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EFFECTIVENESS OF MONITORING IN WILDLIFE PROTECTED AREAS: A CASE STUDY IN KOGYAE STRICT NATURE RESERVE GHANA

DIPLOMA THESIS

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ABSTRAKT

Pytláctví a ztráta stanovišť doposud byly největší problémy, kterým čelí ochranáři, včetně správy KogyaeStrictNatureReserve. Vzhledem k tomu, že pytlácké skupinyse zvětšují ve své velikosti, počtu a sofistikovanosti, je důležitější než kdy jindy, aby reakce na vymáhání práva v chráněných oblastech byla robustní, spolehlivá a účinná. Cílem studie je tedy zhodnotit, jak efektivní jsou hlídky přírodní rezervace Kogyae v omezování nezákonných činností. Údaje byly shromážděny ze standardizovaných hlídkových formulářů, které se používají k evidenci počtu strážců, času stráveného na hlídce avzdálenosti uražené během hlídky. Dále se na formuláře zaznamenávají typy, množství a oblastinelegálníčinnosti, se kterými se strážci setkali a počtu velkých savců zaznamenaných na základě zvířecího druhu a lokality. Model smíšeného efektu byl použit jako statistický model při analýze dat pomocí R softwaru verze 3.3.2. Všechny grafy byly sestaveny pomocí programu Microsoft Excel 2016. Vzdálenost, kterou urazil tým na hlídce (Patrol km) ($\chi2 = 13{,}25$, p $<0{,}0003$) a počet zaměstnanců ($\chi2 = 5{,}23$, p $<0{,}02$) měly signifikantní efekt na počet závažných trestných činů. Mužské efektivní hlídkovédny (EPMD) měly zanedbatelný vliv ($\chi2 = 3{,}25$, p $<0{,}07$) na závažné trestné činy a počet zvířat měl nejslabší vliv a byl nevýznamný ($\chi2 = 1{,}75$, p $<0{,}19$). Dochází k osmi (8) různým druhům nelegálních činností. Nejčastější je kladení pastí, na druhém místě je zaslechnutí výstřelů. Počet zatčených pytláků zaznamenal nejmenší počet výskytů. Během let byl v roce 2010 zaznamenán nejvyšší výskyt nezákonné aktivity. Roku 2008 bylo zaznamenáno nejméně 191 výskytů. Mezi uraženýmikilometry (km) na hlídce a množstvím protiprávních činností existoval významný vztah. Během většiny let,čím dále a déle tým hlídal, tím větší byla pravděpodobnost, že se setkají s nelegální činností. U primátů byl zaznamenán nejvyšší počet pozorování zvířat, následovali menší kopytníci a pak větší kopytníci. Výsledky studie podporují doporučení, že kombinace zvýšené práce s místními obyvateli a cílené hlídání v určených oblastech, významných pro volně žijící zvířata, by měla přispět k dalšímu odrazování od nezákonných loveckých činností.

Klíčová slova: Kogyae Strict Nature Reserve, nelegální aktivity, uražené km na hlídce, zaměstnanci, prosazování práva.

ABSTRACT

Poaching and habitat loss have been the biggest problems facing conservationists including management of Kogyae Strict Nature Reserve. As poaching groups increase in size, number and sophistication, it is more important than ever that law enforcement responses in protected areas are robust, reliable, and effective. The study therefore aims to assess how effective the patrols of the Kogyae Strict Nature Reserve are in curbing illegal activities. Data was collected from standardized patrol forms that are used to keep records of the number of staff on patrol, the time spent, the distance patrolled, types, quantities and locations of illegal activity encountered, and the number of large-mammals encountered by species and location. Mixed effect model was used as the statistical model in the analysis of the data using R software version 3.3.2. All the charts were constructed using Microsoft excel 2016.The distance travelled by the patrol team (Patrol km) (χ^2= 13.25, p<0.0003) and the number of staff (χ^2= 5.23, p< 0.02) had a significant effect on the number of serious offences. Effective Patrol Man Days (EPMD) had had an insignificant effect (χ^2=3.25, p< 0.07) on serious offences with the number animals being the weakest and insignificant (χ^2=1.75, p< 0.19). Eight (8) different kinds of illegal activities occurs with snares being the highest followed by gunshots heard. Number of poachers arrested recorded the least number of occurrences. Among the years, 2010 recorded the highest occurrences of illegal with 2008 recording the least with 191 (occurrences). There was a significant relationship between Patrol km and the number of illegal activities. In most of the years, the farther and longer the team patrols the higher the chance of encountering an illegal activity. Primates recorded the highest number of animal sightings, followed by smaller ungulates and then larger ungulates. The results of the study support the recommendation that, in combination with increased work with local people and targeted patrolling in identified areas of importance for wildlife should contribute to continued discouragement of illegal hunting activities.

Keywords: Kogyae Strict Nature Reserve, illegal activities, Patrol km, Staff, Law enforcement

CONTENTS

CHAPTER ONE

1. INTRODUCTION

Protected areas are often viewed as islands in isolation from their surroundings yet they are subject to many outside influences and in turn affect neighboring lands. These relationships may be primarily ecological or physical, but also include cultural, social and economic considerations (Kathy and John et al., 1986). As demand for efficient and immediate utilization of natural resources increases worldwide particularly in the tropical countries with fast growing populations, the need for protected areas must be clarified. To survive these pressures, protected areas must be justifiable in both biological and socio-economic terms (Kathy and John et al., 1986).

In Ghana, the Wildlife Division of the Forestry Commission has direct management responsibility for 16 protected areas, including three coastal wetlands, totaling 12,585 km^2 or 5.5% of the country (Jachmann, 2008b). Legislation caters for the protection of all wildlife, both in and outside of protected areas, but resource constraints greatly limit the ability to implement conservation legislation (Skonhoft and Solstad, 1998). Prevailing ecological and above all economic conditions determine that voluntary compliance with conservation legislation does not occur, and that the protection of wildlife requires effective and often expensive enforcement mechanisms (Jachmann, 1998; Rowcliffe et al., 2004). For most of the protected areas in Ghana, budgetary allocations are too low to provide adequate protection for their wildlife populations that have been gradually declining due to habitat fragmentation and the trade in bush-meat (Brashares et al., 2001; Brashares et al., 2004). Bushmeat hunting threatens the survival of many forest mammal species, particularly in West/Central Africa (Bakarr et al., 2000; Robinson and Bennett, 2000).

It is of current concern that many reasons including rising demand from an urbanizing population as incomes improve, human population growth and expansion into previously remote forest areas, the spread of more efficient technologies such as guns have led to populations of species reaching critically low levels (Milner-Gulland et al., 2003).

Poaching and habitat loss have been the biggest problems facing conservationists. Conservation legislation has changed most of the ancient hunter gatherer practices on the continent into illegal practices, broadly known as poaching. Despite modern thinking and new conservation approaches, this situation continues to exist, creating conflict of interests and value systems between the conservation establishment and the public. Therefore, the continue

importance of illegal activities and law-enforcement on a temporal and on a spatial basis. Primarily, this allows us to continuously upgrade the system through an adaptive management process, there by optimizing the result at the lowest possible cost. It further allows us to assess the ecological and economic significance of illegal activity in a popular area to assess the effectiveness of different types of law-enforcement effort (Bell, 1983).

Patrolling as a law-enforcement effort is one of the basic and most essential functions of the guard force of the Kogyae Strict Nature Reserve. It is either done on foot or other forms of transport such as the use of vehicles and bicycles by the patrol team. The patrols involve routine inspections inside the reserve, checking the boundaries of the protected area. The patrols are either carried out in the day that is usually referred to as day patrols effective (DPE), at night that is night patrol effective (NPE) and an entire day or two to three day patrols that is long patrol effective (LPE). The main function of the patrol teams is to ensure that the reserve regulations are being observed; that the Strict Nature Reserve is not trespassed; that only authorized personnel are active in restricted zones; and that there is no illegal hunting, logging or clearing of land for agriculture in the reserve.

Strict Nature Reserves are established by law or by statute for research. They are located on state-owned lands and are primarily reserved for the purposes of nature conservation and research. They are also used for teaching purposes, if these do not compromise nature conservation in the area. Strict Nature Reserves are conserved in their natural state so that researchers would be able to compare these with other areas and determine how many of nature changes are natural instead of having been caused directly by man. For most part, Strict Nature Reserves are closed to the public. The conservation regulations in Strict Nature Reserves are stricter than in National Parks.

On the African continent, in majority of conservation areas, the importance of a properly planned and executed law-enforcement program, in combination with monitoring of the effort and illegal activity has always been highly underrated (Jachmann,1998). As poaching groups increase in size, number and sophistication, it is more important than ever that law enforcement responses in protected areas are robust, reliable, and effective. Consequently, the overall shortage of reliable data on law-enforcement resource allocation and related levels of illegal activity generally results in the limited availability of feedback mechanisms for improving law-enforcement operations. Thus, most law-enforcement programs on the continent are ad hoc in nature, not conducted cost-effectively and very little attention is paid

to differential resource allocation to optimize field operations. On this basis, there is the need to assess how effective the patrols of the Kogyae Strict Nature Reserve are in curbing illegal activities.

1.1 Specific Objectives

The objectives of the study therefore seek to;

1. Determine the types of illegal activities encountered by patrol staff in the Kogyae Strict Nature Reserve from 2006 to 2014.

2. Determine trends in illegal activities and animal abundance for the eight-year period.

3. Determine factors affecting the effectiveness of patrol efforts with respect to the illegal activities detected and animals sighted.

CHAPTER TWO

2. LITERATURE REVIEW

2.1 Poaching

In the context of wildlife conservation and management, poaching is basically the illegal taking or possession of game, non-game, protected, threatened, or endangered species (Jachmann, 2004). According to Jachmann, (2004) poaching are acts that violate the wildlife laws (hunting regulations) of Ghana. These are hunting wildlife with the aid of spotlight, during closed season, in forest reserve, or the killing of protected and endangered animals. For categorizing the offences, acts that violates wildlife laws includes; the act of shooting, capturing, taking, injuring, lying in wait for, willfully disturbing, or molesting any wild animal or plant (wildlife), or any attempt to do so without permission. In a Protected Area, it means illegally taking anything from inside it. Poaching is an old century rural practice, generally condoned by village society and is one of the major problems in wildlife conservation and management in most African Protected Areas (PAs). With human population increase around PAs, tropical ecosystems are under increasing pressure for bush meat supply to the surrounding local communities through traditional hunting and quota harvesting (Barve, 2005).

Within the UK, game birds and fish are regularly poached and the USA is currently experiencing tremendous difficulties with illegal poaching in its 366 National Parks. More than 100 species are particularly at risk, including the brown bear, bighorn sheep, elk, grey-banded king snake and various species of butterfly. Estimates suggest that at least 3000 American black bears are shot illegally every year; some to supply the black-market traffic in animal parts for culinary or medicinal purposes. The size of poaching operations is astounding: 1994 estimates suggest that in the USA alone illegal killing of animals is worth more than $200 million per year (Van Biema, 1994). The global gloomy perspective of poaching has received attention in various forms: Public forum, regional meetings, and conferences. Law making and enforcement are some of the strategies to deal with the matter. Another strategy worth noting is the institution of awards to conservation heroes.

Jachmann (1998) categorized wildlife poaching into four as; subsistence gathering, subsistence hunting, commercial meat hunting, and commercial trophy hunting. These classes have varied impact on the wildlife resources. Subsistence gathering which involves gathering for household consumption purposes by majority of members of rural communities and does not have a major impact on the wildlife resources (Oppong, 2007; Jachmann 1998; Thorsell, 1986).

Poaching which is a threat to many protected areas has been classified under three broad types as; subsistence, structured or commercial and 'Chopper poaching'. Subsistence poaching is where the local people hunt the animals for their meat to feed their families and members of their community.

Structured or Commercial Poaching is the cause of most rhino's deaths (Manyenye, 2008). These groups of poachers, consist of 4 to 6 members a group and are organized, knowing the plan down to each second and are equipped with heavy equipment, like Ak47's. The Chopper Poaching which is usually done by professionals by use of helicopters or small planes to fly over reserves and track the rhino's, where they then dart the rhino with an illegal substance, which knocks the rhino out, allowing the poachers to approach and hack off the rhino's horn without a fight.

Subsistence hunting described as killing of wildlife for domestic uses as meat is the most widespread on the continent and often involves many members of the community. It is considered an essential part of the subsistence rural economy (Manyenye, 2008, Loishooki, 2006; Bell, 1986a). Hunting in Africa was traditionally almost exclusively done for subsistence for several years and there are places today where the people only make game solely for subsistence (Bell, 1986b). There were traditional hunting rules, privileges and restrictions, which in part also served to conserve wildlife resources. These hunting rules largely became ineffective through colonization and western technology and through local population migration (Marks, 1984). Cleaver (1992) observed that the impact of traditional hunting on biodiversity is not yet quantified but is presumably very serious. In Zambia, most subsistence hunting is done with dogs, locally manufactured muzzle-loading guns, and snares mostly obtained from electrical conductors (Marks, 1989, Bell, 1986a).

Literature on hunting revealed that off reserve in rural areas harbors low densities of small game and little or no law enforcement and dogs are used to pursue animals such as duiker, grysbok, bush pig, and warthog. On the contrary protected areas in rural settings harbors higher densities and greater varieties of game and wire snares are used to trap the animals (Fitzgibbon, 1995).

Snaring has been noted to be the most destructive and indiscriminate way of killing wild animals. It is extremely difficult to control, since wires are usually available in enormous quantities, and it attract little attention from lawmakers (Oppong, 2007). Wato et al. (2006) held the view that the traditional methods of wildlife hunting, like setting traps and snares are

no longer sustainable as the reasons for hunting are largely moving from subsistence to commercial.

Three basic means of hunting widely occur in Protected Areas in Ghana and which are shooting, trapping and dogs, which are used in hunting small game as well as big game (Holbeck, 1998). Four other minor methods exist, that is catapult, use of fire, cutlass slaying and hand picking, which are mainly used in hunting smaller game and are often species specific (Aalangdon, 2005).

Commercial poaching which is a category of commercial large scale hunting involves hunting and capturing of live animals and sometimes involves extraction of derivatives and meat for trade (Manyenye, 2008). It is not as widespread as subsistence hunting, but sometimes constitutes a major industry, as in the Serengeti region of northern Tanzania (Campbell, 1989). Cleaver (1992) assessed the impact of traditional hunting on biodiversity and indicated that significant degradation of wildlife to supply urban centres with bush meat affected large areas. He also emphasized that, the commercial bushmeat trade is the most significant and immediate threat to the future of wildlife populations in Africa today, and could well lead to the loss of several species of animals (Oppong, 2007; Cleaver, 1992; de Klemm, 1991).

In Ghana, however, commercial hunting of large herbivores has never constituted a major industry, but small-scale commercial hunting of mainly bushbuck, duiker, antelopes and others (Oppong, 2007; Kasim, 2002; Hoffman, 1999; Ntiamoa-Baidu, 1998) has always taken place. Commercial trophy hunting encompasses such commercial hunting of elephants and rhino for high value, non-perishable commodities as ivory and rhino horn. This may be considered the most serious class of illegal hunting, firstly because it has caused the near extinction of black rhino and a drastic reduction in elephant numbers throughout the continent (Jachmann, 1998; Leader-Williams, 1996). Three kinds of illegal wildlife use occur in Kogyae Strict Nature Reserve that is subsistence hunting, commercial bush-meat hunting, and low levels of commercial trophy hunting for ivory. Commercial meat hunting mainly concerns large herbivores such as buffalo, roan antelope, waterbuck and hartebeest.

2.2 Degree of Poaching

Poaching is an unlawful practice in which an animal is hunted illegally mainly for food, subsistence and commercial reasons. Those who practice illegal hunting are known as poachers. Poaching is considered to be an illegal practice due to a number of reasons like the poacher is not a licensed hunter, the animal either belongs to category of endangered species

or dwells in a restricted land (PA), the poacher does not have a legal right to hunt the animal, the means adopted by the poacher do not conform to the prescribed norms laid down by the concerned authorities and the animal is tagged beforehand for research purposes(Mesi, 2002; Bennet, 2001; Messer, 2000; Boshe, 1989; Chinzinga, 1986 and Bell, 1983). The level of illegal activity is a principal indicator of the effectiveness of law-enforcement monitoring system in any protected area and as such it is imperative that the distribution and intensity of it is understood to respond to it (Hillman and Mesi, 2002; Jachmann, 1998; Leader-Williams, 1990; Boshe, 1989).

A study carried out in 1997 showed that over-exploitation of the wildlife resources and destruction of habitats lead to the threat of wildlife in Africa (Browen-Jones and Penday, 1999). The global picture is that the number of bush meat consumers have increased by eight-fold since 1900 and currently represents an equally important conservation concern as growing global population is growing with corresponding increase in resource consumption (World Conservation Society WCS, 1999). Poaching which is widespread activity has become a critical concern in India in the past few decades. Due to illegal wildlife trade, various species of birds and animals are on the verge of total extinction (Bell, 1983). Holbeck (1998) reporting the gloomy situation of Bia and Ankasa Conservation Areas, stated that several species especially monkeys, are now believed to be extinct in Bia and severely threatened in Ankasa. Holbeck also estimated that the total annual bush meat production ranges from, 3,200-3,800 tons for Ankasa Conservation Area valued at about $ 5 million and 5,200 tons in Bia also valued at $ 8 million respectively (Holbeck,1998). Grainger (1994) quoting Mason (1993) observed that there is much unreliable evidence of poaching particularly of buffalo taking place throughout the Mole National Park (Grainger, 1994; Mason, 1993). There is a very high dependency for bush meat by rural communities in Ghana. The wildlife regulations and laws are not respected by many people. Three decades ago, about 70% of Ghanaians ate bush meat but the quantity of bush meat has dwindled resulting in a bush meat crisis in the country (Aalangdon, 2005; Asibey, 1974).

2.3 Profile and Motivational factors of poachers in Ghana

Poaching is one of the serious management problems that the Wildlife Division faces in Ghana. Although poaching around the study area is serious, there has not been much systematic data gathering attempts to appreciate the issue including understanding the poacher's decision – making process (motivational factors) and the dynamics of poaching around the area. Knowing what motivates poachers will help park management to effectively and tactically improve the

existing law enforcement strategy to combat poaching. Poachers have different motivations for what they do. Some kill illegally for food, others for strictly monetary profit. Some poach to secure what they consider to be valuable trophies. And a few individuals poach just for the adventure of seeing how many animals they can kill in each time frame in competition with others (Grainger, 1994). Loishooki and Tesha (2006) contended that people poach for several reasons, among others are peoples believe that wildlife meat is better than livestock meat and has medicinal value while others do it as part of their culture as they have been hunting since time immemorial.

Marks (1979) in a study on hunting ecology of Bisa of the Luangwa Valley collected information on life history of hunters. The survey results which also included process of training, kills and ceremonies after a kill revealed a profile of a subsistence hunter. He recognized four types of hunters in the Valley Bisa community as; Chipumpi or bachibinda as individuals do not use charms, Bachibindabamiti as professional hunters who possess charms, Nfundiwankomboyamipashi as ancestral gourd hunters and Bachibindabawanga or hunter sorcerers (Marks, 1989; Marks, 1984).

In a similar study of hunters in communities around Mole National Park in Ghana a distinction was made between men who hunted occasionally and professional (possess magic or uses magic) hunters (Mason,1993). The two studies mentioned above focused on hunters in the communities. The limitations of interviewing hunters are that usually they consider themselves a mistreated group by wildlife authorities and as such getting information from them demand mutual understanding and respect which at times is difficult (Oppong, 2007).

2.3.1 Motivational Factors Influencing poaching-A Conceptual Framework

Few analytical frameworks have been used to study reasons for poaching. Poudyal (2005) used the conceptual model which is built on the factors that are hypothesized to influence the decision of poachers to indulge in poaching of the one-horned Indian Rhinoceros in Royal Chitwan National Park, Nepal. The model was based on a structure which considers; effectiveness of anti-poaching measures that determine the probability of being caught and convicted, penalties when caught poaching and available economic alternatives among other factors.

The framework designed (Figure 1) that best fit the study considers (a) effectiveness of law enforcement effort (b) penalties (fines and prison sentences) when a poacher is caught poaching and (c) the abundance of large mammals as possible means that can reduce poaching

Figure 1: Motivational factors that influence poaching in Wildlife Reserves in Ghana (Adopted from Poudyl, 2005)
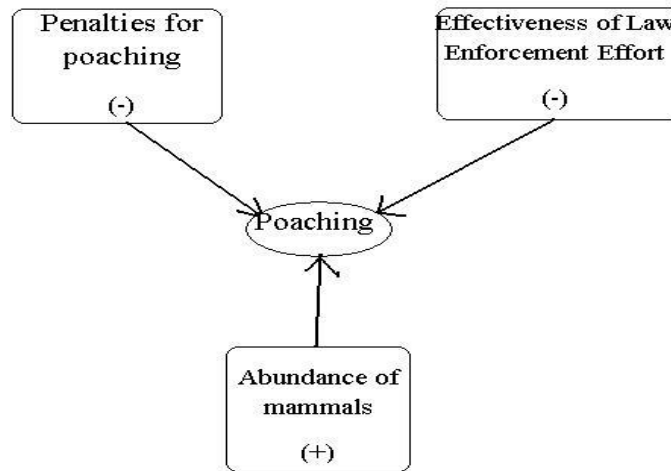
The figure 1 describes how motivational factors could influence poaching in Wildlife Reserves by fringe communities. The frame work builds on the factors that are hypothesized to influence the decision to poach by local people and possible factors that can reduce poaching levels.

2.4 Categories of illegal activities often committed by wildlife offenders in Ghana

The effective management of protected areas requires information about the many human impacts that threaten them (Hillman and Mesi, 2002). Understanding these impacts and how they vary over time and space enable managers to respond to them. Illegal activity includes any human signs that ranged from signs, such as sounds of gunshots, encounters with poachers, discovery of poacher's camps, gin traps, snares etc. Jachmann, (1998) categorized illegal activity as **Serious offences** which directly relate to illegal killing of wildlife, **Minor offences**, which may or may not be related to poaching and **Secondary offences** which relate to a poacher arrested with firearms, trophies and snares as shown in table 1 (Jachmann, 1998).

The table was constructed from information gathered during patrols used for monitoring purposes in Luangwa Integrated Resource Development Project (LIRDP). Information on Serious and Minor Offences were collected in conservation areas where human beings do not stay. Information on Serious Offence alone is collected in conservation areas where people are resident.

Secondary Serious Offences information were mainly items confiscated from arrested poachers such as firearms, trophies and snares **Encounters** in the field, includes information such as arrest and gunshots, whilst **Indicators** were information on indirect observation such as poacher's camps and snares found in the field during patrols.

Table 1: Serious, and Minor Offences used by Luangwa Integrated Resource Development Project (LIRDP) for monitoring of illegal activity in Central Luangwa Valley (adopted from Jachmann, 1998)

SERIOUS OFFENCE ENCOUNTERS	SECONDARY SERIOUS OFFENCE	MINOR OFFENCE
	Firearms Confiscated	
Arrest of Poachers		
Poachers Observed	Ivory Confiscated	
Gunshots Heard	Skins Confiscated	
	Snares Confiscated	
INDICATORS		
Poachers' Camps Found		Fishing
Elephants Found Killed		Tree Cutting
Other Animals Found Killed		Burning
		Motor Tracks
Snares Found		Foot Prints

In Kogyae Strict Nature Reserve, illegal activities recorded by patrol staff are distinguished as Serious Offences, those that directly relate to the illegal killing of wildlife and, Minor Offences, those that may or may not be related to poaching (Jachmann, 2007; Jachmann, 2006; Jachmann, 1998; Grainger, 1994; Mason, 1993).

2.5 Understanding Law Enforcement

Law enforcement is the most visible function of the Protected Area management. This single activity engages most of the staff. Between 80 and 90 percent of the department's personnel work is anti-poaching activities and enforcement (Marks, 1984). Law Enforcement Monitoring (LEM) is a standardized method to register and report what is seen and done during protected-area patrols in a protected area (Hillman and Mesi, 2002). Patrolling involve routine inspection inside the park, checking the boundaries, sometimes patrolling outside the park, and visiting local villages bordering the park. From the beginning, conservation legislation has changed most of the ancient hunter gatherer practices on the continent into illegal practices, broadly known as poaching (Jachmann, 1998). Despite modern thinking and new conservation approaches, this situation continues to exist, creating conflict of interests and value system between the conservation establishment and the public. Therefore, the continued importance of illegal activity and law enforcement in African conservation areas demands a system to monitor the quantity of illegal activity and of law enforcement on a temporal and on a spatial basis. Primarily, this allows us to continuously upgrade the system through an adaptive management process, thereby optimizing the result at the lower possible cost (Jachmann, 1998). It further allows us to provide sound scientific evidence for an informed decision on the continuation of the international ivory trade ban or otherwise (Jachmann and Billiouw, 1997).

The law enforcement unit in any protected area deals with the following several aspects of security issues: Wildlife Protection, Intelligence Gathering, Investigation, Prosecution and Convictions (Wildlife Division, 2009). This involves the regulation of human activity in relation to wildlife and other resources in the best interest of society. In the early 1980s, a study on wildlife related offences was carried out in Luangwa Valley, Zambia (Leader-Williams, 1990).

The main objectives of the above study were to determine whether minimum sentences laid down in law were being upheld, and if commercial elephant and rhino poaching was being differentiated from other types of illegal activity (Leader-Williams, 1996). An analysis of prosecutions in the central Luangwa Valley revealed that the level of deterrence of law-enforcement is a function of both the probability of arrest by scouts and the penalty expected for the offence (Boshe, 1989; Campbell, 1989). From analysis of sentences given to wildlife offenders Leader-Williams et al., (1990) determined the extent to which Zambia upheld its own wildlife laws. The results of the analysis showed that anti-poaching efforts were not helped by magistrates (courts) who misinterpreted the intentions of their country's own wildlife laws

(Leader-Williams, 1990; Bell, 1986b).

In Ghana, the level of deterrence, however, is a function of both the probability of arrest by wildlife police officers (scouts) and the penalty expected for any offence. Thus, a properly planned and executed law-enforcement program may not reach the required level of deterrence, if not supported by a sound penalty structure, where by minimum sentences laid down in the law are being upheld in court (Jachmann, 1998). The Wild Animals Preservation Act of 1961 (Act 43), section 8, empowers Wildlife Officers to arrest without warrant, any person suspected to be concerned with any offence punishable under the provisions of the Act. Wildlife Officers are therefore by law enabled to effect arrest of people suspected of any wildlife offences (Wildlife Division, 2009).

In Kogyae Strict Nature Reserve, arrested poachers suspected to have contravened the wildlife laws and regulations are investigated and prosecuted in a law court of competent jurisdiction with the field staff acting as witnesses. Kogyae Strict Nature Reserve falls within Ejura, Atebubu and Mampong court of jurisdictions. This means that offenders arrested in the park must appear in court in the district where they were arrested. Most often it is not the case because of difficulty in relating the locus of arrest to the district of jurisdiction.

2.6 Law Enforcement Requirements

A law-enforcement program requires manpower and financial inputs, the first in terms of a scout force to carry out conventional patrols and investigative activities, and the second support the scout force with personal emoluments (i.e. salaries, allowances and bonuses), transport and other support facilities. This is expected to result in encounters with illegal activity, frequently yielding outputs in terms of arrests and recovery of firearms and trophies, consequently leading to a level of deterrence against wildlife offences (Jachmann, 1998).

2.6.1 Manpower Requirements

A wildlife management unit should consist of an officer in charge of the entire unit (warden), several officers in charge of the various sections that come under the unit (rangers), such as anti-poaching, utilization, tourism etc., and several scouts and assistants (carriers) to carry out patrol activities (Jachmann, 1998). In addition to the field staff and depending upon the size of the area covered and the number of scouts deployed in the field, a small section with at least one wildlife ecologist and two data analyzing patrol reports and providing feedback to the field staff monthly.

Depending upon the total numbers of staff in the unit, administrative support should be provided by a small team consisting of an administrator, an accountant, a personal officer, a

secretary and several office clerks. For the larger, more self-contained areas, a small workshop with at least two mechanics should provide vehicle maintenance support (Jachmann, 1998).

2.6.2 Training Requirements and Financial Requirements

The warden should have a college or university degree from a school or college specialized in wildlife management (Jachmann, 1998). The rangers in charge of the various sections should all have a college diploma or degree specialized in wildlife management.

The wildlife police officers should be trained at a local institution and should have a certain level of proficiency in the identification of wildlife and plants, general behavior of the most important animal species, seasonal distribution of key-species, basic principles of counting wildlife, objectives and principles of law-enforcement, local wildlife laws, patrolling techniques, firearm safety, navigation with a compass and a map, and patrol report writing. Scouts involved investigations should be trained in investigative techniques at a local institution (Jachmann, 1998).

Financial requirements for a law-enforcement program should include staff salaries, patrol allowances, subsistence allowances, bonus payments upon positive returns in terms of arrest and recovery of firearms and trophies, a budget to purchase and maintain transport facilities, a budget to construct and maintain staff quarters, and a budget to purchase patrol equipment such as boots, tents, rucksacks, torches, firearms, compasses, binoculars, maps, stationery and other minor items (Jachmann,1998).

2.7 Trends in illegal activities in relation to patrol effort and abundance of large mammals in Kogyae Strict Nature Reserve.

Poaching in protected areas leads to decline in animal numbers, to avert this situation staff in Protected Area routinely patrol the area to enforce the wildlife laws and to deter offenders. The fundamental activity for patrols in any law enforcement monitoring system is the standardized collection of indicators of illegal activity and law enforcement, such as the discovery of poachers' camps or encounters with the poachers themselves. However, such information is relatively useless without some measure of the patrol effort required to collect these data. Patrol effort must therefore be the cornerstone of any law enforcement monitoring system (Hillman and Mesi, 2002).

It is a general perception that poachers change their behavior and decision to evade the probability of being detected and arrested. The probability of detection to a considerable extent depends on the level and effectiveness of the patrol effort put in by the anti-poaching

unit. Several studies have considered the effect of the level of enforcement of the poaching of wildlife, most notably in African context (Jachmann, 1997; Milner-Gulland, 1993; Milner Gulland, 1992; Leader-Williams et al., 1990). Leader-Williams et al., (1990) in the study of poaching of black rhino and elephant in the Luangwa Valley (Zambia) found that an increase patrol effort reduced illegal activities within the protected area, which in turn reduced the decline in rhino and elephant populations. A more recent study of monitoring law enforcement, illegal activities, patrol effort, staff performance and wildlife trends in nine protected areas in Ghana which includes Kogyae Strict Nature Reserve looked at the law enforcement effort with regards to encounters with illegal activities and mammal encounters, resource allocation to enforcement budget etc. The study concluded that the success in reducing encounters with illegal activities is due to increased level of enforcement (i.e. manpower and budget) and due to effectiveness in enforcement (Jachmann, 2008; Jachmann, 2006; Jachmann, 2004). That is increase in patrol effort reduces encounters with illegal activity with a corresponding increase in wildlife numbers.

2.8 Definition of Terminologies

Effective patrol day is defined as the actual number of days spent on the field patrolling in a month. The effective patrol day in our context that is in Ghana is set at 8hours per day.

Effective patrol man-days (EPMD) are also defined as the actual time spent on patrols in the field by a patrol group and does not include the time spent on preparation or placements. In Ghana, the duration of an effective patrol day is set at 8hrs. Thus, for each patrol, independent of its duration, the number of patrol hrs. is divided by 8 and multiplied by the patrol size to give effective patrol man-days. That is mathematically expressed as (duration of patrol (hrs.)/8) × patrol size (Jachmann, 2008a).

Patrol efforts consist of all activities that go into a patrol by a patrol team that is; it depends on the number of staff who are on active duty in a month/staff performance in effective days/month/staff results in a specific patrol effort that is the number of effective patrol man-days / month. Thus, the patrol effort depends on the performance and on the members of active staff.

Patrol time on the other hand may be defined as the time spent moving between base and the location where the patrol starts or finishes, preparations, that is obtaining rations, firearms and ammunition, and effective patrol time, that is time spent actively in pursuit of illegal activity (Jachmann, 2008b).

Patrol kilometer is also defined as the length of distance travelled by a patrol team in performing their routine patrol duties.

Staff per patrol may also be defined as the number of individual members making up a patrol team.

Day patrol effective is also defined as the actual time spent patrolling in the field during the day. On the other hand, **night patrol,** effective is also defined as the actual time spent patrolling in the field during the night. Whereas **long patrol effective** is the actual time spent patrolling in the field for more than one day (Jachmann, 1998).

CHAPTER THREE

3. MATERIALS AND METHODS

3.1 Study Area

The Kogyae Strict Nature Reserve lies in the transition zone between the Guinea Savannah and forest zones of Ghana, and covers an area of approximately 386 km^2. Kogyae is shared by the Kwamang and Kumawu traditional areas in Sekyere West and East districts of the Ashanti Region respectively. Before the establishment of Kogyae as a protected area, the core zone within the reserve served as a cultural heritage site for the two traditional areas, in recognition of its role as meeting grounds for militants from both areas to recruit, join forces and repel invading enemies.

In 1952, the colonial Gold Coast government designated the site as the Kujani Bush Forest Reserve under the administration of the Forestry Department. In 1971, the reserve was designated as a Strict Nature Reserve under the Wildlife Reservation Regulations L.I. 710 of 1971 under the then Game and Wildlife Department (Ofori et al., 2014). For the Strict Nature Reserve to maintain a viable ecological unit, the original forest reserve was extended southwards to include the sites of six communities (Figure 3) after some consultations with the traditional heads. The extension included also the Afram River, which flows along the southern portion of the reserve, to ensure constant water supply to wild animals (Wildlife Division, 2002). The six communities within the extended boundaries were Asasebonso, Atakpame, Nyamebekyere (Dagomba), Yahayakura, Aberewanko and Asasebonso (Konkomba). In addition to these six, four other communities, namely Aframso, Birem, Chichibon and Kyeiase are now located along the immediate fringes of the reserve because of the extension. These communities have continued to agitate and protest the extended area from the time of its implementation (Wildlife Division, 2002).

Kogyae is in the Afram Plains physiological region of Ghana, and is underlain by the Voltarian geological system. The site is generally low-lying with average heights of about 120m above mean sea level. A few areas within the reserve have higher elevation, attaining heights of between 215m and 230m. These areas serve as the watershed for a network of streams dominated by tributaries of the Afram and Sene rivers, most of which dry up in the dry season (Hagan, 1998). The climate of the area exhibits characteristics of the forest-savannah transition zone. The flora is reported to include about 105 vascular plant species comprising 57 trees, 10 shrubs, nine climbers, 17 herbs and 12 grasses. The main habitat types are transitional forest,

riparian woodland; Guinea savannah and vegetation with open areas of short grassland (Figure 2) found in areas with shallow soils and iron pans (Wildlife Department, 1994).

Figure 2: Guinea savanna woodland of Kogyae Strict Nature Reserve

According to the records held by the Wildlife Division, the reserve used to support a small population of Elephants (*Loxodonta africana*), which migrated seasonally from Digya National Park but have stopped in recent times. Mammalian species of conservation importance reported to occur in the reserve include the Burron's Kob (*Kobus kob*), Bushbuck (*Tragelaphus scriptus*), Waterbuck (*Kobus ellipsiprymnus*), Maxwell Duiker (*Cephalophus maxwelli*) and Grey Duiker (*Sylvicapra grimmia*). The reserve is reported to support also many primate species including Spot-nosed Monkey (*Cercopithecus petaurista*), Black and White Colobus (*Colobus polykomos*), the Olive Baboon (*Papio anubis*) and Patas Monkey (*Erythrocebus patas*), as well as uncommon species such as the Aardvark (*Orycteropus afer*) and Red River Hog (*Potamochoerus porcus*) (Wildlife Department, 1994).

The KSNR is managed by a Senior Wildlife Officer, frequently assisted by one or more Assistant Wildlife Officers, often with a Protection Officer in charge of law enforcement. Wildlife Rangers make up the hierarchical level below this. They oversee a defined area (range) that is patrol beats and several camps from where patrols emanate. Wildlife Rangers may be stationed in a camp within their range, or they are posted at the protected area's headquarters,

while they make regular visits to the camps that come under their supervision. Patrol staff are of varying ranks, with the most senior patrol staff acting as camp leaders and patrol leaders. Generally, one striking force of patrol staff operates from headquarters and several other teams operate from camps throughout the protected area (Jachmann, 2008a).

Figure 3: shows the map of Kogyae Strict Nature Reserve.

Figure 3: Map of Kogyae Strict Nature Reserve
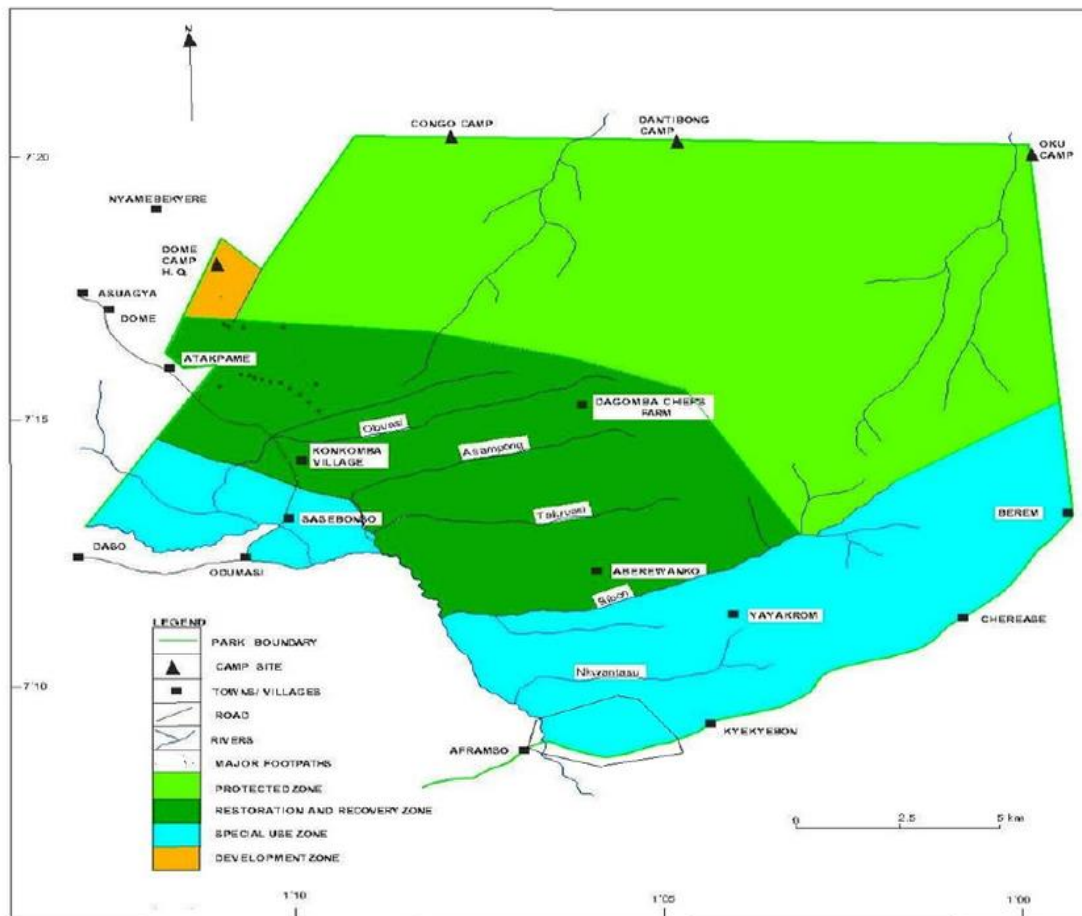
For effective management, KSNR has been zoned into four major land-uses namely the Protected Areas (PA), Special-Use Zone (SUZ), Restoration Zone (RZ) and Development Zone (DZ). The PA is the largest land-use in the KSNR. It constitutes 220km^2, and represents 57 percent of the KSNR. This area of the reserve represents the most important and least disturbed habitats of the KSNR. The SUZ constitutes 98km^2 and represents 20 percent of the KSNR. The SUZ is a land-use practice that is not compatible with conservation activities but has been forced on management as a compromise with the local communities to resolve certain conflicts because of the boundary extension. Other land-uses of the KSNR are the DZ and the RZ

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constituting 1 km and 86 km representing 1 percent and 22 percent respectively.

3.2 Data Collection

A one-day reconnaissance survey (recce) was conducted by going to the various camps around the KSNR. Interviews were conducted to obtain information from some camp leaders and other staff in the various camps. Special discussions were held with management staff that are heads of units, and senior officials in protected area. They gave an overview of the challenges wildlife law enforcement faces with emphasis on their effects on the overall objective of their organization. In all there are seven (7) camps around the Nature Reserve with the Dome camp being the base camp. The other camps are Congo, Dante Bong, Oku, Berem, Kyease and Aframso.

The Kogyae Strict Nature Reserve use conventional law enforcement in the form of foot patrols that start from each of the camps as well as from the area's headquarters. Patrol routes can be viewed as transects with unfixed width used to collect information on indicators of illegal wildlife use and animal observations.

Data was collected from standardized patrol forms that are used to keep records of the number of staff on patrol, the time spent, the distance patrolled, types, quantities and locations of illegal activities encountered, and the number of large-mammals encountered by species and location.

Jachmann, (2008) made assumptions that the relationship between the law enforcement patrol effort and encounters with illegal and wildlife data were reliable and being true accounts of the patrol activities. Jachmann, (2008) contended that patrol data faces the problem of omission attributed to high vegetation density and rainfall in the wet season that may limit visibility and accessibility to certain areas of the park by patrolled teams. The inability for patrols to cover the entire park within certain period of the year resulted in omission in no or low encounters with wildlife and illegal activities. Because of these officers have been trained to randomize patrol movements as much as practically feasible, both to optimize impact of law enforcement, and to enable statistical inference from monitoring data.

3.3 Materials

The researcher occasionally accompanied the ranger patrol team to the field to get firsthand information and cross check the accuracy of data provided in the standardized patrol forms. Materials used were

Field guide books for identification of wildlife (large mammals).

• Binoculars for easy identification of wildlife (large mammals).

• Note books, pens and sheets for recording data.

3.4 Data Analysis

The analyzed variables include number of illegal activities (serious offences), number of animals, patrol km, number of staff and Effective Patrol Man Days (EPMD), month, year. The dependent variable was the number of serious offences because its decrease and increase in number depend on the number of staff and Patrol km.

Mixed effect model was used as the statistical model in the analysis of the data using R software version 3.3.2. Number of serious offences can be affected by year and month, but these variables are not of primary concern and because they are in fact repeated measurements, they are included only as random variables. The fixed effects variables are the number of staff, patrol km, EPMD and number of animals observed. These are the variables that are of primary concern for this study to know their effect on one another.

Bar charts were used to display the categories of serious offences and the different species of mammals observed. Separate charts were constructed for large sized ungulates, small sized ungulates and primates. All the charts were constructed using Microsoft excel 2016.

CHAPTER FOUR

4. RESULTS

The distance travelled by the patrol team (Patrol km) (χ^2= 13.25, p<0.0003) and the number of staff (χ^2= 5.23, p< 0.02) had a significant effect on the number of serious offences. Effective Patrol Man Days (EPMD) had a slightly insignificant effect (χ^2=3.25, p< 0.07) on serious offences with the number animals being the weakest and insignificant (χ^2=1.75, p< 0.19). However, correlation coefficient (R) used shows a slight relationship between number of animals and Patrol km.

4.1 Types of illegal activities (Serious Offences) encountered in the Kogyae Strict Nature Reserve

Figure 4 shows the types of illegal activities that have occurred in the Kogyae Strict Nature Reserve over the past eight (8) years and indicates their trends. In all eight (8) types of illegal activities occurs with snares being the highest followed by gunshots heard. Number of poachers arrested recorded the least number of occurrences.

Among the years, 2010 recorded the highest occurrences of illegal activities with a value of (607) followed by 2011 with 438 occurrences. However, 2008 recorded the least number of occurrences of illegal activities among the years with 191 (occurrences).

Figure 4: Types of illegal activities in Kogyae Strict Nature Reserve from 2006-2014
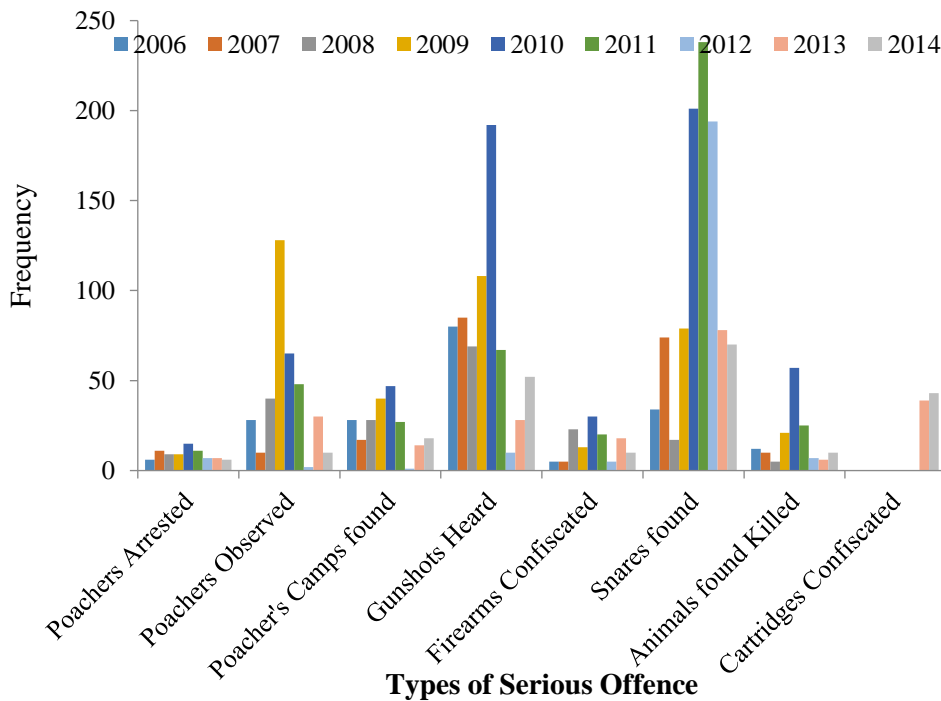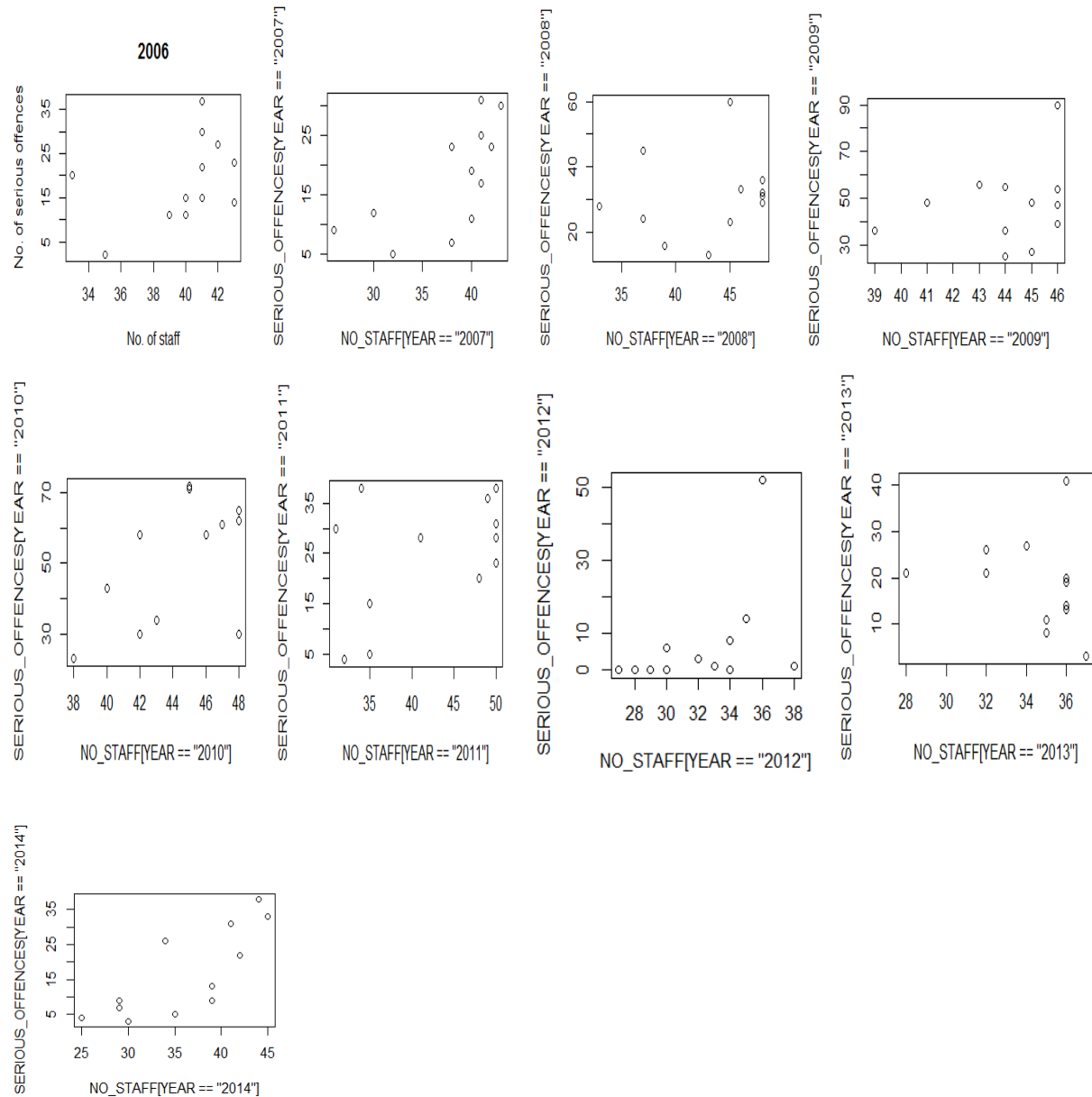
4.2 Comparison of illegal activities and Number of Staff from 2006-2014

The trend of number of staff on patrol during the study period revealed that 2010 had the highest (n=532, Fig 5) and 2012 showed the lowest number of staff on patrol (n=386). The number of staff on patrol had significant influence on the number of illegal activities encountered.

Figure 4.2 shows the relationship between number of staff on a patrol and illegal activities encountered in Kogyae Strict Nature Reserve.

Figure 5: Number of Staff and illegal Activities in Kogyae Strict Nature Reserve from 2006-2014

4.2.1 Comparison of illegal activities and number of staff in months

Figure 5 shows that the month of February had the highest number of staff on patrol in all the years (n=392), followed by May (n=386) and June (n=375). October (n=123) recorded the least number of offences followed by November (n=134), September (n=169) and December (n=182). July (n=308) recorded the highest number of offences followed by February (n=295). The number of staff for November was the lowest in all the years (n=304) followed by October (n=317), August (n=330) and September (n=338).

Figure 5 shows the relationship between illegal activities and number of staff in all the months from 2006 -2014

Figure 6: Relationship between number of staff and illegal activities in the months of 2006-2014
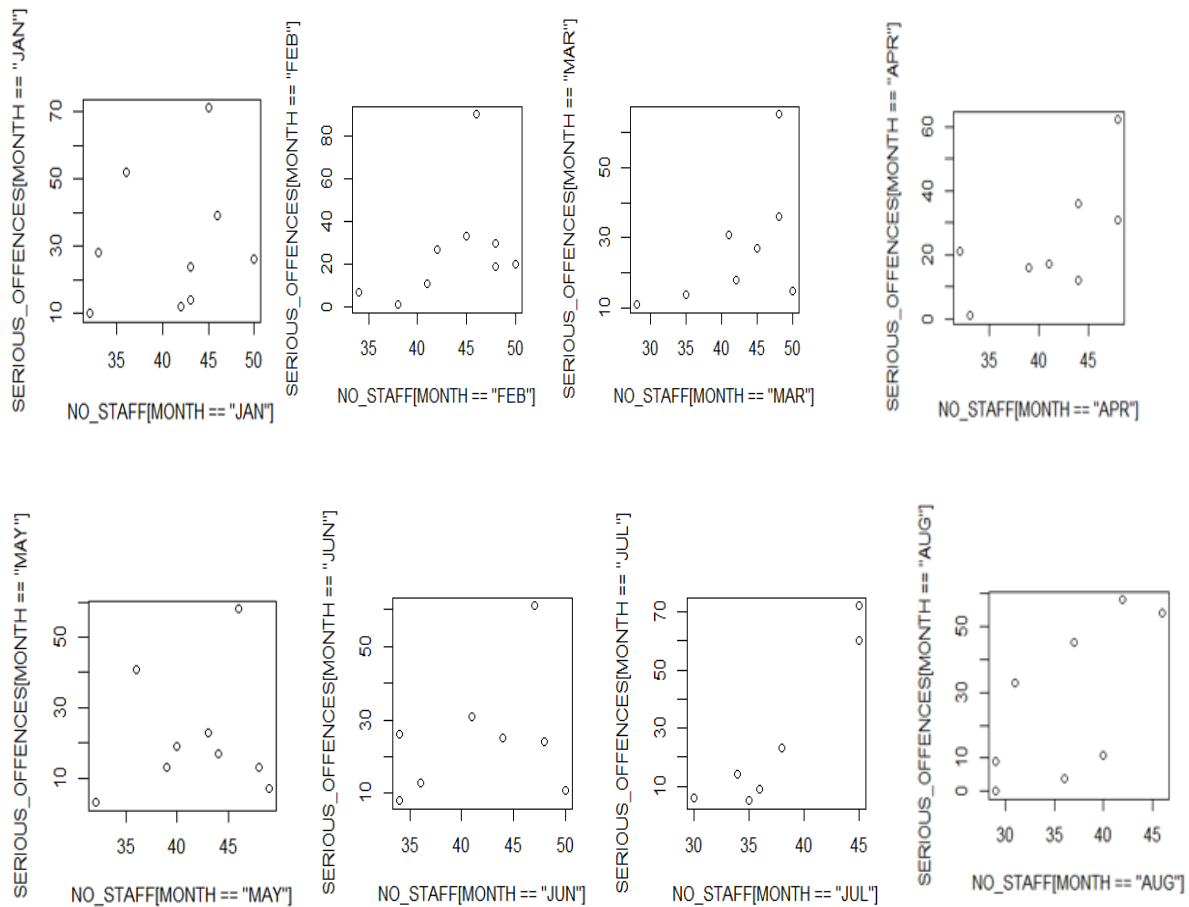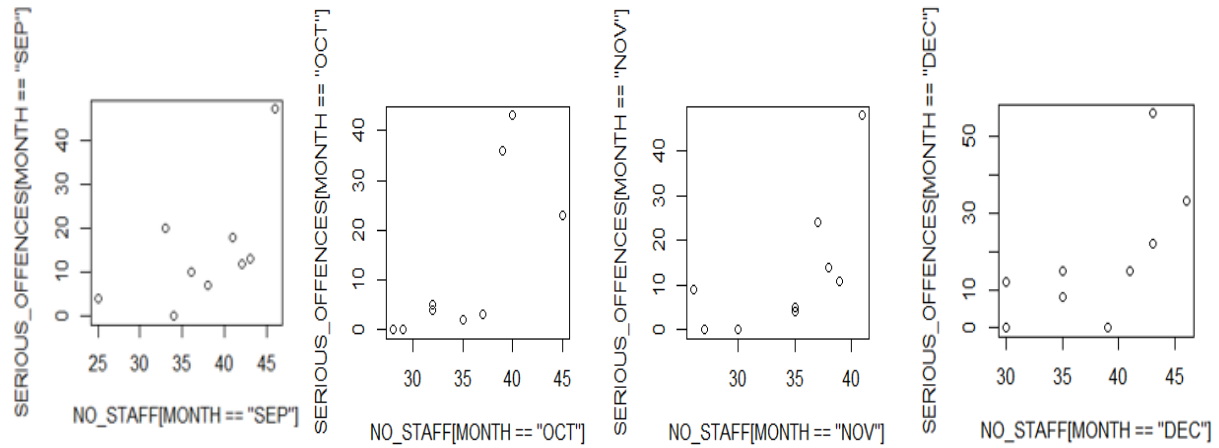
4.3 Relationship between illegal activities and Patrol kilometers (km)

There was a significant relationship between Patrol km and the number of illegal activities. In most of the years, the farther and longer the team patrols the higher the chance of encountering an illegal activity as shown in figure 6.

Figure 6 shows the relationship between illegal activities encountered and the distance the patrol team travelled (Patrol km) from 2006-2014.

Figure 7: Relationship between illegal activities encountered and Patrol km.
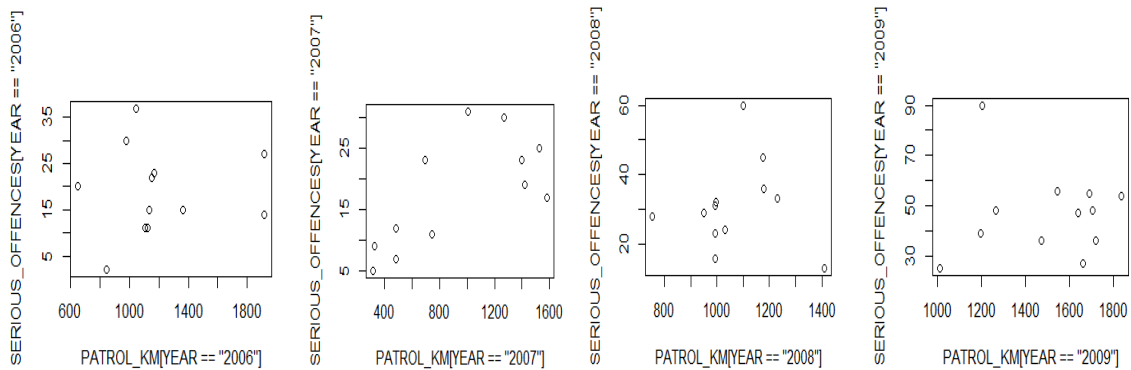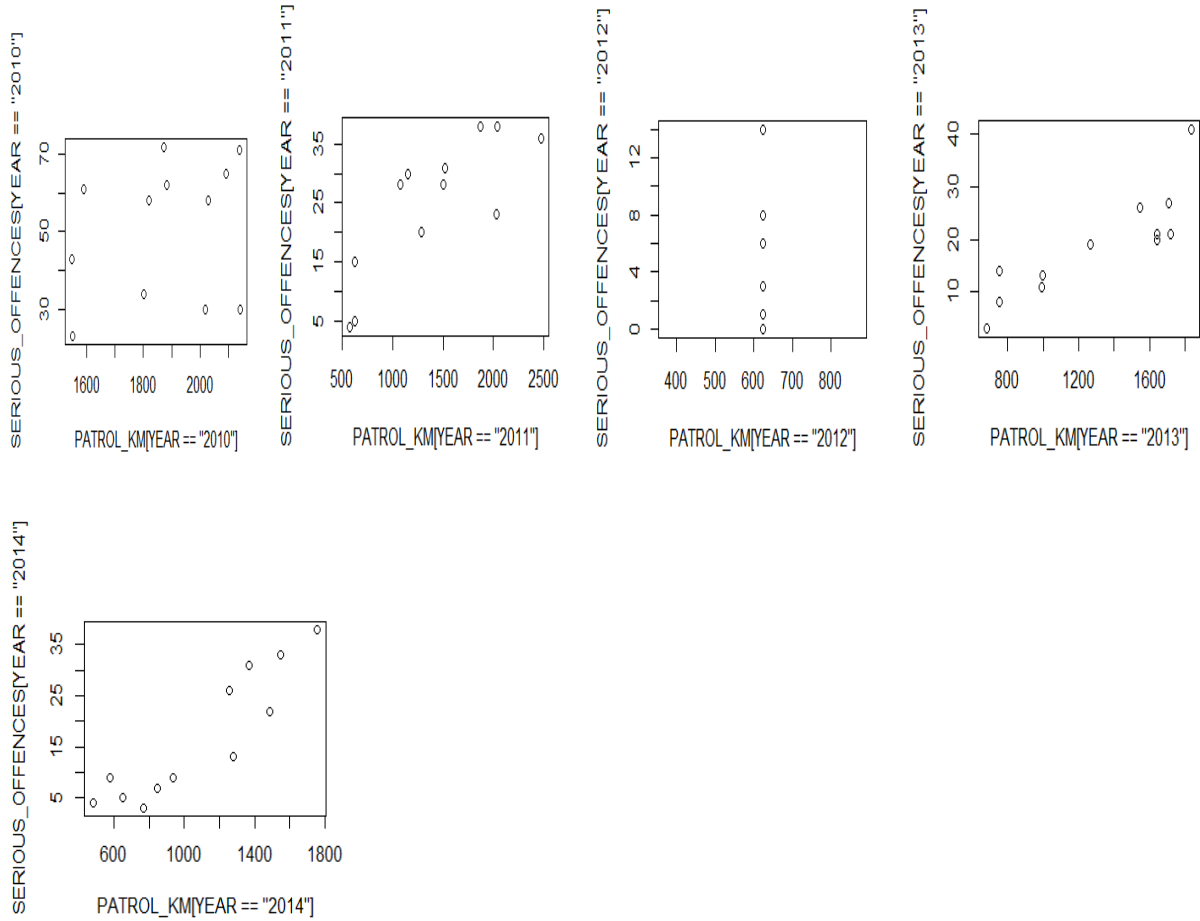
In 2010, the patrol team travelled 22,488 km which was the highest followed by 17,962 km in 2009 and 16770km in 2011 whereas in 2012 the patrol team travelled the least (7476 km). The highest number of illegal activities was encountered in 2010 (n=532) and the least was in 2008 (n=

4.4 Trends in animal observation in Kogyae Strict Nature Reserve from 2006 -2014

Figure 8 shows the diverse kinds of small ungulates that were observed from 2006 to 2014.

Figure 8: Small Ungulates observed from 2006-2014
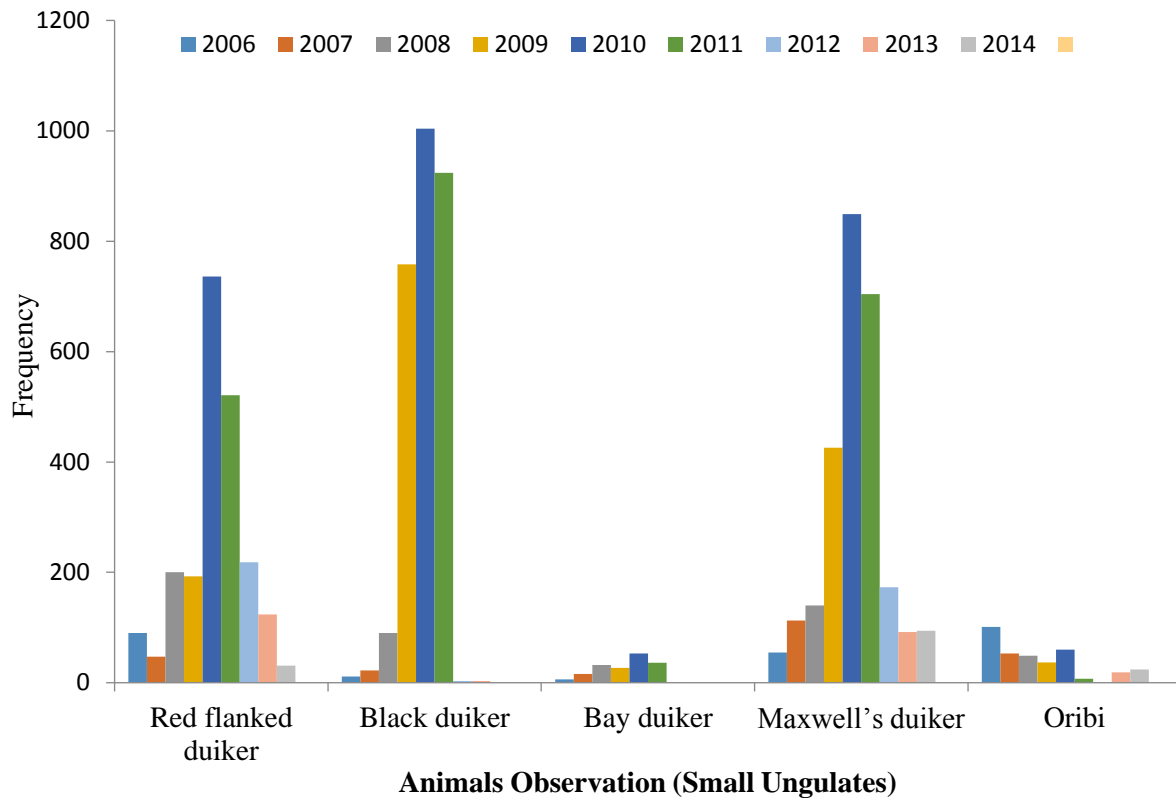
Black duikers *(Cephalophus niger)* were the most observed small ungulates (n=2815). Followed by Maxwell duiker *(Philantomba maxwellii)* (n=2646) and Red Flanked Duiker *(Cephalophus rufilatus)* (n=2160). Oribi *(Ourebia ourebi)* (n=350) and Bay duiker (*Cephalophus dorsalis)* (n=171) were the least observed.

Figure 8 shows the diverse kinds of large ungulates that have been observed in the Kogyae Strict Nature Reserve (KSNR) over the eight-year period (2006-2014).

Figure 9: Large Ungulates observed from 2006-2014
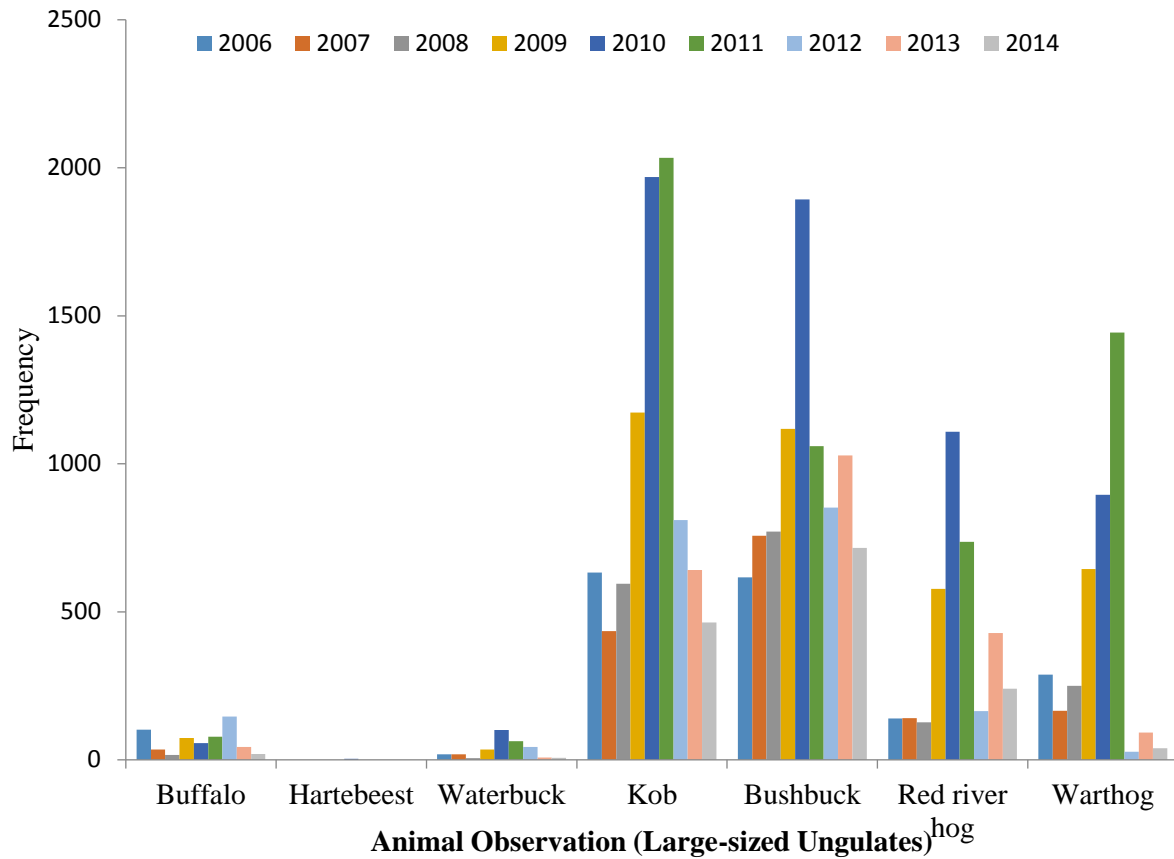
Bushbucks *(Tragelaphus scriptus)* were the most observed large ungulates (n=8811). Followed by Kobs *(Kobus kob)* (n=8754), Warthogs *(Phacochoerus africanus)* with (n=3845) and Red River Hogs *(Potamochoerus porcus)* (n=3662). Buffaloes *(Syncerus caffer)*, Waterbucks *(Kobus ellipsiprymnus*) and Hartebeest *(Alcelaphusn buselaphus)* on the other hand were least encountered with less than 600 individuals.

Fig. 9 shows the types of Primates that have been observed over the eight-year period (2006-2014) in the Kogyae Strict Nature Reserve (KSNR)

Figure 10: Primates observed in Kogyae Strict Nature Reserve
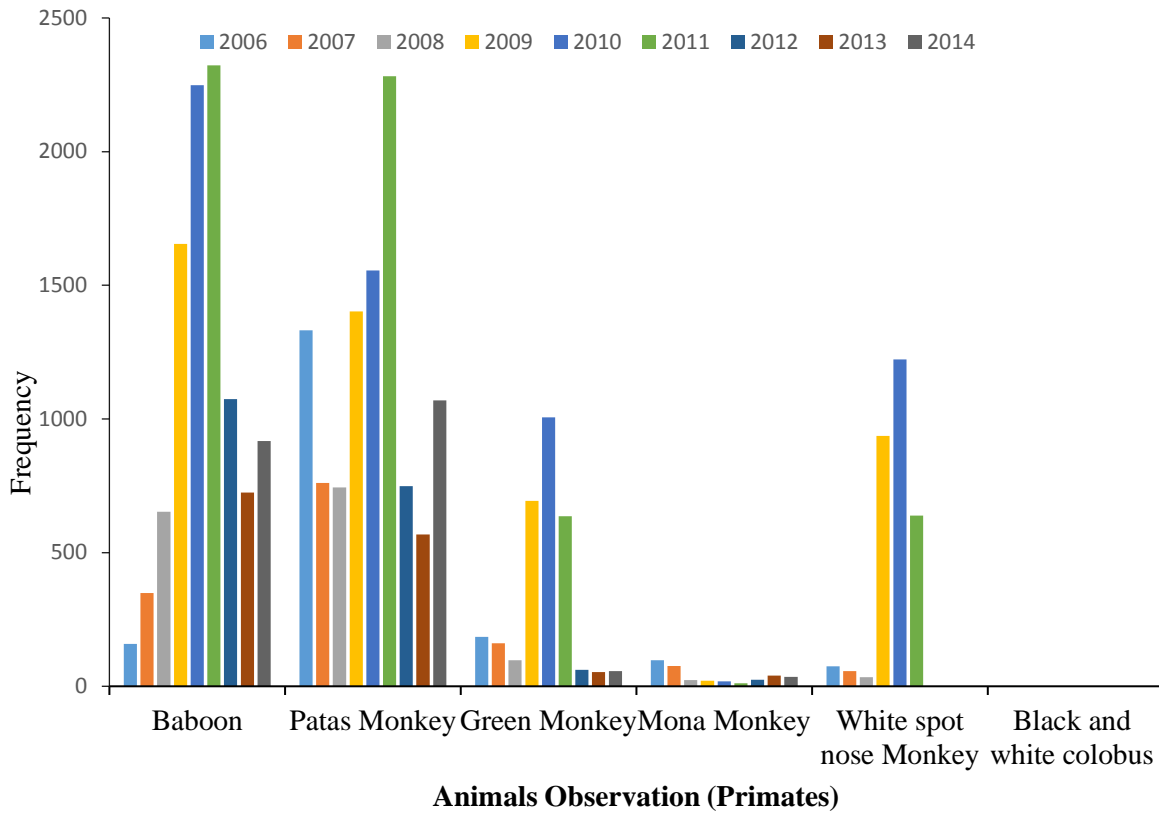
Patas monkeys (*Erythrocebus patas*) were the most observed primates (n=10463), followed by Baboons *(Papio anubis)* (n=10105), White Spot Nose Monkey (*Cercopithecus petaurista)* (n=2963), Green Monkey *(Chlorocebuss abaeus)* (n=2949). Black and White Colobus (*Colobus vellerosus)* was the least observed with only one (1) individual during the eight-year period.

4.5 Correlation of Number of Animals, Illegal Activities, Number of Staff and Patrol kilometers

Table 2: Correlation coefficient (R) of Data variables

	Number of Illegal Activities	Number of Animals
Number of Illegal Activities	-	0.51
Number of Animals	0.51	-
Number of Staff	0.63	0.47
Patrol kilometers	0.66	0.58

The correlation coefficient indicates that number of animals had a slight relationship with Patrol

km and illegal activities respectively (R=0.58; R=0.51). However, number of staff had the weakest relationship with the number of animals (R= 0.47) as shown in figure.

Figure 11: Correlation of Number of animals, Number of Staff, Serious Offences and Patrol km
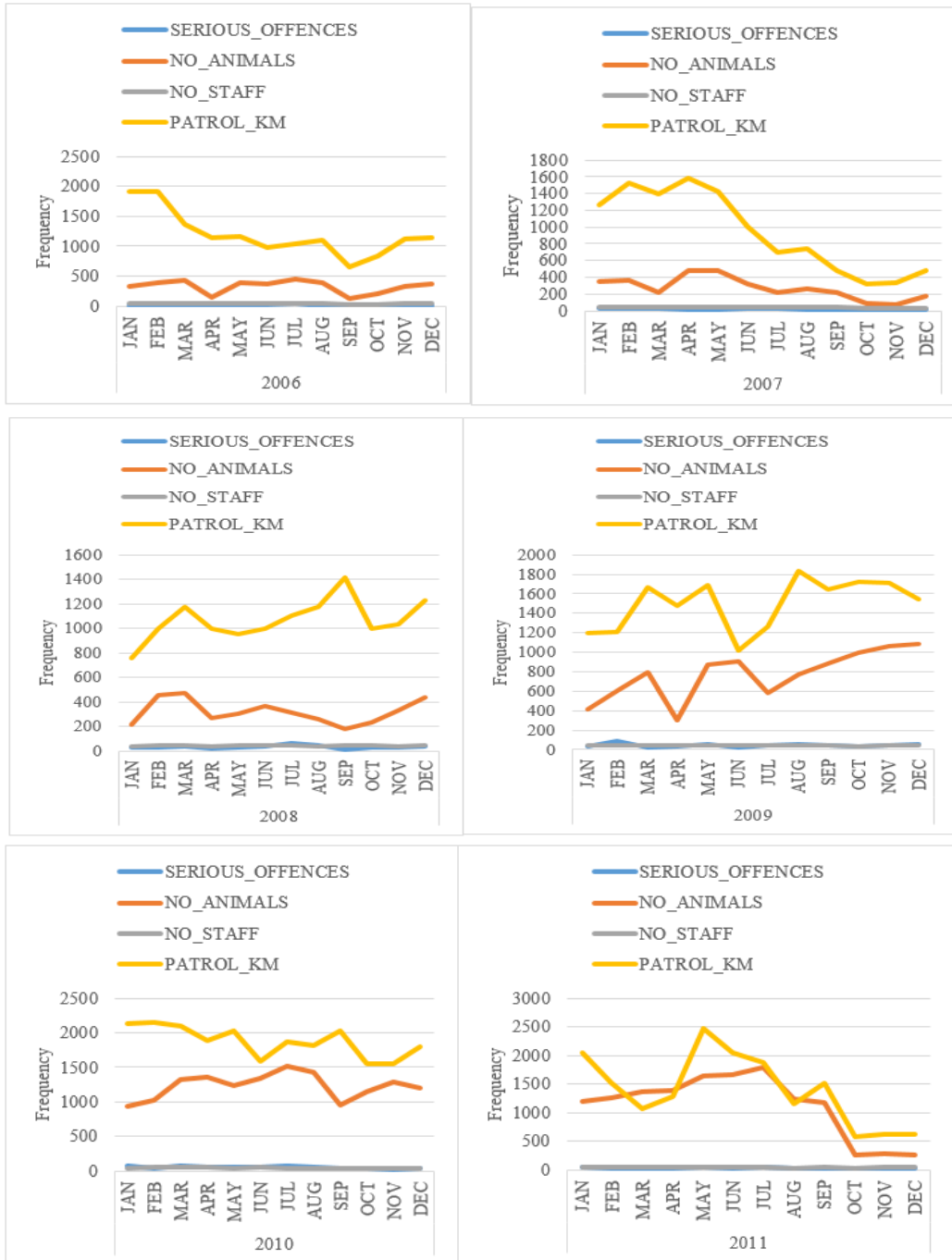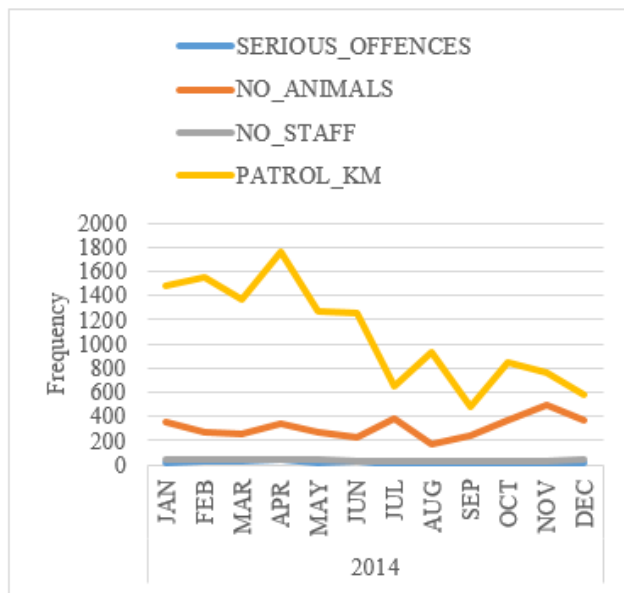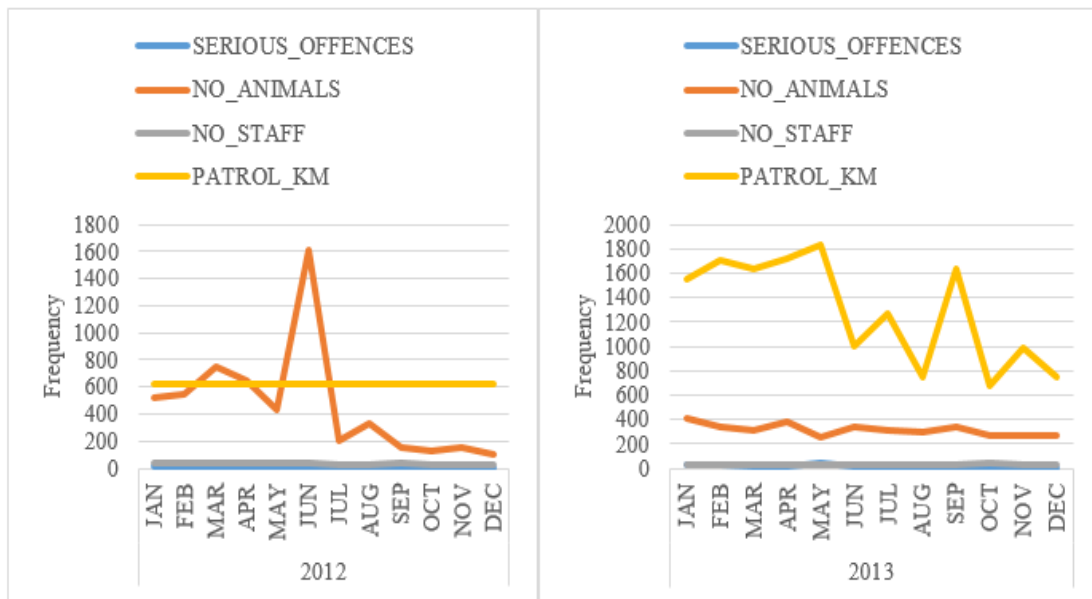
CHAPTER FIVE

5. DISCUSSION

5.1 Illegal activities (serious offences) encountered in the Kogyae Strict Nature Reserve from 2006-2014

Jachmann (1998) classified serious offence or serious illegal activities as poacher's arrest, poachers camp found, poachers observed, animals found killed, snares found, firearms confiscated, gunshots heard, ivory confiscated, snares confiscated and skins confiscated. From the results obtained from the study eight (8) different types of serious offence or illegal activities were observed (Fig 4). These are poachers arrested, poachers observed, poacher's camp found, gunshots heard, snares found, firearms confiscated, animal found dead and cartridges found.

Snares represented the highest among the serious offences encountered (Fig 4). This indicates most people hunted with snares in the Kogyae Strict Nature Reserve (KSNR) as compared to guns. Snares are mostly used to capture small sized ungulates in the KSNR. Mostly, species such as the Maxwell duikers and the red flanked duikers are targeted. However non-targeted species such as some of the large size ungulates also fall victim to these snares. These larger ungulates sometimes escape from these snares thereby injuring themselves. Such injuries on the other hand may be severe and as such causes the deaths to some of these larger ungulates. Since snares are set in hidden and different areas in the reserve, their control and identification becomes very difficult. Again, in the KSNR the use of snares is adopted by poachers mostly in the rainy seasons because of their nature, so many snares can be set even close to the camps without any notification that is naturally identifying them becomes difficult. The high numbers of snares found contradicts with Aalangdon (2005) who revealed that hunters in Ghana use distinct types of weapons and about 90% of them use shot gun for hunting in recent times. However, hunting with guns becomes easily identified because of the loud sound they make when fired. This makes it easy for patrol teams to locate areas where gunshots are heard more than areas were snares are put. In short snares are more difficult to locate than gunshots there by making it difficult to control.

Poachers observed in the KSNR were higher as compared to poachers arrested. This may be attributed to the fact that poachers may be observed at far distances and therefore they run away upon observing signs of the patrol teams. Again, poachers may be observed and run away because of less number of the staff on patrol or less logistics used in their capturing. Cartridges found were

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included in the category of offences from 2013. This is because in the Strict Nature Reserve, no form of hunting is allowed hence cartridges are classified as an illegal activity.

5.2 Comparison of illegal activities and Number of Staff from 2006-2014

Numbers of staff/month/year have a major influence on illegal activities (Fig 5, 6). Figure 5, 6 indicate that as the number of staff per patrol increases in the Kogyae Strict Nature Reserve (KSNR) more illegal activities are encountered. There is more efficiency due to better division of task with more team members for patrol activities. Therefore, there are more eyes to do patrolling and sightings of illegal activities and encounter rate with animals. Again, team members do not get easily tired or bored with many tasks such as the reading of the GPS, recording and guarding. Most of the years and months which recorded less illegal activities had a decrease in number in terms of staff per patrol.

The number of illegal activities reduced in the months of August to December as compared to other months throughout the years. This was generally because from 1st August to 1st December hunting or capture of any wild animal is strictly prohibited in Ghana. Most of the animals are in their breeding season and killing them now will pose great danger to their survival. Even though hunting is prohibited in KSNR most hunters fear the severe punishment they will receive if arrested during this period.

5.3 Relationship between illegal activities and Patrol kilometers (km)

Relating illegal activity to patrol effort is only valid when patrol reports are liable accounts of observations and of the activities of the field staff, and when there exists a constant relationship between the actual quantities of illegal activity and the rate of encounter per unit effort (Jachmann, 1998). Again, quantification of law-enforcement efforts starts with the categorization of the activities of the field staff according to the likelihood of encountering illegal activity, with off-duty time lowest, stand-by time and non-patrol activities intermediate, and patrol time highest (Bell, 1983; 1985a).

Patrol/km also has a major influence on the encountering of illegal activities or serious offences (Fig 7). As more grounds are covered, most areas in the reserve are patrolled. Hence all remote areas where more animals and illegal activities used to occur and were not previously patrolled are covered. That is the more the distance patrolled the higher the possibility of encountering illegal activities in the reserve. Poachers in KSNR avoided areas in the Park that were heavily

patrolled and seek areas with large concentration of animals. After the introduction of the Adaptive Management Approach in 2006, Patrol km varied in level relative to encounters with illegal activity. Hence it is not surprising that encounters with illegal activities change consistently leading to reduction of illegal activities to an acceptable with corresponding increase or stability in wildlife numbers.

5.4 Trends in Animal observation

The year 2010 (n= 14,779) recorded the highest number of animal sightings in the Kogyae Strict Nature Reserve followed by 2011 (n=13,496), then 2009 (n=9,770) whilst 2012 and 2006 follow in that order. 2007 recorded the lowest number of animals (n=3,208). The animal abundance in 2010 was very high than all the years and can be attributed to wider ground coverage by patrol staff (22,488 km in 2010) and again due to proper management practices. The highest number of illegal activities was also encountered in 2010 which confirms that poachers seek areas with large animal concentration.

Amongst the years, primates recorded the highest number of animal sightings, followed by smaller ungulates and then larger ungulates. This trend may be associated to the reasons that most poachers in the KSNR do not target primates but rather the ungulates. Also, larger ungulates were encountered more than the smaller ungulates. Among the two groups of ungulates, a line may be drawn between them. That is, most poachers seem to target the smaller ungulates as compared to the larger ungulates. This may be explained that most of the poachers are subsistence hunters with few being commercial hunters, where these subsistence hunters often target smaller animals than larger animals and may be using snares. This may confirm (Jachmann, 1998) assertion that subsistence hunters often involve many members of communities near the wildlife reserves, and this help them to improve their standard of living. It also confirms why snares were found to be the highest among the serious offences encountered since snares are mostly used to capture small ungulates.

Even though the number of serious offences had a minimal influence on the number of animal observations (χ^2=1.75, p< 0.19), there was decline in animal numbers from 2012. There has been sharp decline in the number of certain species such as waterbuck (n=810, 2012; n=641, 2013; n=464, 2014), White spot nose monkey (n=638, 2011; n=0, 2012; n=0, 2013; n=0, 2014). There was only one observation made on Maxwell duiker since 2012 with 3 each in 2012 and 2013 for

Black duiker. Only one observation of Black and white colobus was made which was in 2006. None has been seen since then. Reasons for the decline are not well known but can be attributed to destruction of their habitat. The Kogyae Strict Nature Reserve is surrounded by a large human population who depend on Agricultural production for their livelihoods. These agricultural activities include crop farming, livestock farming, hunting, lumbering and fishing.

5.5 Factors affecting Patrol effort

Field staff patrol the protected areas to enforce wildlife laws and to deter offenders. Arresting of poachers and putting them before the law court is a deterrence measure to ward off potential offenders of the wildlife laws. Patrol effort has a considerable effect upon the distribution of illegal activity and mammals (Leader-Williams 1990; Leader-Williams. 1996)

Generally, staff densities in the park were too low to cover the entire park in each month and as such the assumption of temporal and spatial consistency in patrol coverage was thereby violated. In a survey of manpower relative to overall size of protected areas in different African countries in 1980, staff: area ratios varied from one man per 580 km^2 to one per 7 km^2(Boshe 1989; Campbell, 1987; Bell, 1985; Bell 1983). At the time of the study staffing level in the KSNR was one patrol staff per 42 km^2 instead of one staff to 28 km^{2}as standard for parks under intensive protection (Bell 1983). Despite the low staffing densities and other constraints illegal activity has been lowered to an acceptable level. To achieve optimal population of mammals that is by curbing poaching, it would be prudent to increase staff numbers which will correspond with increase in patrol effort. This situation will create relative safety refuge areas where there were few animals initially and which will induce some animals from less safe areas to move into.

Patrol effort can be improved in protected areas with low staffing densities by increase in patrol coverage which includes reducing patrol size, increasing patrol time (effective patrol days/staff/month) spent in the field and using helicopters or light aircrafts (Boshe, 1989; Bell, 1986b). These options will involve inputs such as well armed and trained patrol staff with logistical support, better servicing and provision of good vehicular and mechanical support (Leader-Williams, 1990; Tatham, 1988). Regrettably all the three options mentioned at times are less readily affordable or available in most protected areas in African countries which are already lacking infrastructural inputs (funding) in terms of resource allocation to law enforcement programs. Law enforcement effectiveness in Kogyae Strict Nature Reserve employed the method

of using intelligent information from informants as practiced in most African protected areas, which leads to arrest of more poachers outside the park. By this method law enforcement effectiveness is achieved by maintaining a balance between adequate patrols in the field and arrest of poachers through intelligence information from informants from the fringe communities.

CHAPTER SIX

6. CONCLUSION

Eight (8) different types of illegal activities occurs predominantly in the Kogyae Strict Nature Reserve with snares recording the highest and poachers arrested recording the least number of occurrences. The year 2010 recorded the highest number illegal activities and animals seen whilst 2008 recorded the lowest number of illegal activities with 2008 recording the lowest number of animals seen.

Primates recorded the highest number of animal sightings, followed by smaller ungulates and then larger ungulates. This trend may be associated to the reasons that most poachers in the KSNR do not target primates but rather the ungulates.

Number of staff per patrol team and distance patrolled is positively related to the number of illegal activities encountered. If the law enforcement efforts at KSNR are effective in reducing illegal activities, then this supports continued or increased investment in this conservation strategy. It is recommended that the protection activities of the park be intensified during the non-farming season. As protection staff, must be motivated, collection of, and feedback from, data on the incidence of illegal hunting activities should be continued as an adaptive management strategy, and a bonus system should be considered. It also is important to provide as much support as possible to protection efforts to increase the effectiveness of patrols, including provision of up-to-date technology such as cyber-tracking enhancements. This, in combination with increased work with local people and targeted patrolling in identified areas of importance for wildlife should contribute to continued discouragement of illegal hunting activities.

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APPENDICES

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APPENDIX II

Standardized Patrol Form

MIST: Mammal Report

Kogyae Strict Nature Reserve Ground Patrols

MIST Mammal Report
4/1/2013: 5/1/2014
Report Date: 5/31/2014

Patrol days	%Field=PATROL_DAYS%		Total distance							
PA (ID)	**Management sector**	**Observation**	**Observation code**	**Total count**	**Total per km**	**Total per km per days**	**Adult males**	**Adult females**	**Total young**	**Males to females**
KSNR		Baboon	Sighting	725	1.05		0	0	0	0
KSNR		Buffalo	Sighting	44	0.07		0	0	0	0
KSNR		Bushbuck	Sighting	1028	1.98		0	0	0	0
KSNR		Kob	Sighting	640	1.02		0	0	0	0
KSNR		Kob	Droppings	1	0.01		0	0	0	0
KSNR		Red Duiker	Sighting	**3**	0.01		**0**	**0**	**0**	**0**
KSNR		Oribi	Sighting	10	0.05		0	0	0	0
KSNR		Patas monkey	Sighting	568	1.01		0	0	0	0
KSNR		Mona monkey	Sighting	40	0.08		0	0	0	0

APPENDIX III

MIST: Illegal activities Report

Ghana Wildlife Division
KSNR Illegal Activities Ground Patrols
1/1/2013: 1/1/2014
Report Date: 1/7/2014

Area	Observation	Type	Observations/k	Total	Secto
KSNR	Encroachme	Cultivation	0	6	
KSNR	Encroachme	Grazing	0.01	206	
KSNR	Encroachme	Trespassing	0	3	
KSNR	Fire sign	Position	0	1	
KSNR	Poaching	Animals found dead	0	12	
KSNR	Poaching	Gin traps	0	20	
KSNR	Poaching	Seen and	0	7	
KSNR	Poaching	Seen and	0	30	
KSNR	Poaching	Fire	0	0	
KSNR	Poaching	Footprints (new)	0	0	
KSNR	Poaching	Footprints (old)	0	0	
KSNR	Poaching	Gin trap hole	0	14	
KSNR	Poaching	Gin traps	0	40	
KSNR	Poaching	Gunshot heard	0	28	
KSNR	Poaching	Poacher's camp	0	10	
KSNR	Poaching	Poacher's camp	0	4	
KSNR	Poaching	Used Cartridges	0	43	

x

APPENDIX IV

A Kob caught in a Gin trap

APPENDIX V

Wildlife Guards on Muter parade at Park's Headquarters