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Research Article

# Expending Rangers' Efforts in Estimating Incidence of Threats to Wildlife Conservation in a Protected Area

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**Abstract**
Wildlife resources monitoring is considered a critical aspect for documenting trends in wildlife threats and yet the process is often plagued with poor design and implementation. Management of the Kalakpa Resource Reserve (KRR) in Ghana relies on ad hoc conservation strategies in dealing with wildlife threats. The study assessed the rate and trends of threats to wildlife species using field patrol records from 2007 to 2012 of all observations of illegal activities encountered by wildlife guards during regular law enforcement patrols Jonckheere Terpstra Trend and Kruskall Wallis H tests were conducted to compare and determine the linear associations in the yearly and monthly encounter rates of illegal activity (IA) as well as evaluate variations in incidences of IA respectively over the study period. The study revealed eleven (11) categories of illegal activities were in the area which varied significantly in the rate of encounter over the years. Significant decreasing trends were also observed illegal activities. and on a downward trends. Law enforcement efforts in KRR were effective in reducing wildlife threats however, efforts should be made to adopt modern methods of detecting wildlife threats during field patrol activities.

**Keywords**
illegal activity-law enforcement-monitoring-patrol effort-wildlife threats

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## Contents



## 1. Introduction

Biodiversity decline has been well documented as well as the resilience of ecological systems and human communities [1], [2] and [3]. Protected areas mangers therefore require dependable monitoring programs to better understand the extent and factors contributing to the declines. This in effect will guide management actions to curb environmental problems and determine the usefulness of conservation measures [4] and [5]. Regardless of the international assurances to monitor and protect biodiversity, contemporary ecological management approaches are reported as insufficient and biodiversity conservation aims are generally not being achieved [3]. In time past, governments and society in general have sought to establish protected areas as a chief response to the biodiversity crisis [6], however the success of these protected areas adequately conserving species and ecosystems are increasingly being questioned. It is posited that records (data) needed for the evaluation of the effectiveness of wildlife management approaches are frequently lacking [7]; [8]. It is generally acknowledged that there are no bullet solutions to dealing with wildlife crimes in protected areas (PAs). However, operational and well-organized wildlife law enforcement efforts in protected areas need to hinge on sustained and well-targeted actions across a number of inter-related components of protected area management [8]. Law enforcement patrols thus form a key aspect of a site's anti-poaching efforts. Their effectiveness, and specifically that of the patrol staff efforts, is one of the most important reasons in providing an effective restriction on illegal activities in an area. [8] further mentions that routine foot patrols form the basis of law enforcement efforts in most protected areas. They further argue that, effective law enforcement management requires anticipatory and strategic planning. Such an effort tends to guide future operations, and therefore should make use of a wide range of anti-poaching strategies and approaches, including the deployment of professional staff [9].

In a small protected area like the Kalakpa Resource

Reserve (KRR), management continues to rely on ad-hoc protective or conservation strategy in dealing with wildlife threats (hence forth referred as illegal activity). It is reasoned that law enforcement strategies need to be recurrently monitored, evaluated and should remain dynamic in order for management to effectively anticipate and react to changing conditions on the ground. In this regard, three key issues were of critical concern in this current study which include; (a) field patrols need to be seen beyond normal routine acts; (b) there is a need for protected areas to evaluate and embrace innovative mechanisms rather than ad hoc measures to deal with wildlife illegalities and (c) there is a need for scaling up conservation efforts to ensure awareness, commitment, collaboration and intrinsic motivation among field staff as well as the fringe communities to safeguard wildlife resources. Although wildlife resources monitoring is considered as a critical aspect for documenting trends and learning from the past, the process is often plagued with poor design and implementation. The current management strategy embraced by the KRR lacks the novel approaches developed to curb illegal harvesting of wildlife in some protected areas elsewhere. Such innovative strategies include the use of remote sensing methods to improve mapping and prediction of wildlife habitats as well as illegal activity incidences. [10] reports that a number of protected areas now use the Management Information System (MIST) and Spatial Monitoring and Reporting Tool (SMART).

Yet, one of the most important knowledge gaps affecting the ability of the managers of the KRR is the ability to effectively and empirically assess illegal activity incidence over time due to lack of the supporting software. Another central challenge for managers of protected areas is to develop a staff force with the abilities, motivation and dedication that matches or exceeds that of the poaching cartels they are up against. Regrettably, due to lack of institutional commitment, bureaucracy, centralized decision-making processes, weak personnel management, limited allocation of resources and financial support, this is rarely achieved. Wildlife patrol staff therefore lacks the abilities, intrinsic motivation, and commitment to their work, the area they work in, and the organization they work for. In this research paper, it is reasoned that so far as a significant proportion of the budgetary allocations to the protected areas are used for organizing and conducting field patrol operations, law enforcement efforts ought to be cost-effective, reliable and credible. The central objective of this study was to assess the rate and trends of wildlife threats to wildlife species using field records in Kalakpa RR over a six-year period (2007- 2012).

## 2. Materials and Methods

### 2.1 Study Area

Kalakpa Resource Reserve is one of three PAs located in south-eastern Ghana close to the border with Togo. Just as most of the PAs, it was created by the Ghana government in 1975 with the aim of protecting its valuable and uncommon combination of dry forest and short grassland savannah. It is one of the remnants of the Guinean savannah vegetation and an imperative component of the nation's ecological heritage. The reserve is located between latitude 06º 23' N and longitude of 00º 25' E with an elevation of 60–400m (Fig. 1).

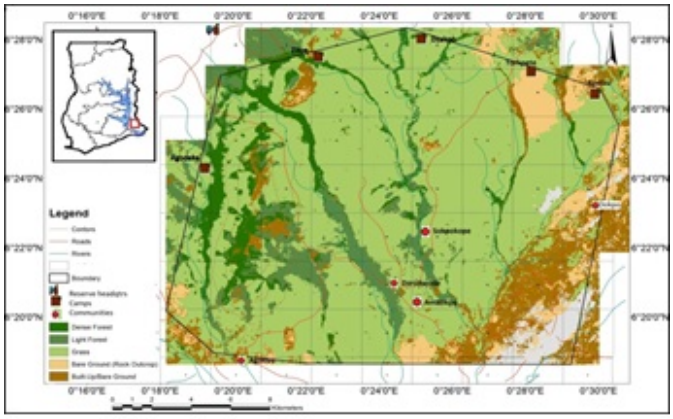


**Figure 1.** Map of KRR with map of Ghana (insert) showing the location (red box) of the study area [11]

The area covered by the reserve is about 320km2 and lies in the Southeastern part of the country within the administrative jurisdiction of the Ho Municipal and Adaklu District assemblies of the Abutia and Adaklu Traditional Council. Since the 1960s-1970s, it served as a hunting ground where expatriates from Accra and Tema pursued buffalo and other game. To the south and east, it is bordered by low lying plains. Adaklu Mountain (595 meters above sea level) is a prominent and beautiful landscape feature to the northeast of the reserve. The reserve inhabits both savannah and forest species of animals, notably grazing herbivores. KRR is also endowed with different species of butterflies and birds. Several bird surveys have been conducted in KRR by bird experts and tourists and have been documented. The reserve also harbors about 270 avifauna species [12].

### 2.2 Data Analysis

For analysis of the data, a Jonckheere Terpstra Trend test which significantly produces a more robust trend results was conducted to compare and determine the linear associations in the yearly or monthly encounter rates of illegal activity across the study period [14]. The Jonckheere trend test is a non-parametric analysis. Effect sizes for the Jonckheere trend test were determined via the Kendall's tau-b test. Kruskall Wallis H test was conducted to evaluate variations in incidences of IA. This test

was conducted to establish the differences in observations across the six-years under study. Where a significant p-value was recorded, post-hoc tests (Mann Whitney U tests) were conducted to evaluate pairwise differences (year-by-year). These follow up post hoc tests were to determine where exactly the differences occurred controlling for Type-1 error across test by using the Bonferroni approach [15].

## 3. RESULTS

### 3.1 Types and relative abundance of Illegal activity encountered from 2007 - 2012

Eleven (11) different categories of illegal hunting activities (offences) were encountered and recorded between January 2007 and December 2012 in Kalakpa. The categories of illegal activities comprised: fire arm related acts including gunshots heard, empty pellet shells found, carbide powder identified; poaching related acts (i.e. poachers footprint identified, active/abandoned poaching camps, animals found killed, traps/snares found, poachers arrested); and confiscations including shotguns confiscated, animal skins and chainsaws. Table 1 indicates that gunshot was the most observed illegal activity with yearly average of 0.1 per kilometer walked and a total encounter rate of 0.58 ($\pm$ 0.06) followed by empty cartridges, poacher activity and carbide powder with total densities of 0.29 ($\pm$0.05) , 0.24 ($\pm$0.04) and 0.16 ($\pm$0.05) respectively. All other illegal activities including traps/snare found, chainsaws seizures, shot guns confiscated, killed animals found and animal skins confiscated were among the least detected as shown in Table 1.

### 3.2 Trends in illegal activity incidence from 2007 to 2012

The line graph (solid line) in Fig. 2 shows the yearly trend of illegal activity incidence between 2007 and 2012. The result shows that there is a general yearly decreasing trend (broken line) in the encounter rate with illegal activities across the study period with a coefficient of determination of $R^2 = .87$.

The highest percentage (48.2%) use of both commercial and farm-made feeds was also in the Ashanti region whilst the least (20.4%) was in the Brong Ahafo region (Fig. 3).

From Fig. 2 and 3, there was a general decreasing trend (broken line) in illegal activity incidence (monthly and yearly) across the study period.

**Table 1.** Categories and abundance (Kilometric Index of Abundance) of illegal activities encountered from 2007 to 2012

| Illegal Activity | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | IA/km | SD(±) |
|---|---|---|---|---|---|---|---|---|
| Gunshots heard | 0.197 | 0.116 | 0.122 | 0.091 | 0.041 | 0.018 | 0.585 | 0.064 |
| Empty pellet found | 0.159 | 0.053 | 0.039 | 0.026 | 0.007 | 0.008 | 0.291 | 0.057 |
| Carb. powder found | 0.113 | 0.039 | 0.005 | | 0.004 | | 0.162 | 0.051 |
| Poach. act. obs. | 0.028 | 0.011 | 0.078 | 0.104 | 0.018 | 0.003 | 0.241 | 0.041 |
| Poach. Arrested | 0.008 | 0.008 | 0.019 | | 0.009 | 0.003 | 0.047 | 0.006 |
| Poach. Camps iden. | 0.003 | 0.013 | 0.011 | 0.002 | 0.004 | 0.008 | 0.040 | 0.005 |
| Dead anim. Found | 0.003 | 0.011 | 0.028 | | | 0.008 | 0.049 | 0.011 |
| Traps/snares | 0.008 | 0.016 | 0.025 | 0.006 | 0.003 | 0.005 | 0.061 | 0.008 |
| Shot guns conf. | 0.003 | 0.018 | 0.004 | 0.006 | 0.003 | 0.006 | 0.039 | 0.006 |
| Chainsaws seized | * | * | 0.004 | * | * | * | 0.004 | * |
| Ani. skins conf. | * | * | * | * | 0.001 | 0.018 | 0.020 | 0.012 |
| Illegal tree cutting | - | - | - | - | - | - | - | - |

Data source: Field patrol records (2007-2012) * = Denotes no observation and – = denotes no data available

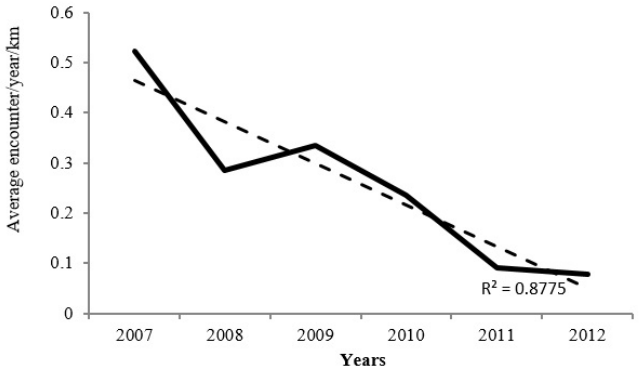


**Figure 2.** Line graph showing yearly trend in illegal activity incidence from 2007 to 2012.

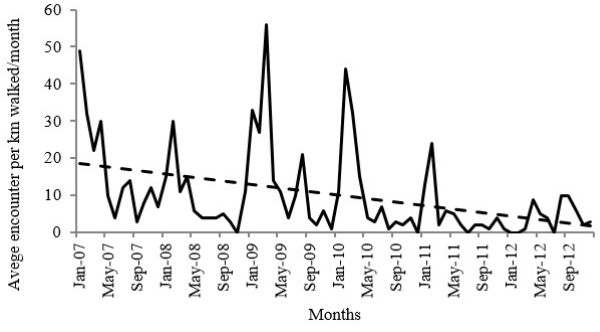


**Figure 3.** Line graph showing monthly trends in illegal activity incidence from 2007 - 2012

### 3.3 Yearly trends of illegal activity

Overall, there was a statistically significant linear trend in the yearly encounter rate of illegal activity over the study period ($p < .001$) (Table 2).

**Table 2.** Jonckheere-Terpstra Test for yearly Illegal activity encounter rate

| | *Illegal activity* |
|---|---|
| Number of Levels in YEAR | 6 |
| N | 72 |
| Std. J-T Statistic | -3.624 |
| Asymp. Sig. (2-tailed) | 0 |
| Eta squared (d) | -0.32 |

Encounter rate with illegal activity decreased statistically significantly ($p < .001$) with an effect size of d = -.32 representing 32 percent decline in illegal activity across the study period (Table 2).

### 3.4 Monthly trends of illegal activity

**Table 3.** Jonckheere-Terpstra Test for monthly Illegal activity encounter rate

| | *Illegal activity* |
|---|---|
| Number of Levels in MONTHS | 12 |
| N | 72 |
| Std. J-T Statistic | -4.597 |
| Asymp. Sig. (2-tailed) | 0.001 |
| Eta squared (d) | -0.391 |

Similarly, illegal activity encounter rate significantly decreased ($p = .001$) across months with an effect size of d = - .391 representing 39 percent monthly decline over the twelve months of each year of the study (Table 3).

**Table 4.** Mann-Kendall trend test of yearly encounter rate illegal activity between 2007 and 2012 with respect to the four patrol effort indices

| **Index** | **S** | **Z** | **P-value** |
|---|---|---|---|
| Illegal act./km | -1* | 5.53 | $< .05$ |
| Illegal act./EPMD | -1* | 5.08 | $< .05$ |
| Illegal act./NPm | -10* | 5.16 | $< .05$ |
| Illegal act./NS | -9* | 4.64 | $< .05$ |

* = Denote significant trend with P-value less than .05

The results from the Mann-Kendall trend test (Table 4) showed a statistically significant decreasing trend in yearly encounter rate of illegal activity across the study period with respect to all patrol indices.

## 4. DISCUSSION

The observed fluctuations in illegal activity occurrence recorded during the study period could be attributed to a number of factors which may include low staff numbers per patrol, non-detectability of illegal activity among others. Enquires from the PA office revealed that the year 2007 and 2010 were marked by mass staff transfers which could be argued to have affected staff efforts. This argument is supported by the assertion of [16] that the departure of the PA manager of KRR for further studies created a void in the patrol activity organization. The study revealed that prior to the introduction of the MIST system for monitoring protected area activities, patrols were organized in an ad hoc manner hence the high incidence of illegal activities recorded in 2007. This could mean that not all areas were being monitored hence perpetrators of wildlife crime had their way. In addition, there were still more communities within the protected area hence the higher incidence of illegal activities. It was revealed (personal communication with staff) that anytime the attempt was made by the Forestry Commission (FC) to move a community out of the PA, illegal activity incidence also went up. Inhabitants as it was learnt have a habit of committing all sort of wildlife crime as a way of indicating their displeasure when they learn they were to be moved out of the PA. Similarly encounter rate with illegal activities increased from 2008 till 2010 and this could be attributed to a break down in the monitoring system of the PA. It was found that the two years subsequent to the introduction of the MIST system was marked by a breakdown of gargets (GPS systems) and low budgetary allocations form government. The lack of fund from the central government for the planning and conduction of field monitoring activities also contributed to the increase in the illegal activity incidence. None of the GPSs had been replaced since they were introduced in 2004 according to the Park Manager (PM) (personal communication with PM).

The decrease in illegal activity between 2007 and 2008 could partly be attributed to a series of research activities at the time. The presence of researchers and field staff could have deterred poachers from carrying out their activities. Some of the studies at the time include that of [17], [18] and [13]. Research has shown that the consistent presence of law enforcement staff on the field has the potential to reduce the incidence of illegal activities within a PA [19]. The observed dwindling trend could also be as a result of improved monitoring approaches that have been adopted by the PA management. Field monitoring activities are regularly conducted and planned to effectively cover the entire area under protection. It can be argued though subjective that the current tensions between the staff of the PA and the residents of the communities in the PA have also in a way contributed to the decrease in illegal activity incidence in the area. The observed downward trend in illegal activity could also be attributed to the introduction of a satellite camping system introduced. These satellite camps have been established at strategic locations within the PA to enable patrol activities to cover extensive areas with a lesser effort. The entire PA under the camping system has been divided into ranges with patrol limits. It is argued therefore that the camping system adopted by the PA was effective in curbing illegal activity rates. The range system is argued in this thesis to be an effective and efficient approach that has improved management efforts hence the apparent decline in illegal activity incidence. The higher numbers of gun shots recorded was not unexpected as gunshot could even be heard by staff from the camping base. It is however argued that gunshots heard may not have been the most occurring illegal activities but for the sound it produces, it was the easiest to be distinguished. It argued that gunshots recorded sometimes could have occurred outside the PA and therefore a strategy needs to be developed to record gunshots that actually occur within the protected area. The fewer animal skins reported could be attributed to the fact that animal skins could only be detected from homes of poachers. However, under the current system of monitoring, reporting animal skins found is argued as one of the most difficult illegal activities to monitor.

In the case of protected area legislation, the available evidence indicates that with levels of illegal resource use [20];[21] and rates of decline in exploited populations [22] both have been shown to respond strongly to patrol effort in protected areas. There is also some evidence that the rate of off-take of protected species outside protected areas declines with increasing enforcement effort [23]. This was the revelation of this study when a general yearly decreasing trend in the encounter rate of illegal activities was recorded with respect to increasing staff efforts. The fewer incidence of illegal activity was in congruence with [19] indicating that improvement in staff efforts to curb illegal activities resulted in a decrease in illegalities in a protected area. The "illegal" entry and use of resources by local residence has in the past to recent time been a point of conflicts of interests and in some cases local communities tend to consider wildlife and forest conservation to be contradiction to local community development. Such is the situation in the case of the KRR. However, the up scaling of patrol efforts might have led to the reduction in human activities in the protected area thereby making the PA an unsafe area for poachers.

## 5. Conclusion

Most of the ingredients being used in farm-made fish diets by small-scale fish farmers are directly used as human food, and thus their continuous inclusion in fish diets will lead to direct competition with human demand. Further research need to be conducted into the possibility of including other kinds of locally available feed ingredients,

preferably those unsuitable for direct human consumption so as to meet the growing demand of fish diets for aquaculture expansion in the country. For fish farmers to produce good quality farm-made fish diets, the farmers should be trained regularly in how to formulate and produce nutritionally balanced high quality fish diets.

## 6. Acknowledgement

Monitoring efforts resulted in a declining trend in encounter rate with illegal activities. This result may be interpreted as a positive outcome for the law enforcement efforts in KRR if patrol efforts have actually produced a decline in the occurrences of illegal activities. Finally, since the law enforcement efforts in KRR are effective in reducing illegal activities, the results of this study therefore supports the continued or increased investment in this management strategy (law enforcement). A more efficient system that will enable the detection of gunshots within the range of the PA boundaries should be introduced. It is reasoned that such a sound detection system could help management of the PA to analyze and to establish hot spots to illegal activities in the area. Management of the protected area should make the effort to adopt modern and efficient spatial methods during field patrol activities. By so doing, field observations can be geo-referenced for purposes of validity and reliability of the field reports and subsequent usage for management planning.

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