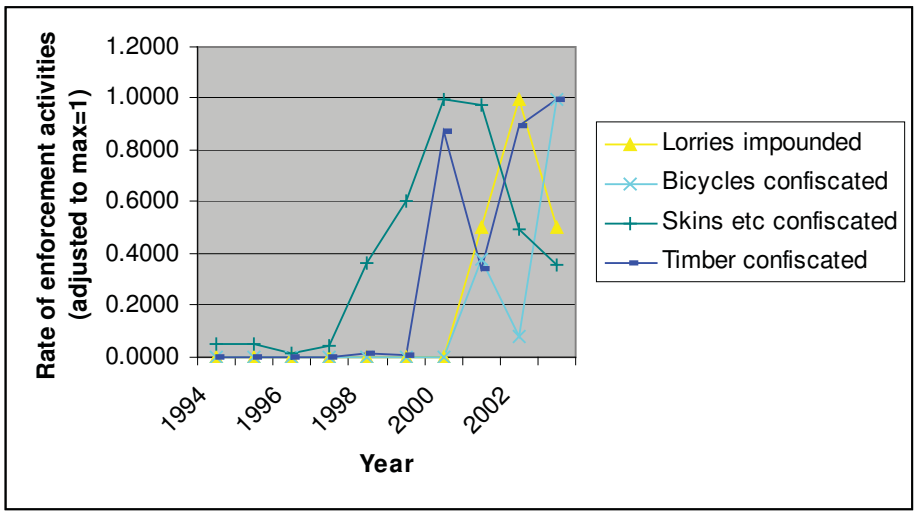


Figure 5.5 b Anti-poaching activities for CHCWP from 1994-2003: lorries impounded, bicycles confiscated, skins etc confiscated and timber confiscated. Values adjusted to maximum=1 for each activity.

However, if effort or expenditure is not constant, changes in the levels of the enforcement indicators may be an artefact of effort or expenditure, and therefore only give limited meaningful information about poaching levels. For example, *Figures 5.6 and 5.7* shows that the number of poachers arrested corresponds closely to the number of patrol days (r^2= 0.774, df=9, p<0.001). Therefore changes in the number of poachers arrested do not indicate whether poaching is increasing or decreasing, and may imply that poaching levels are constant. However, the fact that the enforcement indicator closely correlates to enforcement effort implies that an increase in patrol effort may be beneficial, as it will result in more arrests.

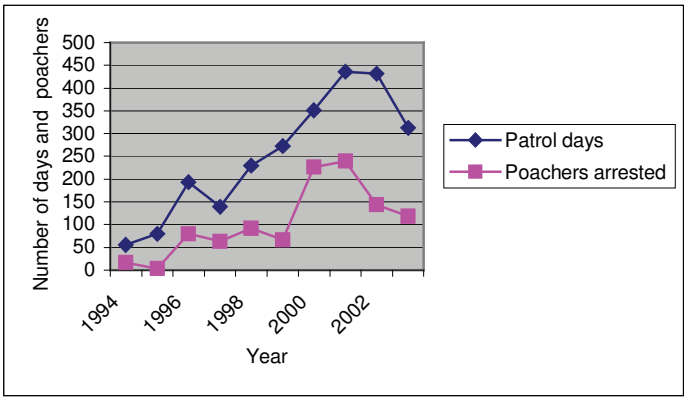


Figure 5.6. Patrol effort and number of poachers arrested over time for CHCWP from 1994-2003.

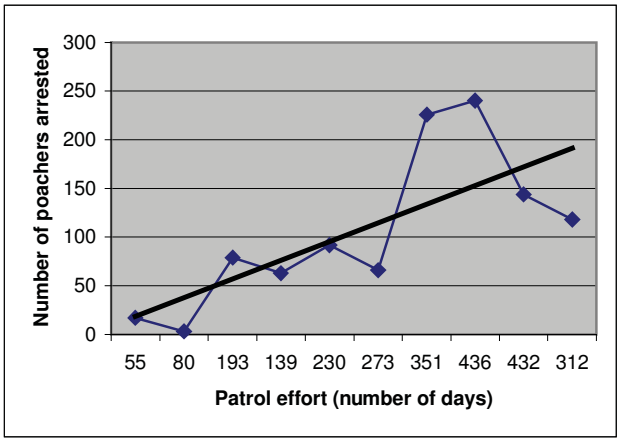


Figure 5.7. Patrol effort vs. number of poachers arrested for CHCWP from 1994-2003.

Rates of enforcement indicators give a clearer picture of the changes in poaching levels that may be occurring. Analysis of the rates of anti-poaching indicators for CHCWP shows that there been a significant decrease in firearms confiscated (r^2=0.482, df=9, p<0.05), bows and arrows confiscated (r^2=0.600, df=9, p<0.01) and snares destroyed (r^2=0.509, df=9, p<0.05), suggesting a decrease in these three types of poaching during this period. There has been no significant change in the number of skins etc or bicycles confiscated, but there has been an increase in the rate of lorries impounded (r^2=0.600 df=9, p<0.001), which may indicate an increase in timber poaching, supported by the significant increase in the rate of timber confiscations (r^2=0.607, df=9, p<0.01). Alternatively both the increase in lorry impoundments and timber confiscations may be an artefact of improved recording of activities, as there is complete absence of records on lorry impoundment prior to 2000 and timber confiscation prior to 1998, which may be due to patrol units either not carrying out these activities or failing to record them, rather than the absence of such poaching. Changes in number of firearms and bows & arrows confiscated, poachers arrested, or snares and poachers' camps destroyed are less likely to be an artefact of changes in recording efficiency as they all have records dating from the earliest years of the project, although there still may be an effect of improved data recording.

There has not been a significant change in the rate of total enforcement activities during the period 1994-2003 (r^2= 0.233, df=9, p>0.1). However, *Figure 5.8* shows a decline in total enforcement activities until 1997, and an overall increase from 1998 to 2003. The increase can be explained mostly by the increase in timber confiscations, as analysis excluding timber confiscations reveals a significant decrease in the rate of total enforcement activities from 1994-2003 (r^2= 0.513, df=9, p<0.05). This decrease is due to the decline in the rate of firearms and bows and arrows confiscated and snares destroyed, and not a result of a decrease in the rate of poacher arrests, since no significant change in the rates of poachers arrested was found. However, poacher arrests may be considered as the most important enforcement activity as it is both the greatest deterrent to poachers and is likely to have the greatest effect in protecting wildlife.

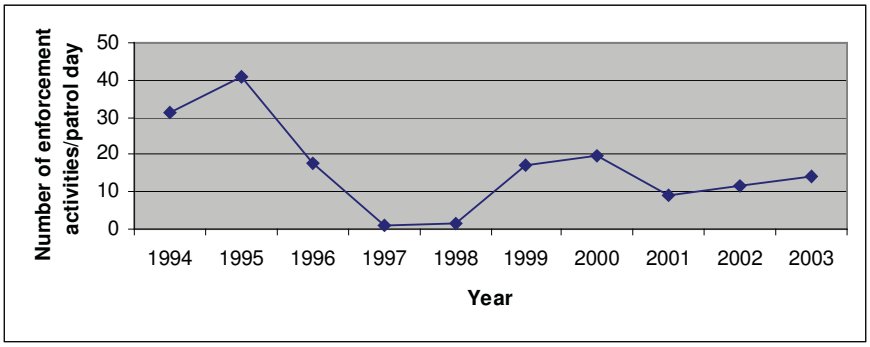


Figure 5.8 Total enforcement activities/patrol day over time for CHCWP from 1994-2003

5.1.4 Rewards

Rewards to scouts for undertaking enforcement activities can be used as an incentive to encourage commitment to anti-poaching projects. *Figure 5.9* shows the relationship between rewards/patrol day awarded and the total number enforcement activities/patrol day. Before 1999 there is no clear relationship between the two, with rewards remaining at a constant low and total enforcement activities declining. Therefore any link between the two variables is speculative, but the low value of rewards may have discouraged game scouts to commit to the patrols and act effectively. However, *Figure 5.9* shows that from 1998 to 2003 there is a link between rewards and total enforcement activities, with an apparent one-year time-lag. Due to this one year delay, at first inspection there is no significant relationship between the two, but when the rewards/patrol day are shifted back one year, a significant relationship emerges (r^2=0.909, df=4, $p<0.05$). The trend of rewards follows behind total enforcement activities, suggesting that number of enforcement activities influences the value of rewards paid out the following year, but the rewards do not significantly influence the total number of enforcement activities, which would be expected if the reward scheme was acting effectively.

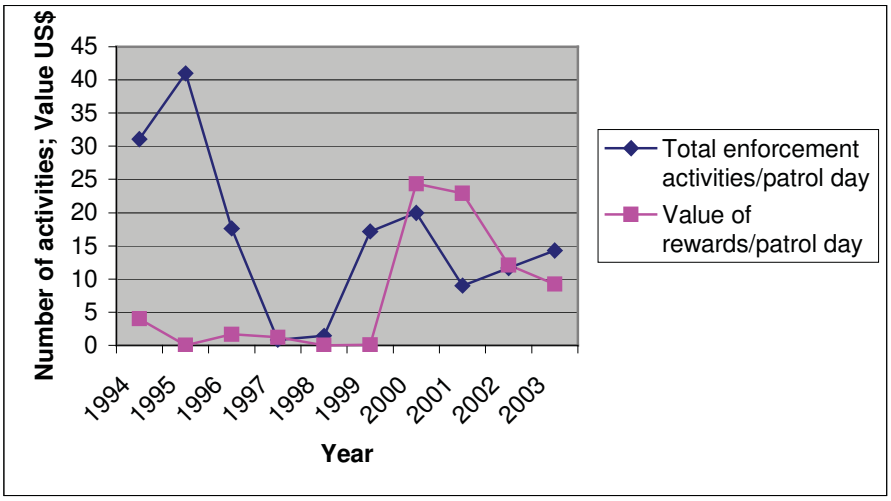


Figure 5.9 Value of rewards and total number of enforcement activities per patrol day for CHCWP from 1994-2003

It may be possible that the inclusion of enforcement activities that are not incorporated into the reward scheme may reduce the apparent relationship between rewards and enforcement activities. Therefore, the data was analysed with the activities that are not rewarded removed from the total enforcement activities i.e. only poachers arrested, firearms confiscated, snares destroyed and poachers' camps destroyed were included. However, no significant relationship was found (r^2=0.113, df=9, p>0.1), and the relationship observed in *Figure 5.9* from 1998-2003 can no longer be seen (see *Figure 5.10*), although a decline in both rewards and enforcement activities occurs from 1999 onwards. The absence of relationship between the two suggests that the reward scheme was not being effective, or that any positive effect of the scheme is masked by the impact of other variables.

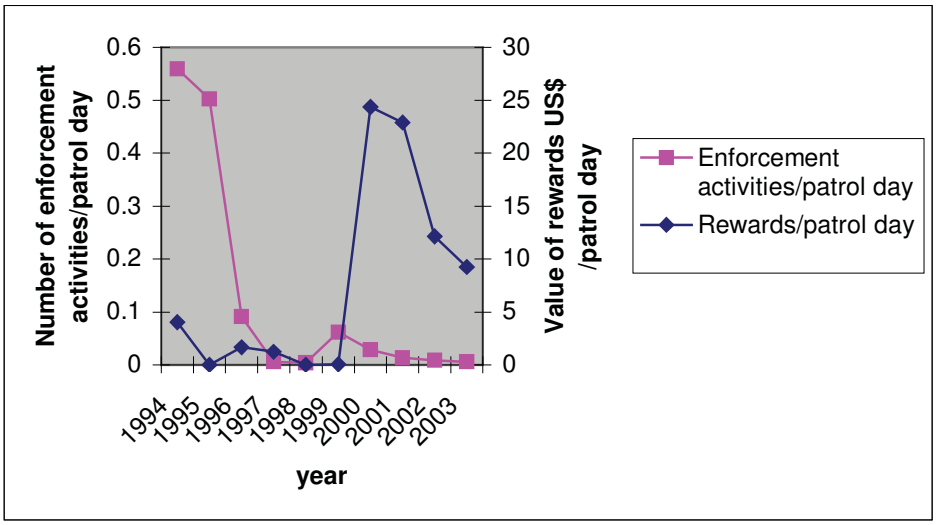


Figure 5.10 Value of rewards and number of enforcement activities (for which rewards are offered) per patrol day for CHCWP from 1994-2003

5.2 MBOMIPA

5.2.1 Village benefits

For community management projects such as MBOMIPA, village income is the primary goal. The village income from hunting in LMGCA, Idodi and Pawaga shows a significant increase from 1996-2004 ($r^2=0.751$, $df=8$, $p<0.01$), see *Figure 5.11*. In order to determine the cause of this increase, the data could be compared to species values, hunting quota and offtake, and hunting success per unit effort and over this period, since village income is directly dependent upon hunting. Increased income may be a result of: (i) increased value of species; (ii) an increase in offtake due to increase in quota; (iii) an increase in offtake due to higher success rate of hunting per unit effort, which may indicate an improved condition of the wildlife population. Understanding the underlying processes that cause changes in income is fundamental for effective management and insuring future financial security.

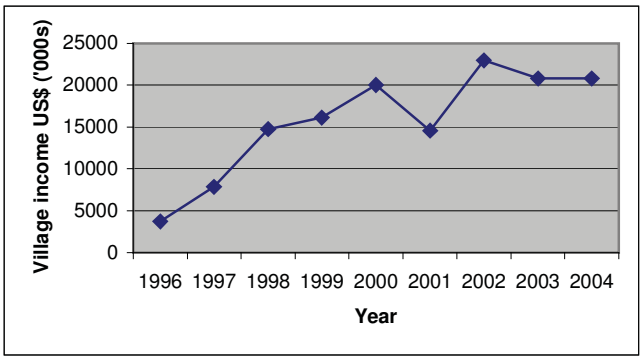


Figure 5.11 Village income from hunting for MBOMIPA villages, from 1996-2004.

5.2.2 Wildlife monitoring data

Previous analysis of air survey wildlife estimates and ground surveys suggests that the ground survey data can be useful in monitoring relative changes in wildlife abundance, in both magnitude and direction, but is not consistent in terms of proportional abundance (Ecosystems 2003). *Table 5.3* compares estimates using Ground Survey Index, which is based on the average number of individuals seen per 10hr of patrol over 3 years for Lunda. The Air Survey Estimate is a statistically merged population estimate derived from six aerial surveys between May 1999 and October 2002 for the entire southern portion of the Lunda-Mkwambi Game Controlled Area (Ecosystems 2002). Both agree on the four most abundant species, but the sets are not consistent in terms of proportional abundance (Ecosystems 2003). Difference can be attributed to the variation in sensitivity to different species, for example the difficulty in seeing impala from the air, and the increased likeliness of observing waterbuck in ground surveys due to the close proximity of Lunda to Ruaha River (Ecosystems 2003). These differences in sensitivity strengthens the case for ground surveys, as they allow monitoring of species not seen usually seen from the air, particularly small, camouflaged or elusive species. Additionally, ground surveys operate at a fraction of the costs of aerial surveys, and have the benefit that they involve local employment and knowledge, giving a sense of ownership and responsibility to the local community

Table 5.3. Comparison of two methods of estimating relative abundance (Ecosystems Consultants 2003)

Ground survey index		**Rank**	**Air survey estimate**	
53.96	Impala	**1**	Impala	453
13.87	Giraffe	**2**	Giraffe	400
12.66	Elephant	**3**	Elephant	368
10.84	Zebra	**4**	Zebra	243
5.92	Waterbuck	**5**	Eland	86
4.93	Kudu	**6**	Warthog	59
3.68	Buffalo	**7**	Waterbuck	48
3.46	Warthog	**8**	Buffalo	45
0.98	Eland	**9**	Kudu	22

(ix) Enforcement indicators (anti-poaching activities)

Due to the lack of consistent data on anti-poaching activities, analysis is restricted to four years from Lunda, from 2000-2003. No significant change in patrol effort (total number of patrols, average duration, average size or total observation hours) (see *Figure 5.11*), and no significant correlation between patrol effort with total number of poaching signs was found Therefore, any change in enforcement indicators may be attributed to changes in poaching levels, since effort can be considered relatively constant. However, no significant change was found for the total number of poaching signs of this period, suggesting that poaching levels have also been constant through this period. Using rates of poaching indicators (number per hour) provides a more sensitive analysis, but also shows no significant change in total number of poaching signs/hr over this period (see *Figure 5.12*)

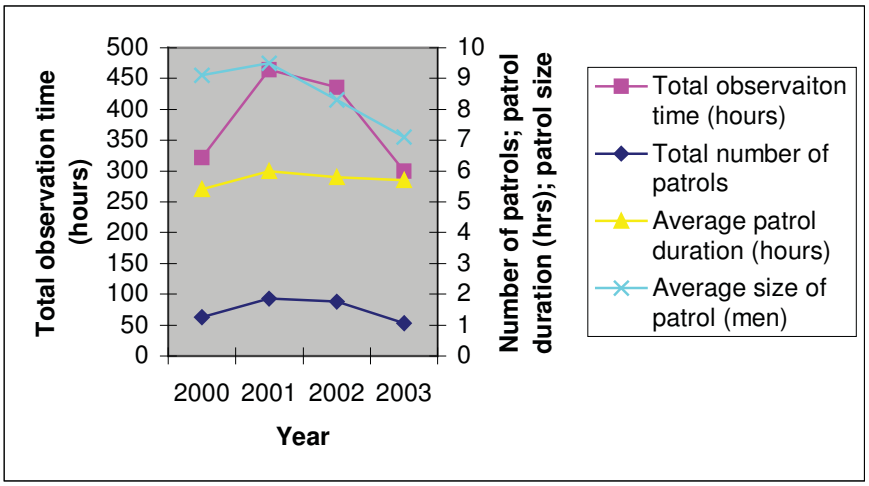


Figure 5.11 Patrol effort (total observation time, total number of patrols, average patrol duration and average patrol size) for MBOMIPA from 2000-2003, Lunda area.

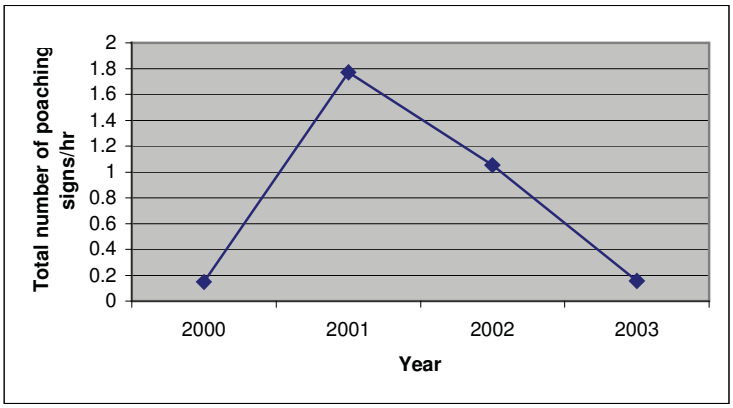


Figure 5.12 Total number of poaching signs/hr for MBOMIPA from 2000-2003, Lunda area.

6. ESTIMATING A MONETARY VALUE FOR ANTI-POACHING ACTIVITIES

6.1 Theory

Traditionally the benefits of anti-poaching activities are described by the changes in rates of enforcement activities or signs of poaching. This can give an accurate representation of the real-life situation, by indicating whether poaching is decreasing, increasing or remaining constant. Community wildlife management projects undertaking such activities are therefore able to describe their impact and success in this way. However, in a world dominated by financial operations, it can be useful to describe benefits in a monetary term, and for some stakeholders this may carry more weight than trends in poaching activities alone. Assigning a monetary value to anti-poaching activities is thus an alternative method of describing the benefits of the projects. The total value of anti-poaching activities can be described as:

V= D+d+g+I

where *V= Value of anti-poaching patrols*
D= direct value of species saved from enforcement activities
d= deterrence value, which is the sum of the value of species saved as a consequence of the deterrence effect of enforcement
g= gain in productive stock
I= value of other indirect benefits (e.g. ecosystem improvement)

In thus evaluation only D (direct value) is calculated, suggesting that any value obtained is potentially less than the actual value. It is not easy to speculate the values of the other components, but it is reasonable to judge that deterrence value may be a major component of the total value, particularly for projects running efficient and effective patrolling.

6.2 Methodology

6.2.1 General

In order to assign a value to each anti-poaching activity, there are three main pieces of information that are required:

1) the number of animals that a poacher kills in a year (n)
2) the average value of a poached animal (P)
3) the length of time (in years) a poacher would be out of action following an enforcement activity (t)

The value of each enforcement activity (E) can be described as follows:

$$E=nPt$$

Having estimated the value of each enforcement activity, these values can be multiplied by the total number of occurrences of that activity in a year. The sum of these values represents the total estimated value of all anti-poaching activities.

The values were obtained from a questionnaire that was administered to MBOMIPA game scouts in Lunda-Mkwambi Game Controlled Area (*for questionnaire, see Appendix II Figure (i)*). All game scouts that were available were interviewed but this was restricted by the fortnightly turnover of scouts and logistical constraints. In total 18 village game scouts and one field officer were interviewed individually from the Lunda and Kinyengesi game posts (all of which will be referred to as *game scouts*). The game scouts were asked to base their questions on a particular place and year of their choice, for which they have some knowledge or experience. This was done to encourage the game scouts to base their answers upon the real-life situation and utilise indigenous knowledge, rather than to speculate. They were also permitted to complete more than one questionnaire, based on a different area and/or year, although none utilised this opportunity.

6.2.2 Number of animals poached

The number of animals that a poacher may kill in a year can vary dramatically, and will depend on many variables, such as access to weapons and snares, perception of risk, social stigma, availability of wildlife etc. It could

therefore be difficult for a game scout to state accurately the number of animals killed by a poacher. Scouts were asked what type of poachers there are, in order to take into consideration possible differences between subsistence and organised 'commercial' poaching, and to allow responses of later questions to reflect any differences. Three different questions were used to determine an estimate. Firstly, the number of animals killed by an average poacher within the area and year that the scout had chosen to base his answers (Scenario 1). Secondly, the scout was asked that if he knew a specific poacher how many animals did that poacher kill in a year (Scenario 2). Thirdly, the scout was asked what species of animals are poached and how many of each species were killed, either by a specific poacher if he knew one, or a general poacher if he did not. This provided an estimate based upon the sum of the number of each species killed (Scenario 3). The mean average of these three scenarios is described as Scenario 4.

6.2.3 Species values

Species values need to be identified in order to estimate the average value of a poached animal, but they are not homogeneous throughout Tanzania. The values used for estimating the value of anti-poaching activities for CHCWP are those assigned for tourism hunting (RHS), whilst the values used for MBOMIPA are those assigned for Mkupule resident hunting (a district within the LMGCA). However, the following species appeared in the questionnaire responses but are not legally hunted in LMGCA and therefore are not assigned an official monetary value: baboon, hippopotamus, hyena, kudu, leopard, lion, sable antelope, waterbuck and zebra. Therefore, for these species the values assigned for tourism hunting were used to estimate a value for those in LMGCA. This was achieved by calculating the value of species that are legally hunted in Mkupule (buffalo, bush-pig, dik-dik, duiker, eland, impala and warthog) as a percentage of tourism hunting values. The average of these percentage values was calculated as 17.46% of tourism hunting values. Therefore the tourism hunting values were multiplied by 0.1746 in order to assign values for the missing LMGCA data. This can be seen in *Table 6.1* below.

Table 6.1 Species values, assigned and estimated.

Species	Assigned Value US$		Value of LMGCA species as % of RHS	Estimated value of LMGCA species US$
	Tourism hunting (RHS)	Mkupule (LMGCA)		
Baboon	90.00	-	-	15.72
Buffalo 1st	600.00	183.3	30.55	-
Bushpig	190.00	22.9	12.05	-
Dik Dik	170.00	16.5	9.71	-
Duiker	180.00	22.9	12.72	-
Eland	840.00	220	26.19	-
Hippopotamus	840.00	-	-	146.70
Hyena	190.00	-	-	33.18
Impala	240.00	50.4	21.00	-
Kudu-Greater	1170.00	-	-	204.34
Kudu-Lesser	1300.00	-	-	227.04
Leopard	2000.00	-	-	349.29
Lion	2000.00	-	-	349.29
Sable antelope	1200.00	-	-	209.58
Warthog	320.00	32.1	10.03	-
Waterbuck	440.00	-	-	76.84
Zebra	590.00	-	-	103.04
		Average	**17.46**	

The scouts did not specify in their answers whether the kudus that were poached were greater or lesser, therefore an average value of the two was used. No value has been officially assigned to guinea fowl in tourism hunting areas. Therefore, the value of guinea fowl in Mkupule (US$ 3.7) was used for those poached in CHCWP areas. No value has been calculated for the poaching of hares due to lack of information.

Elephant, giraffe and wild dog are not legally hunted in Tanzania. Elephants are protected under CITES, whilst giraffe (the national animal of Tanzania) and wild dog are Red Listed. The values used in this analysis are those that have been assigned by the government to assist in dealing fines to poachers caught with these species: elephant US$5000, giraffe US$ 12000, wild dog US$1200.

6.2.4 Average value of a poached animal

In order to estimate the average value of a poached animal it needs to be known how many of each species is killed by a poacher. Therefore the game scouts were asked what species are killed by a poacher (either a specific poacher if they know one, or a general poacher for time area and year which they chose to base their answers upon), and the number of each species (this question was also used to determine the number of animals killed by a poacher, Scenario 3). The relative composition of species killed could then be determined, and multiplied by the monetary value of each species. The sum of these values is the estimated average value of a poached animal. Often carnivores are not considered typical species that poachers kill, and therefore may be neglected in the responses by the game scouts. Therefore, the scouts were asked if other species, such as large carnivores, are also sometimes killed. In cases when the scout knew that the species had been killed but did not know how many, a minimum value of one animal was used.

6.2.5 Snaring

The species and number of animals caught in snares may be expected to be different from those killed by weaponry such as firearms and bows & arrows as snares are less selective. Therefore, although snaring is a form of poaching, snared animals were dealt with separately. The relative composition of species was determined in the same manner as general poaching, but based upon answers for snared animals only. In order to determine the number of animals killed by a poacher, the scouts were asked when poachers snare and how many snares they use, which helped to clarify the number animals caught per snare, which is required in order to estimate the value of destroying a snare. When the scouts did not know how many of a particular species was caught in a snare, a minimum number of one animal for each species mentioned was used, whilst if a range was given, the average was used. Only five scouts reported snaring, which stresses the difference between LMGCA and CHCWP areas, since the latter have high reports of snaring in the data sets.

6.2.6 Enforcement activities

The activities for which a monetary value was estimated are those which can actually hinder a poacher in some way, as opposed to recording of poaching signs, such as tracks or voices. The following activities were included:

- arresting a poacher
- destroying a poachers' camp
- confiscation of firearms
- confiscation of bows and arrows
- confiscation of a bicycle
- impounding a lorry
- destroying a snare

The game scouts were asked how long a poacher would be out of action following each of the enforcement activities, except for destroying a snare, which was dealt with separately *(See 6.2.5),* due to the ease of assembling snares and their limited direct use of poachers' time. The scouts were also asked how many poachers use a camp, in order to incorporate the possibility that several poachers may be hindered by destroying a camp. No values were given by the game scouts for impounding a lorry, and only one scout responded for confiscating bicycles, as the scouts do not recall poachers using these vehicles in the area. This again emphasises the differences between poaching activities of LMGCA and CHCWP areas, as data from CHCWP patrols show that bicycle confiscation and lorry impoundments do occur in CHCWP areas. Ideally, the questionnaire would be administrated to each of the CHCWP areas in order to take into account that poaching is not homogeneous, but will instead vary over different parts of the country. However, as this was not possible due to time and logistical constraints, the results from LMGCA can still be used to provide a constructive basis with which to estimate anti-poaching values for the CHCWP. However, the lack of valuation of lorry impoundment means that the overall estimation of the value of anti-poaching activities in the CHCWP areas will be underestimated.

In cases where a range of values was given by the game scouts, the average value was used for further analysis, whereas in cases where the length of time was described as 'up to *x* years', this maximum value *x* was used. In some cases, the time that the poacher would be out of action was described as 'forever'. This was taken as 20 years, based upon the average male life expectancy at birth in 2005 of 44.56 years (Index Mundi 2005) minus the estimated average age of a poacher of 24 years, obtained from personal correspondence using information from Maswa Game Reserve. The value of 20.56 was rounded down to 20 years as a more convenient number and taking into account that this is a rough estimate.

6.3 Results

6.3.1 Questionnaire results

6.3.1.1 Number of animals poached

The game scouts were asked what types of poaching occurs, in order to take into consideration that different types of poachers may vary significantly in the number of animals and species they kill. The responses can be seen in *Table 6.2*. No scouts referred to organised commercial poaching as opposed to local subsistence poaching, which would be expected to show the greatest difference in numbers and species of animals killed. Therefore the estimations of the number of animals killed by a poacher in a year has been taken to represent local poaching using any or a combination of the types of poaching listed in *Table 6.2*, with the exception of fishing and honey collecting. This is because fishing can be considered as a separate form of poaching and is on a different scale in terms of the number of animals killed (for example, one scout revealed that a fishing poacher can catch over 2000 fish as the rivers dry out). Bees killed during honey collecting are an artefact of collecting the product, and the number killed is not representative of most poached wildlife.

The estimated number of animals poached by a poacher in a year, under the four scenarios, are summarised in *Table 6.3.* The individual responses can be viewed in *Appendix II, Table (ii).* Not all interviewees were able to answer all questions (for Scenario 1 n=16, for Scenario 2 n= 9 and Scenario 3 n= 15). The differences in the averages for each scenario are very noticeable, with the responses for Scenario 2 being considerably less than Scenarios 1 and 3. There are many reasons that could account for the differences, although without further investigation it is not possible to conclude the cause. For example, the high value that results from Scenario 1 (general poacher) may be an artefact of the perception of poaching being a problem in the area, or the low value of Scenario 2 may be a result of concealment of activities of the known poacher. Scenario 3 has the highest values, as the total number of each species killed often added up to more than the answer given to the number killed by a general poacher or a specific poacher. This may be in part due to the scout thinking more closely about poaching and therefore was able to recall more species. One scout in particular chose to include 100 guinea fowl killed in a year in his answer to this question, which may have significantly influenced the result. It was therefore decided to continue further analysis based upon the average of all three estimates (Scenario 4).

Table 6.2 Types of poaching as expressed by MBOMIPA game scouts.

Types of poaching	**Number of respondents (n=19)**
Local firearms *(gabore)*	18
Bows/arrows (poisoned)	8
Fishing	6
Rifles/shotguns	5
Snares	4
Honey collecting	3
Dogs	2
Spears	2
Poisoning water	1
Other traps	1
Poisoning food	1

Table 6.3 Number of animals killed by a poacher per year, under four scenarios (described in section 6.2.2)

	Number of animals/poacher/year
Scenario 1	16.34
Scenario 2	5.44
Scenario 3	23.87
Scenario 4 (average)	15.22

6.3.1.2 Average value of a poached animal

The relative compositions of species poached and their relative value can be viewed in *Appendix II, Table (iii)*. The responses to whether other species such as large carnivores are also poached can be seen in *Appendix II Table (iv)*, and include hyena, leopard, lion and wild dog. The average value of a poached animal in the CHCWP areas was estimated at US$842.28, whilst in for MBOMIPA areas it was estimated at US$560.92. This difference are due to the different species values, as CHCWP is based upon tourism hunting species values, whilst MBOMIPA is based upon resident hunting in Mkupule, within LMGCA.

6.3.1.3 Snaring

The relative species composition of snared animals and their relative value can be viewed in *Appendix II Table (v)*. The average value of an animal caught in a snare in CHCWP areas was estimated at US$1069.18, whilst for MBOMIPA areas it was estimated at US$ 757.68. Again, this difference is due to the different species values.

The average number of animals caught per snare was estimated at 2.18 (See *Table 6.3*). This value, when multiplied by the average value of a snared animal, gives the estimated value of wildlife saved from destroying a snare.

Table 6.3 Number of snares and animals caught per poacher, and number of animals per snare, extracted from questionnaires administered to game scouts.

	No. of snares/poacher	No. of animals caught (minimum)/poacher	No. of animals/snare
	3.5	4	1.14
	6	22	3.67
	3	1	0.33
	4	7	1.75
	1	4	4.00
Average	3.5	7.6	**2.18**

6.3.1.4 Enforcement activities

The average times that a poacher would be out of action following enforcement activities are shown in Table 6.4. The individual responses can be viewed in the *Appendix II Table (vi).* Confiscating firearms and arresting poachers results in the longest duration that a poacher would be out of action, destroying a camp and confiscating a bicycle has very limited impact, whilst confiscating bows and arrows is intermediate impact.

Table 6.4 Time poachers out of action following enforcement activities

Enforcement activity	Time poacher out of action (years)
Poacher arrested	4.44
Poachers' camp destroyed	0.01
Firearms confiscated	4.56
Bows & arrows confiscated	2.83
Confiscating bicycle	0.33

6.3.2 CHCWP

The estimated value of animals killed per poacher/year predicted under the four scenarios, and the value of wildlife snared per poacher/year for CHCWP are shown in *Table 6.5*. The differences between the four scenarios, and the reason for the separation of snaring from poaching in general, are explained in *6.3.1.1* and *6.2.5* respectively. The estimated values of anti-poaching activities for CHCWP are shown in *Table 6.6*, obtained by multiplying the time that a poacher would be out of action following the enforcement activity by the value of wildlife killed per poacher per year. The value for destroying a poachers' camp also incorporates the fact that several poachers may use a camp. Questionnaire responses lead to an estimated average of 8 poachers per camp. Therefore the estimated value of destroying a camp is obtained by multiplying the time out of action (0.01 years), the number of poachers per camp (8 poachers) and the average value of a poached animal. *Table 6.6* shows that arresting a poacher and confiscating weapons (firearms, and bows & arrows) have the highest value, destroying poachers' camps have relatively little value, whilst confiscating a bicycle and destroying a snare has intermediate value.

Table 6.5 Estimated value of poached wildlife for CHCWP

		Value US$
Animals/poacher/year	Scenario 1	13762.18
	Scenario 2	4581.99
	Scenario 3	20105.18
	Average (Scenario 4)	12816.67
Snared animals/poacher /year		2330.82

Table 6.6 Estimated values of anti-poaching activities for CHCWP

Enforcement indicator (anti-poaching activity)	Value US $			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4 (Average)
Poacher arrested	61117.82	20347.67	89282.89	**56916.13**
Poachers' camp destroyed	586.60	195.29	856.93	**546.27**
Firearms confiscated	62757.85	20893.68	91678.69	**58443.41**
Bows & arrows confiscated	39004.03	12985.43	56978.34	**36322.60**
Confiscating bicycle	4587.15	1527.18	6701.06	**4271.80**
Destroying snare	2330.82	2330.82	2330.82	**2330.82**

Scenario 4 was used to calculate the value of anti-poaching activities of CHCWP from 1994-2003, although the same calculations can be run under each of the different scenarios. *Figure 6.1* shows the contribution of the different enforcement indicators to the total value for each year. Arresting poachers and destroying snares have the greatest contribution for most years. There is no significant change in the total value of activities over this period as a whole, however there is a significant increase from 1994-2001 (r^2=0.641, df=7, $p<0.05$). This could be explained by an increase in effort, as the total value of anti-poaching activities/patrol day actually decreases over the period 1994-2003 (r^2=0.643, df=9, $p<0.01$), see *Figure 6.2*. Low value of anti-poaching activities can have two explanations: low levels of poaching, or ineffective patrols. In this case, the value per patrol day was high at the commencement of anti-poaching patrolling and has since been declining, a result of a decrease in the number of enforcement activities. This is most likely due to a decline in poaching levels, implying that anti-poaching patrols are being effective. However, it is possible that a decrease in enforcement activities could also be a result of increased

concealment of poachers as they adapt to the presence of patrol units, or that patrols have become less effective at uncovering poaching activities

In order to put the value of anti-poaching activities into context, it is useful to analyse the data in comparison to expenditure to assess whether the activities are cost-effective. The expenditure on anti-poaching activities per patrol day over the period 1994-2003 is on average US$57.75, whilst the value of anti-poaching activities per patrol day is on average US$59208.18 (see *Table (viii) Appendix III*). Therefore the expenditure is on average only 0.16% of the value of the anti-poaching activities, indicating that the patrols are extremely cost effective. The average value of used hunting quota and anti-poaching activities can be viewed in *Table (viii), Appendix III*. The value of used quota is estimated on average as 2.6% of the value of the wildlife saved from anti-poaching activities from 1998-2003 (maximum 4.6%). Even if estimations of the value of anti-poaching activities are an order of magnitude too great, the value of used hunting quota is still on average only a quarter of the value of anti-poaching activities. This provides strong implications for the benefit of such projects, and should encourage other tourism hunting companies to adopt similar strategies in order to protect the wildlife population and benefit local communities.

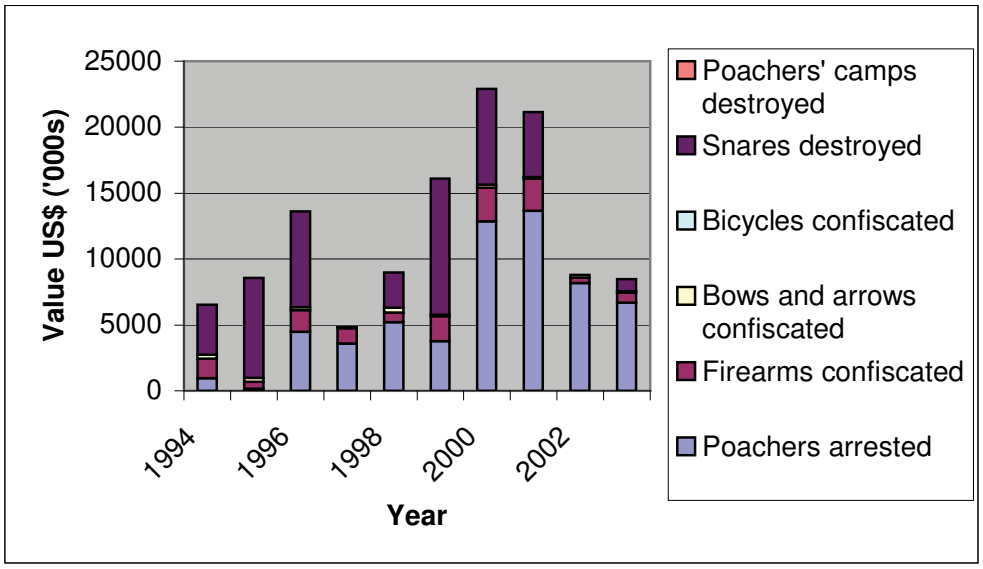


Figure 6.1. Contribution of different enforcement activities to total value of anti-poaching activities for CHCWP from 1994-2003.

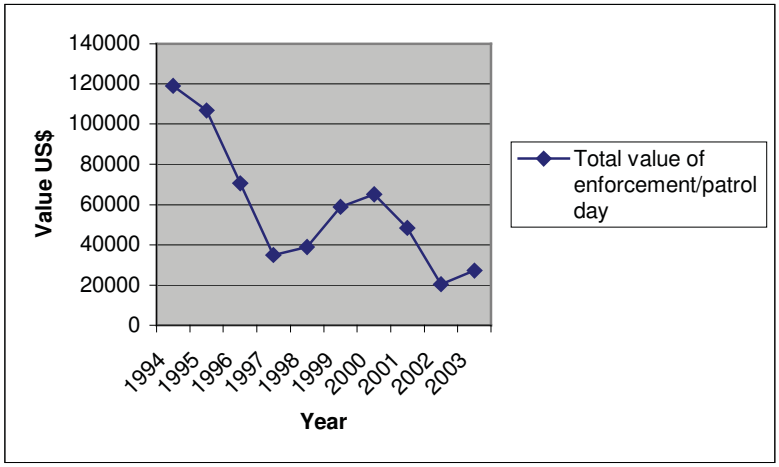


Figure 6.2 Total value of enforcement activities/patrol day for CHCWP from 1994-2003

6.3.3 MBOMIPA

The estimated value of wildlife killed per poacher/year, predicted under four scenarios, and the value of wildlife snared per poacher/year for LMGCA are shown in *Table 6.7*. The estimated values of anti-poaching activities are shown in *Table 6.8*. Evaluation was only conducted for Lunda 2000-2003 since these are the only continuous data available for anti-poaching activities.

Table 6.7 Estimated value of poached wildlife for LMGCA

		Number	Value US$
Animals/poacher/year	Scenario 1	16.34	9165.37
	Scenario 2	5.44	3051.39
	Scenario 3	23.87	13389.07
	Scenario 4 (average)	15.22	8535.28
Snared animals/poacher /year		2.18	1651.74

Table 6.8 Estimated values of anti-poaching activities for LMGCA

Enforcement indicator (anti-poaching activity)	Value US $			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4 (Mean average)
Poacher arrested	40701.50	13550.56	59458.06	**37903.37**
Poachers' camp destroyed	390.65	130.06	570.67	**363.79**
Firearms confiscated	41793.67	13914.17	61053.55	**38920.47**
Bows & arrows confiscated	25974.78	8647.66	37944.80	**24189.08**
Confiscating bicycle	3054.82	1017.03	4462.58	**2844.81**
Destroying snare	1651.74	1651.74	1651.74	**1651.74**

A cost-benefit analysis could determine if the activities are cost effective, and put the values into context. The only available expenditure records for patrols cover all MBOMIPA posts (rather than just Lunda) and are only available from July 2003- June 2005. Also, this evaluation only assesses the value of anti-poaching activities and not the wildlife monitoring activities, which are conducted concurrently with the anti-poaching activities, and therefore the value is underestimated. However, if these data are used, the average expenditure on patrols is US$11913.75, and the average value of anti-poaching activities is estimated as US$4237.83 (See *Appendix II Table (vii)*). Therefore the value of the anti-poaching activities is estimated at 35.6% of the costs, suggesting that the value to the anti-poaching activities is relatively low compared to expenditure. This may be due to low levels of poaching and/or inefficient patrolling methods. The data shows no significant change in the value of anti-poaching activities in this period, and therefore does not give any positive indication of effectiveness of the patrols, although it does not necessarily suggest ineffective patrolling. Therefore, an examination in the patrol methods and utilisation of local knowledge on poaching levels in the area is necessary to determine the cause of the low value (discussed further in *Chapter 7).*

It can be seen from *Fig 6.3* that the value of anti-poaching activities increases from 2000-2002, and decreases in 2003. The MBOMIPA project itself ended in 2002 and since then the MBOMIPA Association, without external input, has managed patrols. This change in status may have affected patrol effectiveness, and may explain the decline after 2002, but a longer time-series would be needed to address this. However *Figure 6.4* suggests that the occurrence of destroying snares in 2002 may be cause of the peak, yet there is no apparent reason why snares were found and destroyed in this year alone. Again, a longer time-series is necessary to distinguish trends and anomalies and provide and insight into changes in poaching levels. *Figure 6.4* also shows that only two anti-poaching activities (snares destroyed and poachers camps destroyed) contribute to the total value. The data records show no occurrences of the most valuable anti-poaching activities, arresting poachers and confiscating firearms, and also no confiscations of bows and arrows or vehicles. It may be possible that

poachers have actually been arrested during this period but their arrest not recorded in the patrol sheets, which would be revealed by access to conviction records. The other reason for the lack of other contribution to the enforcement value is the type of data collected by MBOMIPA, the majority being poaching signs (such as voices, tracks, fires) rather than actual activities, such as confiscating weapons or vehicles.

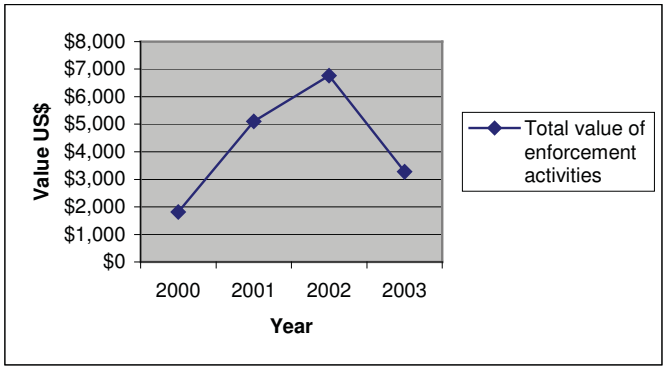


Figure 6.3 Total value of anti-poaching activities in Lunda 2000-2003

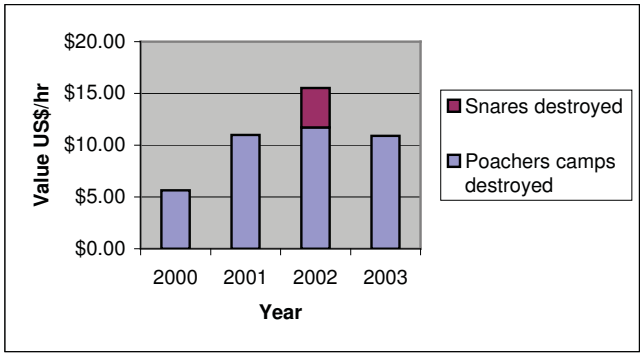


Figure 6.4. Contribution of different enforcement activities to the total value of anti-poaching activities per hour in Lunda 2000-2003

7. DISCUSSION

This chapter uses the data analysis from the previous chapters and observation of patrol methods and data collection to make recommendations for improvement to the patrol activities, by drawing upon the strengths and weaknesses of both CHCWP and MBOMIPA.

7.1 Resources and patrol operations

Availability of resources is the factor that usually has the largest impact on effectiveness of any operation. Indeed, lack of resources is a significant concern of the MBOMIPA game scouts, as summarised in *Table 7.1*. The most important issues for anti-poaching patrols, as portrayed by more than half of respondents, are improved firearms, raised salaries for game scouts and transport for patrols. Fundamental improvements such as these will have the most dramatic outcome on the effectiveness of the patrols, and only then will minor recommendations have a significant effect. Training for game scouts is also an important issue, as is continuity. Patrols for MBOMIPA operate on a fortnightly turnover of game scouts from local villages. This creates a high throughput, resulting in many of the scouts being inexperienced. Furthermore, since each scout will only be employed for a short period each year, coupled with very low salaries, the scouts can not rely on this employment as a sufficient form of income, and will therefore require other income sources. This *per se* need not be a problem, except that it is feasible that some game scouts may themselves be poachers, creating a conflict of interest in the patrolling. The game

Table 7.1 Improvements to anti-poaching activities as expressed by MBOMIPA game scouts, when asked whether they had any other points to make

Comments made regarding anti-poaching activities	**Number of respondents (n=19)**
Improved firearms for patrols	15
Raised salaries for game scouts	12
Car/transport	11
Radio calls	5
Other	*5*
Training for game scouts	4
Uniforms	4
Education to villagers on anti-poaching activities and wildlife management	3
Medical supplies at camp	2
Increased number of game scouts	2
Arrest those making/selling weapons and snares	2

scouts therefore need incentive not to poach, and incentive to monitor. It would therefore be preferable to employ villagers on a more long-term basis, and provide them with sufficient training and salaries, thus creating a more experienced and effective patrol team. Indeed, as stated by Messer (2000) "Regardless of the strictness of the anti-poaching policies or the amount of money spent on weapons, efforts must be made to keep the anti-poaching units free of corruption. This can include significantly raising the wages of unit members". These scouts may then be able to rely on this employment as their income, and if previously a poacher, may no longer be involved in such activities. In addition to increasing wages, reward schemes can be used as an incentive to game scouts to show commitment to the anti-poaching activities, fulfilling their duties according to their training. In some cases, for example in Luangwa Valley, Zambia (Jachmann and Billiouw 1997), reward schemes have shown to be effective. However, for CHCWP, analysis of rewards with total number of enforcement activities does not suggest that their reward scheme was acting as an incentive to scouts. Therefore, CHCWP's decision to terminate the reward scheme may be optimum decision in this case, as the resources may be redirected to other needs, such as patrol equipment or wages.

Specific concerns of CHCWP game scouts have not been addressed in this assessment due to logistical constraints. However, a concern that has been raised by villagers is that patrolling is not as frequent as they would like and does not continue throughout the whole year. This is due to two reasons, both of which are not easily solved: lack of resources, and practical constraints during the rainy seasons. Increasing resources available for patrolling requires increased donations and sponsorship. Illustrating to donors that the project is effective and is achieving the desired benefits can help attract funding, which may be achieved by utilisation and application of appropriate data. However, although there are not sufficient funds to operate the patrols as frequently as desired, the patrol units themselves are well equipped, being provided with transport, firearms, supplies and a trained field officer. The expenditure on anti-poaching patrols has not changed significantly during the period 1999-2004 despite a decline in overall expenditure, which provides benefits in two forms: continuity of patrol effort and effectiveness, and reassurance to villagers of the reliability and benefits of the

project. This latter point should not be underestimated, as support from local people is fundamental in the operations of the activities. This also illustrates the merit of monitoring anti-poaching expenditure. CHCWP also has a lower turnover of scouts, as villagers nominate a limited number of potential scouts from which the patrol teams are selected. This improves the overall experience of the patrol unit and can provide the scouts with sufficient income for them to be discouraged from illegal hunting. Practical constraints of patrols due to difficult environmental conditions in the rainy season are less easily solved. Poachers often operate on foot and are more mobile than the patrol units. Therefore CHCWP limit patrol effort during these periods, instead concentrating resources into the periods when effective patrolling is possible. Theoretically patrol units could also operate on foot during these periods, but due to the large area involved and the practicalities of escorting arrested poachers over long distances by foot, the effectiveness would be severely hampered and may result in patrols being more costly than beneficial.

7.2 Anti-poaching activities

7.2.1 Enforcement indicator data

Anti-poaching patrol data can be useful for expressing effectiveness of the enforcement by examining trends over time. The number of activities alone has limited implications, since it does not take patrol effort into account. However, if a close relationship between enforcement activities and patrol effort can be seen, this may suggest that poaching levels are constant, and that an increase in anti-poaching activities would be beneficial, as seen in the close relationship between the number of poachers arrested and the number of patrol days for CHCWP. However, rates of enforcement indicators are generally more informative, as any trends observed would not be an artefact of changes in patrol effort. For example, the decline in the rate of firearms and bow and arrows confiscated and snares destroyed for CHCWP suggests that poaching using these three methods has been decreasing and patrols have been at least in part

effective. Unlike CHCWP, anti-poaching data for MBOMIPA, which is only available for four years (2000-2003) for the Lunda area, shows no significant changes in levels of enforcement activities. However these results are still informative and do not necessarily imply that the patrols are ineffective. Firstly, a significant change in poaching levels may not be detected over such a short period. Secondly, MBOMIPA has been running since 1998 so the most profound decrease in poaching levels may have been observed in the earlier years. Thirdly, in areas where poaching is commonplace, the initial aim of anti-poaching patrols may be to prevent an *increase* in poaching levels i.e. to keep poaching levels constant, before attempting to *decrease* poaching. Longer time-series data are therefore necessary to determine the effects of anti-poaching patrols.

As discussed above, it is important to record patrol effort in order to distinguish between the effects of changing effort and actual changes in poaching levels. Patrol effort in CHCWP is recorded as number of patrol days, but could be more sensitive by documentation of the number of hours of observation as well as the number of patrol days, as carried out by MBOMIPA. Some of the CHCWP anti-poaching data have the potential to provide valuable information, but their use is being limited by inconsistency and inefficiency in documentation. For example, it is recorded whether a poaching activity is a meat-poaching incident or a timber-poaching incident. However, this is done not for each incident but for the patrol session as a whole, which may last several days and involve several poaching incidents. If the actual number of meat and timber poaching incidents were recorded, trends in type of poaching can be assessed more accurately. It may also be worth recording charcoal, honey-collecting and fishing incidents as separate poaching types, particularly as charcoal poaching appears to be increasing in Tanzania, and fishing appears to be relatively unmonitored in comparison to terrestrial wildlife. Documentation of poached items is also inconsistent in CHCWP records, particularly timber poaching. In no incident was the species of the timber ever recorded, and there is no consensus on how to describe the amount of timber lumbered. It is not consequential what method is chosen to record timber quantity, as long as there is a clear and consistent method adopted by all game scouts. One possibility would be to estimate the total number of logs, average length and approximate diameter, thus

allowing an overall volume to be calculated. Documentation of animals poached also poses problems, but potentially can be useful in determining poacher preference. In CHCWP the species, the number of individuals, the animal part (meat, bones etc) and sometimes an estimated weight is documented. In MBOMIPA the species and method by which it was killed is documented. The latter method is probably more informative, since it provides information on poacher behaviour.

7.2.2 Estimated monetary value of anti-poaching activities

Estimating the value of anti-poaching activities provides a means of identifying the most effective activities and those that have a lesser impact. The value of destroying poachers' camps is small relative to other enforcement activities, since they can be rebuilt in a few hours, whereas arresting a poacher has much higher value, due to the time spent in prison and the deterrence impact from gaol time. MBOMIPA game scouts are sometimes aware of the position of poachers' camps, yet they have not been destroyed, and poachers often return to these camps. Locating camps but leaving them intact could provide a means of increasing the number of poacher arrests if game scouts return frequently to the camp. This requires two main criteria; firstly, the accurate recording of camp location, and secondly, sufficient resources to deal with arresting a poacher, in particular weapons and a vehicle. CHCWP can fulfil these criteria. GPS could be used to record camp location, whilst weapon and vehicle resources are sufficient for the task. However, GPS should only be used for this purpose if field officers are able to utilise the data and relocate the camp. If this is not the case, then camp location should also be recorded manually in order to be accessible and meaningful to the patrol units. MBOMIPA do not appear to currently have sufficient resources, as they operate on foot and without sufficient weaponry. From 2000-2003, destroying camps contributed to the majority of the value of anti-poaching activities in Lunda. Therefore, considering the high risk and cost involved in arresting poachers and the low likeliness of achieving a successful arrest, compared to the low cost and risk of destroying poachers' camps yet small but probable benefit achieved, camps should only be left intact when scouts are

confident that they would be able to arrest a poacher safely and escort him to a secure unit.

The only other enforcement activity that contributed to the estimated value of anti-poaching activities in Lunda was destroying snares, although only 26% of game scouts questioned reported snaring in the area. Indeed, most of the recorded data on anti-poaching activities do not have monetary value, since they do not hinder poachers in any significant way other than the presence of the patrol units acting as a deterrent, which may itself be severely limited by the lack of arrests occurring in the areas. Recording poacher signs (such as voices, footprints, fires etc) can only be useful if the locations of these signs are recorded in order to determine poacher behaviour. If MBOMIPA game scouts record these locations they can concentrate patrols in these areas, with the intention of obtaining higher value results, such as arresting a poacher or confiscating firearms. Likewise, CHCWP patrols could utilise such information, but only if the location is accurately recorded and referred to by game scouts. Similarly, location of snares could be recorded, which for both projects can act as a method of returning to areas of higher poaching intensity. For CHCWP, if GPS is used to record snare location it may be possible to map the data to examine poacher behaviour and identify areas that require most attention or predict future problem areas.

The estimated value of anti-poaching activities is relatively low for Lunda. This is in part due to the lower species value in LMGCA, since the values are only a fraction of tourism hunting values that occur in the CHCWP areas. The other two main factors may be low levels of poaching and/or ineffective patrolling. Lack of resources has already been discussed as a factor hindering MBOMIPA patrols, in particular by making it difficult to find and arrest poachers. However, lack of resources also has indirect effects. Due to absence of a vehicle for patrolling, the total area being monitored systematically, as a proportion of the whole of LMGCA, is very small, and is essentially confined to a radius of about half a day's walk from two fixed posts (Ecosystems 2003). This results in poachers adapting their behaviour to avoid these areas, thus both avoiding arrest and giving the impression that poaching has been decreasing

when in fact it has only shifted. The aim of enforcement activities is not to simply redirect poachers to other areas, but to deter them from poaching at all. This is only achieved with a sufficient deterrence by enforcement patrols so that poachers perceive a high risk of being caught, as well as other forces such as education and alternative income sources. Moreover, given that no poachers have been arrested in Lunda from 2000-2003, poachers may no longer even consider this area as high risk. Therefore patrols ideally need to extend further into LMGCA and increase arrest rate in order to act as a deterrence. However, without a vehicle this is very difficult. Overnight foot patrols are a possibility, although this would require supplies and tents. It may also be necessary to increase scout wages if overnight foot patrols are undertaken, due to the physical demands and increased risk to safety that the scouts would be placed under. These proposed increases in resources are likely to require serious consideration by project managers, who will be concerned whether the benefits of such changes will outweigh the costs involved. For MBOMIPA, a decision would have to be made whether anti-poaching activities are to be considered a serious and important part of the patrols with dedication to creating effective enforcement, and therefore whether it would be worth investing in improved anti-poaching patrols in order to decrease levels of poaching.

For CHCWP the estimated value of anti-poaching activities is very high both relative to expenditure and to the value of the offtake by RHS, and also in comparison to MBOMIPA. This is in part due to the high value of species in tourism hunting areas, and a combination of high levels poaching and efficient patrolling. Expressing the value of anti-poaching activities in a monetary term is useful to compare the benefits to the wildlife population achieved by the project with the impact of the hunting company. This could be particularly interesting as tourism hunting is a controversial activity and community wildlife management projects that are linked to hunting companies are not yet widespread. Therefore if the value of anti-poaching activities is greater than the value of the offtake, the company would actually be increasing the health of the wildlife population, suggesting that adoption of anti-poaching patrol schemes would be a intelligent strategy for other tourism hunting companies. In the case of CHCWP, with the value of hunting offtake being on average only 2.6% of that of the anti-poaching

activities, the project is more than compensating for the loss of wildlife due to the tourism hunting of RHS. Although high value of anti-poaching activities may be considered as a positive result because the enforcement activities are resulting in significant protection of wildlife, a decrease in the total value would be expected if the enforcement were actually resulting in a decline in poaching. For CHCWP the total value of enforcement per patrol day (unit effort) has been decreasing from 1994-2003, suggesting that anti-poaching activities have been successful in decreasing poaching levels. These data are not only informative, but also can be helpful to attract funding for the project since the benefits can be clearly expressed. It may also be useful in encouraging other hunting companies to consider adopting community wildlife projects. Assigning a monetary value to anti-poaching activities does require further data requirements beyond that of normal patrol operations, as poaching behaviour (such as number of animals killed by a poacher, and relative species composition of those killed) needs to be assessed. For a more accurate estimation, these assessments should be undertaken in each of five CHCWP areas since poaching will differ amongst them, although this current evaluation at least provides an indication of the situation.

7.3 Wildlife monitoring

Monitoring of wildlife populations in a way which provides meaningful information is more difficult than monitoring enforcement activities. This is because many ground survey techniques do not provide absolute abundance estimates, since individual animals are not distinguished between over time. Therefore, in order to obtain population estimates, ground surveys need to be scientifically rigorous, for example by using tested line transect techniques rather than simple animal counts, or alternatively either aerial surveys or tagging techniques, both of which are resource intensive. Nevertheless, MBOMIPA has shown that simple animals counts using ground surveys can provide information on change in populations in both direction and magnitude. Such information could be used to influence quota setting in order to maintain a stable wildlife

population. However, the data is not sufficient to set the quota initially, since estimates of the absolute population are required. If resources permit, which would most likely be funded by external sources such as NGOs, aerial surveys could be used to estimate absolute population size in order to influence initial quota setting, then repeated after a number of years on a regular basis as verification. In the interim years, ground surveys data can be calibrated to provide information on changes in population size. Alternatively ground surveys could be developed from the simple animal count system into line transect techniques, which can provide the population estimates required for quota setting, which is indeed the purpose of the MBOMIPA wildlife monitoring programme. Line transect techniques are a realistic and viable option, but require comprehensive training of game scouts. This technique would also be incompatible with anti-poaching activities, since they both would require different sets of protocols that if were to be combined would result in both activities being performed inefficiently and may even become unachievable. Regardless of which methods are used, wildlife monitoring *per se* does not provide any benefit to the wildlife population; only if the data is used for its intended purpose will it fulfil this role. However, there is still no indication that there is any serious intention to use this data as MBOMIPA had intended, which undermines the entire purpose of the wildlife monitoring. Therefore, continued monitoring combined with active pursuance of the application of the data is required.

Ground surveys by MBOMIPA have shown to provide some useful information on wildlife populations despite running on a very limited budget. The most useful of these data are the live animal sightings, in which the species, the number of individuals and the number of males/females/juveniles are recorded, although the recording of sex and stage of maturity has not shown to be valuable for assessment of the populations (Ecosystems 2003). The use of data on animal signs has not shown to have significant value, not only due to the inconsistency of data collection, but also because there was no significant difference between observed numbers and number of signs, and it was therefore recommended that recording such data should be abandoned (Ecosystems 2001). Reports of dead animals were so infrequent as to not provide any meaningful

insight. Therefore, for projects such as CHCWP that may wish to consider wildlife monitoring, reporting of live animal sightings can provide some meaningful information on changes in populations, both in size and direction. However, before undertaking wildlife monitoring programmes, it needs to be considered to what use the data can be applied. If the purpose is to influence quota setting there should be some agreement between relevant authorities and the project in order to avoid unnecessary waste of resources. Projects such as CHCWP may not necessarily be able to influence quota setting, but they can use such data to influence hunting offtake in their associated hunting blocks. For example, if ground surveys indicate a significant decline in a species then the hunting company may decide to reduce offtake of that species, regardless of the legal quota, in order to maintain a sustainable population. Ground surveys to monitor wildlife populations can run concurrently with anti-poaching activities, as illustrated by MBOMIPA. However, the MBOMIPA patrols appear to have a greater emphasis on wildlife monitoring, perhaps to the detriment of efficient enforcement. Rebalancing this issue may be beneficial to MBOMIPA since the wildlife data is not yet being used for quota setting as intended, and anti-poaching activities are not resulting in high value benefits for the wildlife. CHCWP could successfully incorporate wildlife monitoring into its patrols, but emphasis on anti-poaching activities should be maintained.

Monitoring of the health of the wildlife population may also be achieved from data other than ground surveys or aerial surveys. In theory, information on hunting success per unit effort can provide at least some indication on population health, since hunting success should increase when the population increases. This would require data on the species hunted and the length of time taken to achieve the kill. Such data also has the benefit of not diverting attention away from anti-poaching activities in the way that ground surveys may. A more sensitive analysis would include data on trophy quality, such as skull size. Trophy quality on its own does not necessarily provide information on wildlife health, because hunters are often bias towards larger prey. Therefore trophy quality must be considered alongside hunting effort, and analysed over time in order to identify changes in the health of the population. MBOMIPA have indicated intention to obtain this data, both trophy quality, and hunting performance (number of

hunts/kill, number of hunt hours, and percentage of failed hunts), which if analysed appropriately could act as a very useful addition to their wildlife monitoring system, and strengthen their case to influence quota setting. However, only in a few cases are any data on hunting obtained, usually the hunting quota and percentage of quota taken. CHCWP keep records on trophy quality, although it has not been made accessible and is not utilised. The project should record the number of hours per hunt, and relate it to trophy quality, thus obtaining some indication of the health of the wildlife population.

8. FURTHER WORK

The methods in this evaluation can be developed in many ways in order to gain a greater knowledge of poaching activities and optimal patrol tactics. The most significant expansion would be to extend the games scout questionnaires to all areas that CHCWP operated within, in order to base the monetary value of anti-poaching activities estimations on poaching behaviour within the relevant areas, rather than only upon the poaching behaviour within LMGCA, derived from MBOMIPA game scout responses. This would provide a more accurate estimation, since it would take into account heterogeneity in poaching behaviour over Tanzania. This method of estimating a monetary value of the anti-poaching activities could also be utilised by other community wildlife projects as an alternative way of expressing project impact and effectiveness, and could be developed more fully than was possible in this evaluation.

The estimation of a monetary value of anti-poaching activities is useful for determining which activities are most effective in protecting the wildlife, and therefore which activities of the project are having the most impact. However, each enforcement activity has a cost in terms of the time taken, which could potentially be spent on other enforcement activities, and also the risk to the game scouts involved, for example when encountering armed poachers. Therefore, when deciding on the most appropriate balance of enforcement activities, these costs should be considered as well as the benefits. Game scouts themselves could

record the length of time taken on each activity and risks involved in order to include this aspect in a cost-benefit analysis.

The chief role of anti-poaching patrols is to act as a deterrent to poachers, yet it is difficult to extract from enforcement indicator data how effective the patrols are being as a deterrent, other than observing a decline in the rate of enforcement activities. It would therefore be useful to investigate arrest rates, likeliness of conviction and average length of imprisonment or value of fine, in order to determine the actual probability and cost to a poacher of being arrested. This could be compared to the risk perceived by local individuals, and the way that their perceived risk and response to this risk has changed over time, which could be obtained by questionnaires. Recording length of time between conviction and re-offence would also be a useful way of estimating deterrence effect of enforcement.

9. SUMMARY

9.1 Analysis of available data records

Analysis of rates of enforcement activities over time for CHCWP suggest that the activities are being partially effective, as the rate of firearms confiscated, bows and arrows confiscated and snares destroyed has decreased, although the rate of poachers arrested, which may be considered the most important indicator, shows no significant change. The reward scheme does not appear to be effective at increasing anti-poaching activities. Anti-poaching data for MBOMIPA is restricted to only four years (2000-2003) for one area (Lunda), resulting in limited ability to determine project impact. No significant change in anti-poaching activities or patrol effort is seen, which may be a result of either constant poaching levels or ineffective patrolling. By using a comparison with aerial survey data, wildlife monitoring using live animal counts has been shown to be useful for indicating changes in populations in both magnitude and direction.

9.2 Estimation of a monetary value of anti-poaching activities

Estimation of a monetary value of anti-poaching activities suggest that arresting poachers and confiscating firearms have highest value, confiscating bicycles and destroying snares have intermediate value, whilst destroying poachers' camps have relatively low value, although these values depend on the species values for the area in question. CHCWP has high value of anti-poaching activities, relative to the value of hunting offtake by RHS and costs of the patrols, suggesting that anti-poaching activities are being efficient and are resulting in significant wildlife protection. The decline in value over time also suggests that anti-poaching activities are being effective in reducing poaching levels. The value of anti-poaching activities for MBOMIPA is low relative to costs, and the lack of significant change over time may either imply that poaching levels are constant, or that the enforcement patrols are being ineffective.

9.3 Recommendations

In order to improve the effectiveness and efficiency of anti-poaching activities several recommendations can be made, based upon the evaluation of CHCWP and MBOMIPA operations. The most crucial, but usually most difficult factor to change due to budget constraints, is the improvement of resources, particularly firearms, salaries for game scouts and transport for patrols. Other improvements are secondary to the impact of increased resources, although can still play a considerable role in enhancing anti-poaching effectiveness. These include:

- Reducing the turnover of game scouts and improving training, in order to enhance effectiveness of patrols and to increase game scout commitment, thus discouraging corruption.
- Recording the location of poachers' camps and snares, whilst leaving camps intact, so that scouts can return in order to increase the probability

of arrest (assuming sufficient resources to successful carry out arrests), thus having a greater impact on wildlife protection.

- Improving consistency of data, and developing a clear consensus on recording methods, particularly for variable items such poached wildlife.

Since CHCWP does not undertake wildlife monitoring, the evaluation of these activities is based upon MBOMIPA operations. Recommendations include the following:

- For ground surveys, live animal counts can be used to provide information of changes in populations in both direction and magnitude. However, line transects are required for absolute abundance estimates, which would not be compatible with running effective anti-poaching activities concurrently.
- Animal signs, recording of animal sex and maturity and recording of dead animals is not likely to be useful.
- Trophy quality analysed alongside hunting success per unit effort can be used as an alternative method of assessing wildlife health, and may be suitable for projects where anti-poaching is the primary goal and wildlife monitoring is a secondary objective.
- If the aim of wildlife monitoring is to influence quota setting, there must be active pursuance of the appropriate use of this data in order to justify the costs of such activities.

10. CONCLUSIONS

A collaborative and cooperative approach to conservation, including transferability and transparency of data, is essential for the adaptive management of community based wildlife management projects. It allows comparisons to be made between projects, providing an insight into the strengths and weaknesses of different methods of wildlife monitoring and anti-poaching patrolling, and consequently improvements can be made to enhance effectiveness and efficiency. CBNRM projects need to show that they are achieving their intended benefits and that they are cost effective in order to influence community wildlife management strategies beyond their own projects, and to attract funding to improve their own operations. This requires collection and application of relevant data, to illustrate the benefits, both at the community level and health of wildlife populations, and the costs involved.

CHCWP and MBOMIPA both operate in different ways to achieve similar goals, and many of their methods are appropriate to their budget and circumstances, so that not all aspects can be applied equally to both projects. However, the success of the anti-poaching activities of CHCWP can have much relevance for MBOMIPA, as emphasis towards improved anti-poaching activities will increase the benefits achieved by the project by improving the health of the wildlife population. CHCWP can consider aspects of MBOMIPA wildlife monitoring methods, if considered in relation to the benefits that this could achieve. In this way, with appropriate monitoring and evaluation, community wildlife projects can support one another by increasing the knowledge base from which management and monitoring systems can be built upon.

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APPENDIX I

Table (i). Number of enforcement activities for CHCWP from 1994-2003

Year	Firearms confiscated/ surrendered	Bows and arrows confiscated	Lorries impounded	Bicycles confiscated	Snares confiscated/destroyed	Poachers' camps destroyed	Skins etc confiscated	Timber confiscated	TOTAL
1994	25	9	0	0	1627	24	7	0	**1692**
1995	9	8	0	0	3243	10	7	0	**3277**
1996	28	6	0	0	3124	169	2	0	**3329**
1997	20	1	0	0	24	0	6	0	**51**
1998	12	11	0	0	1135	0	53	48	**1259**
1999	33	3	0	0	4423	48	89	33	**4629**
2000	44	6	0	0	3113	104	147	3358	**6772**
2001	42	2	1	9	2116	69	143	1303	**3685**
2002	7	5	2	2	1295	60	73	3438	**4882**
2003	13	0	1	24	397	27	52	3839	**4353**
Total	**233**	**51**	**4**	**35**	**20497**	**511**	**579**	**12019**	**33929**

APPENDIX II

Figure (i). Questionnaire, administered to game scouts, for the estimation of a monetary value of anti-poaching activities

Background information:
a) What is the area and year that the following responses are based upon?
Area:
Year:
(You may fill in more than one questionnaire based on a different place or time)

b) What is your job?

Questions:

1) What types of poachers are there?

2) (a) How many animals does a wildlife poacher catch in a year?

(b) If you know a poacher, how many animals did he catch in a year?

3) (a) What animals does a poacher catch?

(b) How many of these does he catch?

Species *Number*

4) Are other species, such as large carnivores, sometimes killed?

a) If so, what species and how many?

b) For what reason?

5) When do poachers snare?

6) How many snares would he use?

7) (a) What species are caught in a snare?
(b) How many of these species?

Species *Number*

8) Do any of these animals go to waste (either by rotting, or are unwanted?)

9) When do poachers set up camps?

10) If a hunter sets up a camp, how many poachers use this camp?

11) How long would a poacher be 'out-of-action' by:
a) being arrested?
b) destroying a camp?
c) confiscating firearms?
d) confiscating bows & arrows/spears?
e) impounding a lorry?
f) confiscating a bicycle?

Other points you wish to make

APPENDIX II

Table (ii). Number of animals killed per poacher per year

	Number of animals/poacher (Scenario 1)	Number of animals/known poacher (Scenario 2)	Number of animals/poacher : species total (Scenario 3)
	24	-	216
	36	10	10
	4	3	3
	12	2	2
	5	-	20
	10	-	3
	12	7	14
	12	-	8
	36	-	34
	-	-	-
	-	-	-
	36	2	3
	-	-	-
	14	18	17
	36	5	19
	1	-	2
	1.5	1	3
	20	-	-
	2	1	4
Average	16.34	5.44	23.87

Table (iii) Relative species composition and average value of poached animal

			CHCWP		LMGCA	
Poached species	**Number killed (total)**	**Relative composition**	**Value per animal (US$)**	**Total value (US$)**	**Value per animal (US $)**	**Total value (US $)**
Buffalo	45	0.1108	600	66.50	183.3	20.32
Dik-dik	69	0.1700	170	28.89	16.5	2.80
Duiker	8	0.0197	165	3.25	22.9	0.45
Eland	12	0.0296	840	24.83	220	6.50
Elephant	1	0.0025	5000	12.32	5000	12.32
Giraffe	16	0.0394	12000	472.91	12000	472.91
Guineafowl	100	0.2463	3.7	0.91	3.7	0.91
Hippo	1	0.0025	840	2.07	146.7	0.36
Hyena	3	0.0074	190	1.40	33.18	0.25
Impala	81	0.1995	240	47.88	50.4	10.06
Kudu	17	0.0419	1235	51.71	215.69	9.03
Leopard	9	0.0222	2000	44.33	349.29	7.74
Lion	2	0.0049	2000	9.85	349.29	1.72
Sable antelope	10	0.0246	1200	29.56	209.58	5.16
Warthog	1	0.0025	320	0.79	32.1	0.08
Waterbuck	4	0.0099	440	4.33	76.84	0.76
Wild dog	1	0.0025	1200	2.96	1200	2.96
Zebra	26	0.0640	590	37.78	103.04	6.60
Total	406	1.0000				
			Average value of poached animal	842.28		560.92

Table (iv). Other animals killed and reasons for death.

Other species killed	**Number killed (minimum) in a year**	**Reason**			
		Depredation (Livestock attack)	**Skins**	**Meat**	**Accidental (unwanted)**
Hyena	3	1	0	0	2
Leopard	9	3	5.5	0.5	3
Lion	2	1	0	0	1
Wild dog	1	0	0	1	0

Table (v). Relative species composition and average value of a snared animal

Animals caught in snares	Number killed (total)	Relative composition	Value per animal (US$)	Total value US$
Baboon	1	0.0192	15.72	0.30
Buffalo	1	0.0192	183.3	3.53
Bush pig	5	0.0962	22.9	2.20
Dik-dik	3.7	0.0712	16.5	1.17
Duiker	1.4	0.0269	22.9	0.62
Eland	1	0.0192	220	4.23
Giraffe	3	0.0577	12000	692.31
Hare	0.2	0.0038	unknown	-
Kudu	4.5	0.0865	215.69	18.67
Impala	16	0.3077	50.4	15.51
Mbawala	2	0.0385	unknown	-
Sable antelope	0.2	0.0038	209.58	0.81
Warthog	3	0.0577	32.1	1.85
Waterbuck	6	0.1154	76.84	8.87
Zebra	4	0.0769	103.04	7.93
Total	52	1		757.68

Table (vi) Time poacher out of action (years)

Arresting poacher	Destroying poachers' camp	Confiscating firearms	Confiscating bows & arrows	Impounding lorry	Confiscating bicycle
3.0000	0.0000	0.1667	0.1667	-	-
1.0000	0.0000	2.0000	0.5000	-	-
1.0000	0.0027	-	-	-	-
0.2083	0.0068	1.0000	0.5000	-	-
3.0000	0.0002	0.2500	0.0027	-	-
2.0000	0.0027	0.0192	0.0027	-	-
1.0000	0.0000	0.0000	-	-	-
2.0000	0.0000	-	-	-	-
0.5000	0.0000	1.0000	-	-	-
forever	0.0000	forever	-	-	-
2.0000	0.0000	0.0000	-	-	-
7 up to forever	0.0000	2.0000	-	-	-
forever	0.0001	0.0000	-	-	0.3333
0.1667	0.0833	0.8330	-	-	-
3 to 6	-	1.0000	-	-	-
3.0000	0.0001	5.0000	-	-	-
2 to 3	0.0000	forever	forever	-	-
2.0000	0.0000	forever	1.0000	-	-
1.0000	0.0001	up to 5	0.5000		

Table (vii) Estimated anti-poaching values for MBOMIPA, Lunda area, from 2000-2003

	Value US $					
	Poachers arrested/hr	**Poachers' camps destroyed/hr**	**Snares destroyed/hr**	**Total value of enforcement activities/hr**	**Total observation time (hours)**	**Total value all enforcement activities/yr**
2000	0.00	5.64	0.00	5.64	322	1815.69
2001	0.00	10.99	0.00	10.99	464	5097.76
2002	0.00	11.71	3.80	15.51	436	6763.73
2003	0.00	10.91	0.00	10.91	300	3274.14
Average	*0.00*	*9.81*	*0.95*	*10.76*	*380.50*	*4237.83*