

# The Use of Field Patrol in Monitoring of Forest Primates and Illegal Hunting Activities in Kakum Conservation Area, Ghana

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**Abstract:** Human activities that are likely to affect primate populations in the Kakum Conservation Area in Ghana were monitored over three years in relation to number of primates sighted over the same period. The main aim was to monitor and determine trends of illegal activities in relation to primate numbers and seasons of the year. Along the patrol route, the patrol officers enumerated all encounters with human activities associated with hunting, capturing or harming animals, and all sightings of primate groups within the visual range of the observer. These encounters were examined in terms of monthly man-days of patrol effort and distances walked (km), providing indices of encounter. In all, six primate species were encountered from 2007 to 2009: bush baby (*Galagoides demidoff*), Bossman potto (*Perodictus potto*), Lowe's monkey (*Cercopithecus campbelli lowei*), spot-nose monkey (*Cercopithecus petaurista petaurista*), olive colobus (*Procolobus verus*), and Geoffroy's pied colobus (*Colobus vellerosus*). Categories of illegal activities documented in the 360 km<sup>2</sup> protected area included poachers arrested, firearms confiscated, used cartridges found, gunshots heard, snares found, poacher's camps encountered, primates found killed, and skins confiscated. The indices for these illegal activities showed a decrease over the three years, while encounters with primate groups were unchanged. An expectation of differences in detection of illegal activities between the farming and non-farming seasons was not supported. The results support recommendation of consistent, high-intensity patrol efforts throughout the year by well-equipped patrol units.

**Key words:** monitoring, hunting, illegal activities, primates, patrol, Kakum Conservation Area

**Résumé:** Les activités humaines qui affecteront probablement des populations de primate dans la Région de Conservation Kakum au Ghana ont été contrôlées plus de trois ans par rapport au nombre de primates aperçus pendant la même période. Le but principal était de contrôler et déterminer des tendances d'activités illégales par rapport aux nombres de primate et aux saisons de l'année. Le long du trajet de patrouille, les officiers de patrouille ont énuméré toutes les rencontres avec les activités humaines associées à la chasse, le fait de capturer ou la malfaisance aux animaux et à toutes les vues de groupes de primate dans la gamme visuelle de l'observateur. Ces rencontres ont été examinées du point de vue des jours d'homme mensuels d'effort de patrouille et les distances ont marché (le km), en fournissant indices de la rencontre. En tout, on a rencontré six espèces de primate à partir de 2007 à 2009: le bébé de buisson (*Galagoides demidoff*), le Boss potto (*Perodictus potto*), le singe de Lowe (*Cercopithecus campbelli lowei*), le singe de nez de tache (*Cercopithecus petaurista petaurista*), l'olive colobus (*Procolobus verus*) et le pied de Geoffroy colobus (*Colobus vellerosus*). Les catégories d'activités illégales documentées dans la 360 région km<sup>2</sup> protected ont inclus des braconniers arrêtés, les armes à feu les cartouches confisquées, utilisées trouvées, les coups de feu ont entendu, les pièges trouvés, les camps de braconnier rencontrés, les primates ont trouvé tué et les peaux confisqué. L'indices pour ces activités illégales a montré une diminution au cours des trois ans, pendant que les rencontres avec les groupes de primate étaient inchangées. Une attente de différences dans la détection d'activités illégales entre l'agriculture et la non-agriculture des saisons n'a pas été soutenue. Les résultats soutiennent la recommandation de conséquents, les efforts de patrouille de haute intensité tout au long de l'année par les unités bien équipées de patrouille.

**Mots clé:** le contrôlant, la chasse, les activités illégales, les primates, patrouille, Région de Conservation de Kakum

## INTRODUCTION

Forest destruction poses dire threats not only to the existence of the remaining forest areas themselves, but to the ecological benefits that forests provide, and the economies and human livelihoods that depend on them (Christy *et al.*, 2007). Most forests in West Africa are less than 500 km<sup>2</sup> and represent habitat islands surrounded by a 'sea' of agriculture (Struhsaker,

1997). In the case of Ghana, where the majority of tropical rain forests have already been destroyed and the remaining forest patches are only a few hundred km<sup>2</sup> in area, it can be stated that it is essentially too late for a compromise between conservation and exploitation. Since the beginning of the century, under the protectionist policies throughout the continent, land was set aside for conservation areas with little or no regard for the impact of these changes on the livelihoods of the members of rural communities. Consequently, rural communities were alienated from the resources upon which their nutritional and material well-being depended. Moreover, revenues derived from wildlife were not reinvested back into the area, but instead were channeled into the government's central treasury. As a result, many local hunters began to operate secretly, hunting for commercial and personal gain. These policies forced most local hunters into an illegal, underground economy while wildlife stocks were rapidly depleted for short-term and transient benefits (Jachman, 1998).

The discrepancy between conservation laws and the interests of the general public manifests itself in the continuous efforts of the Ghana Wildlife Division to prevent the illegal use of wildlife resources. The main objective of setting aside areas for conservation of species in Ghana is to ensure the survival of the various species represented in the diverse ecological regions, a goal not uniformly supported by local communities. As a consequence, wildlife resources have been depleted to a point that negates the option of sustainable harvest of many species. A strong law enforcement component within protected areas, therefore, is of utmost importance to ensure the conservation of biological diversity, establish a resource base for the continued development of wildlife management approaches, and to increase the densities of most wildlife and prevent the extinction of numerous individual species (Jachman, 2004).

It is against this background that from January 2007 to December 2009, a planned, patrol-based monitoring and delimited data collection procedure was initiated in Kakum Conservation Area in Ghana. The main objectives were to monitor human activities that are likely to kill, harm, or capture primates, and to relate the presence of these activities to number of primates encountered per patrol effort. The ultimate purpose is to determine the trend of encounters of these human activities in relation to numbers of forest primates, as an assessment of the influence of spatial and temporal occurrences of these hunting activities on primates, including changes over time. Here, we report on examination of the data collected over the three-year period of the procedure, assessing both primate sightings and detection of illegal hunting activities with respect to measures of patrol effort and temporal variation.

## MATERIALS AND METHODS

### *Study area*

Kakum Conservation Area (KCA) lies in south-central Ghana (Central Region), just 30 km from Cape Coast (Figure 1). The area is composed of the Kakum National Park and adjoining Assin Attandanso Resource Reserve, and covers 360 km<sup>2</sup> of moist evergreen forest of the Upper Guinea forest belt. KCA has a bi-modal rainfall pattern occurring from May to July and from September to October, with an average annual rainfall of 1,500-1,700 mm. The terrain is generally undulating, with an elevation of between 150-250 m above sea level (Monney *et al.*, 2010). The conservation area is managed by a senior wildlife officer, an assistant wildlife officer in charge of the community education unit, a wildlife protection officer in charge of law enforcement and biodiversity monitoring who is assisted by two wildlife rangers, and 30 patrol officers divided over eight protection camps. Monitoring patrols are equipped with GPS units, compasses, grid maps, and rifles.

### *Data collection*

The illegal hunting activities and number of primate groups were monitored with data that were collected between 2007 and 2009. The conservation area uses conventional law enforcement in the form of foot patrols that frequently emanate from each of the camps, as well as from the headquarters. Patrol routes can be viewed as transects with unfixed width used to collect information on indicators of illegal wildlife use and animal observations. During the patrol activities described here, standardized data sheets were used to keep records of the numbers of staff on patrol; the duration of the patrol; the area traveled; the types, quantity, and locations of illegal activity encountered; and the numbers of primates encountered, by species and location. Because patrol movements should be unpredictable by nature, the 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. The patrol routes were drawn and the location of each encounter was recorded on a grid map of the study area.

Patrols took place either during the hours of day time (day patrol), night time (night patrol), or both (long patrol). For primate sightings, the number of primate groups detected during patrol was recorded. In the case of illegal hunting activities, these were categorized according to those offences which directly relate to wildlife killing or capturing, including poachers arrested, poachers observed, firearms confiscated, spent cartridges found, skins confiscated,

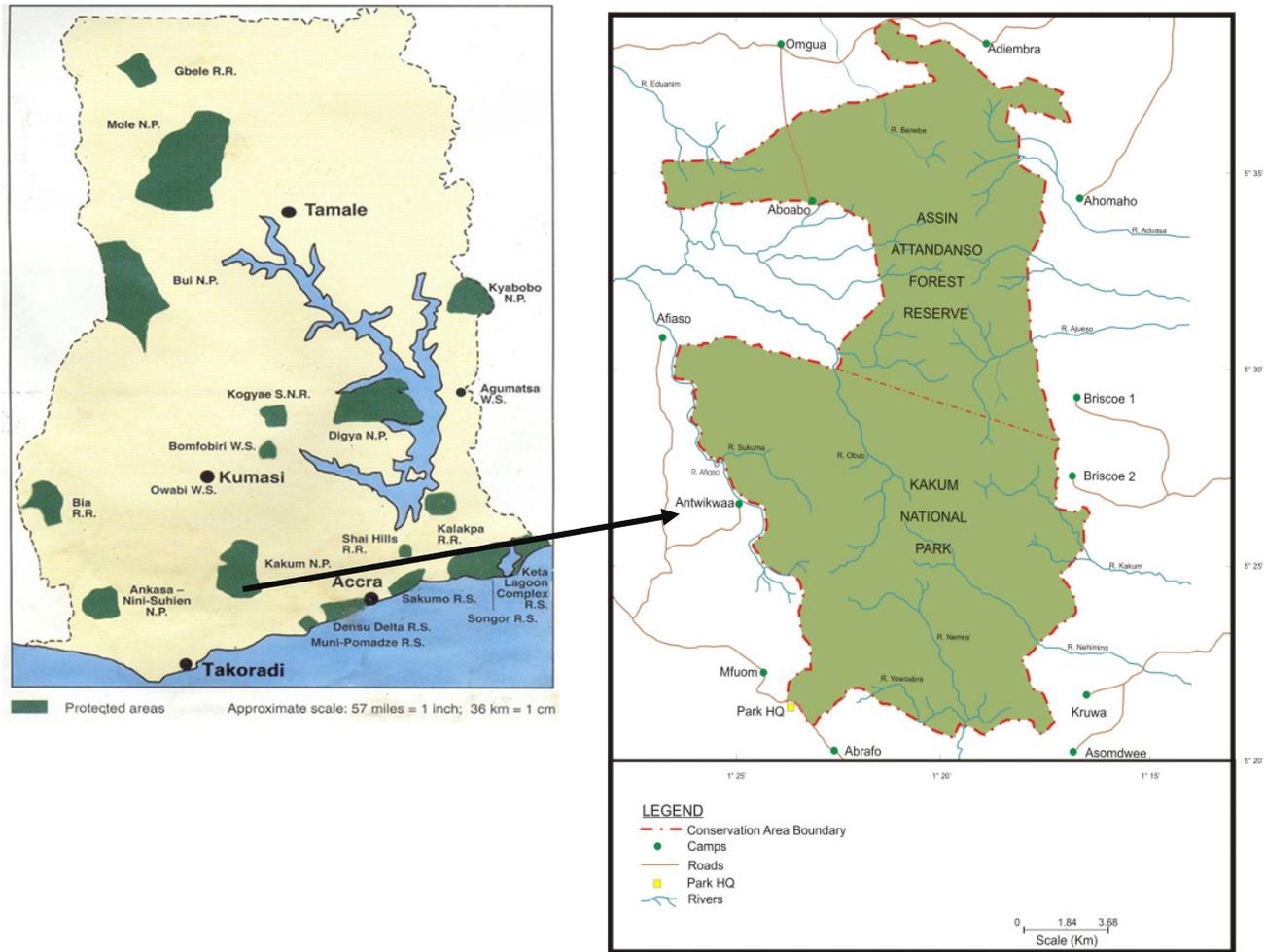


Figure 1: Map of Ghana showing protected areas - with enlargement of the Kakum Conservation Area

gunshots heard, poacher’s camps found, animals found killed, and wire snares recovered.

**Data analysis**

As detections can vary based on the measure of monitoring effort utilized, and given the potential for these measures also to vary in how reliably each might be able to detect primate sightings versus illegal human activities, analyses were conducted utilizing two separate indices to assess levels of illegal activities and number of primate groups encountered. Results based on each index are compared, with any differences discussed. One of these indices, referred to as the “catch per unit effort index” (C/E), is computed utilizing monthly patrol man-days as the measure of effort (see Jachmann, 1998, 2008a, 2008b). As described by Jachman (2008a), this index has been used in management of protected areas in Ghana due to its ease of interpretation, and the fact that minimum monthly

standards for patrols in the country’s protected areas are set using effective patrol man-days. In this index, “Catch” refers to number of encounters with either an illegal activity (e.g., arrests of poachers or snares recovered) or with primate groups during the month. The index, therefore, is total number of encounters with illegal activities or with primate groups in a given month divided by total number of effective patrol man-days in that month (following Jachmann, 2008a; Bell, 1985). One patrol day is designated to be 8 hours in length; the unit “patrol man-days” is then equivalent to the number of staff on patrol, multiplied by the number of days patrolled. In other words, for each patrol, independent of the duration, the number of patrol hours was divided by 8, and multiplied by patrol size (number of staff on patrol), to give the measure of effective patrol man-days, with these summed for each month during the three year period of the study. A second index, referred to as the “kilometric index of abundance” (KIA), is based on the number of kilometers

walked by patrols (see Groupe, 1991). This is the number of encounters with illegal activities or with primate groups in a given month divided by the distance in kilometers walked by patrols in that month.

Data analysis is based on non-parametric statistics. For comparisons across more than two years or between three or more variables, Kruskal-Wallis tests were conducted; for evaluation of differences between two categories, Mann-Whitney U tests were utilized. The relationship between indices of hunting activities and primate sightings, and between measures of effort and encounters, were assessed through use of Spearman's rank correlations. All analyses utilized  $p < .05$  in assessing significance.

## RESULTS AND DISCUSSION

### Patrol Effort

An average of 381 monthly man-days of patrol effort were expended across the 36 months of the study (range=211-565 man-days/month,  $SD=88.14$ ). This effort significantly varied across the three years ( $H=15.56, p < .001$ ). Monthly man-days of patrol did not differ between 2008 and 2009, but in each of these years a significantly greater investment of man-days of effort occurred relative to 2007 (2007 vs. 2008:  $U=121.0, p < .01$ ; 2007 vs. 2009:  $U=129.0, p < .001$ ). As such, subsequent to the first year of the study, patrol man-days increased and remained at this higher level of effort.

Patrol officers walked an average of 643 km each month across the three years (range=463-831 km/month,  $SD=98.87$ ). In contrast to patrol man-days, monthly kilometers walked did not vary significantly across years ( $H=5.815, p=.055$ ). Overall, across the 36 months of patrols, the number of man-days per month was positively correlated with number of kilometers walked in those months ( $r_s=.6234, p < .001$ ). This was not consistent across the three years of study, however. For 2007 and 2008, the correlations were not significant ( $r_s=.2308, p=.471$ ;  $r_s=.3965, p=.201$ ; respectively). In 2009, there was a significant positive correlation between these measures of effort ( $r_s=0.690, p=.013$ ); only in this last year of the study was an increase in number of patrol officers associated with a greater distance covered during monthly patrols.

### Primate Sightings

From January 2007 to December 2009, six primate species were encountered, identified and monitored during patrols. These were as follows: bush baby (*Galagoides demidoff*), Bossman potto (*Perodictus potto*), Lowe's monkey (*Cercopithecus campbelli lowei*), spot-nose monkey (*Cercopithecus petaurista petaurista*), olive colobus (*Procolobus verus*), and Geoffroy's pied colobus (*Colobus vellerosus*). Figure 2 illustrates the variation in relative sightings of these various taxa, by month, over the three years of the study. Detection rates for the various species differed significantly ( $H=146.3, p < .001$ ), likely due both to the activity patterns and behavior of the various species, and

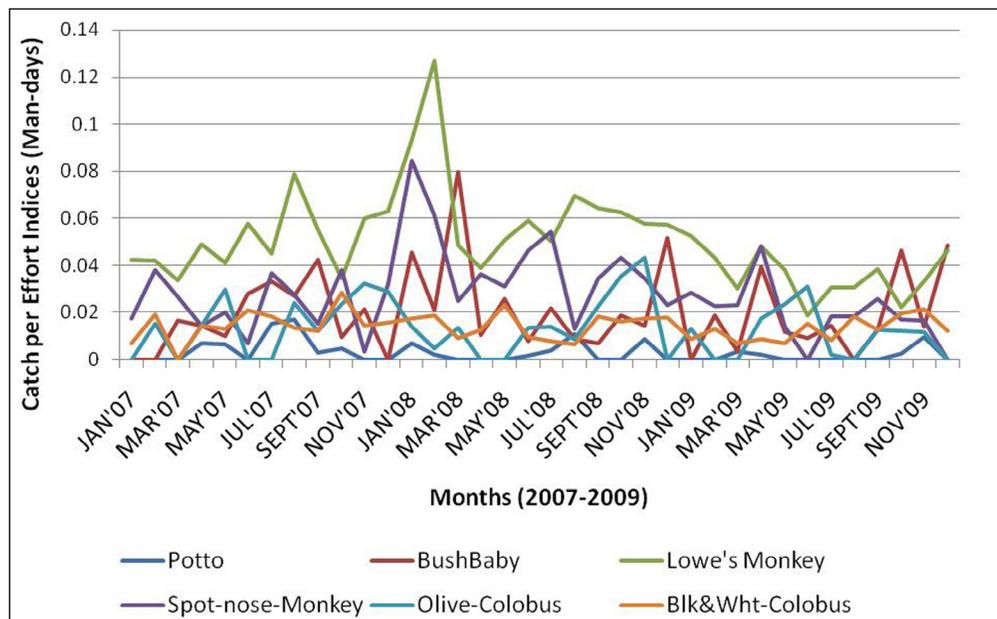


Figure 2. Catch per effort indices for six primates sighted from January 2007 to December 2009.

to overall difficulty associated with detecting primates under conditions of poor visibility in tropical forests (Struhsaker, 1997), a factor of clear importance for the nocturnal species observed during night patrols. The positive side of this poor visibility in rainforests, however, is that it may be, as suggested by Rucks (1976) and others, the main form of protection for primates against hunters.

The average numbers of primate groups sighted per km walked in 2007, 2008, and 2009 were 0.11 (SD=0.05, N=12), 0.10 (SD=0.04, N=12), and 0.10 (SD=0.04, N=12), respectively. Monthly rates of encounter with primate groups (KIA) were not significantly different across the three years ( $H=0.49, p=0.78$ ), nor were any pairwise comparisons between specific years, using this index. As illustrated in Figure 3, primate group detections per km walked remained stable over the full course of the study, despite monthly fluctuations. The differences in sightings between months was not a function of variation in kilometers walked in particular months, as there was no correlation ( $r_s=.217, p=.499$ ).

Comparison of the two indices (C/E and KIA) indicated that these were not equivalent in detections of primate groups per month ( $r_s=.261, p=.124$ ). Utilizing the C/E index

of effort, there was a significant difference between years in the monthly numbers of primate groups sighted ( $H=9.15, p<.01$ ). As presented above, man-days of effort did increase over the study period, with effort by this measure increasing in 2008/2009, relative to the first year of the study (2007). There also was a significant positive correlation between monthly man-days of effort and primate groups sighted, but only for 2009 ( $r_s=.594, p=.0415$ ). During this final year of study, having a greater number of patrol officers led to more sightings of primate groups, an effect likely enhanced by the significantly greater number of kilometers walked by these patrols in 2009 during months when they invested more man-days on patrol. The latter also suggests that the KIA measure should be the more reliable in estimating numbers of primate groups and evaluating any changes in these numbers over the course of the study. These results, then, suggest that the number of primate groups sighted did not change significantly over the three-year period.

**Illegal Hunting Activities Encountered**

Table 1 provides details on the totals, means and standard deviations of the various illegal hunting activities encountered from 2007 to 2009; Table 2 presents the illegal

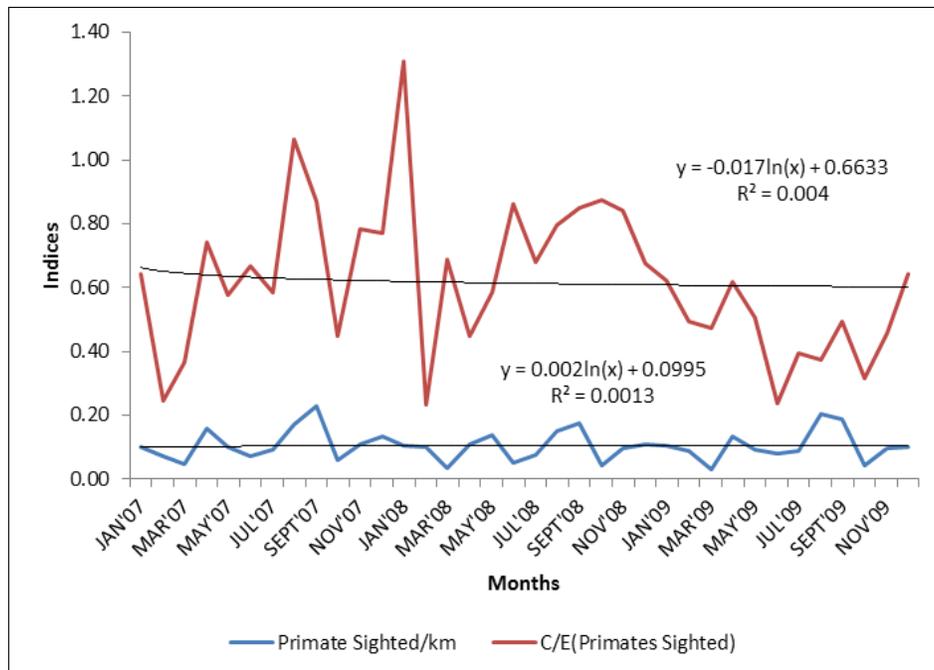


Figure 3. Trends of indices (KIA and C/E) of primates encountered from January 2007 to December 2009

**Table 1 - Total, mean and standard deviation of number of illegal hunting activities recorded from 2007 to 2009.**

Category of illegal hunting activity	2007	2008	2009	Total	Mean	Standard Deviation
Poachers arrested	36	30	11	77	25.67	13.06
Poachers escaped	12	10	15	37	12.33	2.52
Gunshot heard	117	136	187	440	146.67	36.19
Firearms confiscated	9	7	6	22	7.33	1.53
Skins confiscated	5	0	0	5	1.67	2.67
Poacher's camps found	59	33	20	112	37.33	19.88
Animals found killed	15	4	3	32	7.33	6.68
Snares found	331	452	114	897	299	171.25
Cartridges found	295	245	280	820	273.33	25.66
Carbide powder	47	45	63	155	51.67	9.87
Footprints	166	220	175	561	187	28.93

**Table 2 - Total, mean and standard deviation of number of illegal hunting activities recorded per month from 2007 to 2009.**

Month	2007	2008	2009	Total	Mean	SD
January	61	142	84	287	95.67	41.74
February	36	138	77	251	83.67	51.33
March	75	109	63	247	82.33	23.86
April	126	73	97	296	98.67	26.54
May	67	85	73	225	75.00	9.17
June	124	83	31	238	79.33	46.61
July	179	134	54	367	122.33	63.31
August	130	226	56	412	137.33	85.24
September	97	135	52	284	94.67	41.55
October	76	96	85	257	85.67	10.02
November	114	94	103	311	103.67	10.02
December	151	79	111	341	113.67	36.07

activities recorded by month of each year. The various categories of these recorded hunting activities did not differ across the three years ( $H=0.31$ ,  $p=0.86$ ). The frequencies of encounters of these activities did vary across months, however ( $H=7.24$ ,  $p=.03$ ). Such variation across time periods could relate to environmental variations (e.g., rainfall) or to seasonal changes in human activity patterns, such as cycles of farming activities. Mensah-Ntiamoah (1989) has suggested that subsistence hunting in the area is practiced by local hunters, mostly farmers living around the conservation area. A comparison of detections of illegal hunting activities between the farming and non-farming seasons, however, was not significant ( $U=132.5$ ,  $p=.36$ ), indicating little influence of farming activities on rates of hunting activity detected.

Mean numbers of illegal hunting activities encountered per km walked in 2007, 2008, and 2009 were 0.18 (SD=0.08, N=12), 0.17 (SD=0.06, N=12), and 0.11 (SD=0.04, N=12), respectively. In comparing detections of these activities across years based on patrol effort, both indices of effort indicated a significant difference across years (KIA:  $H=7.67$ ,  $p<.01$ ; C/E:  $H=13.28$ ,  $p<.05$ ). This similarity in results between the two indices is in congruence with the fact that, in contrast to the data for primate group sightings, the two indices were positively correlated in number of illegal activities detected, both overall ( $r_s=.894$ ,  $p<.001$ ) and

within each year of the study (2007:  $r_s=.958$ ,  $p<.001$ ; 2008:  $r_s=.815$ ,  $p<.01$ ; 2009:  $r_s=.977$ ,  $p<.001$ ), indicating that the two measures of effort tracked one another with respect to detections of illegal hunting activities across the study period. This is not unexpected, given that encounters with evidence that remains visible for extended periods of time (e.g., many of the categories of hunting activities) should be less susceptible to variance in patrol coverage and measure of patrol effort (relative to rates of encounters with animals such as primates) (Jachman, 2008a).

As seen in Figure 4, both indices suggested that there was an overall trending downward of detection of illegal activities, although the degree of difference and its significance varied between specific years of the study. Monthly illegal hunting activities encountered did not differ, by either index, between 2007 and 2008 (KIA:  $U=67.5$ ,  $p=.409$ ; C/E:  $U=88.5$ ,  $p=.347$ ). Between 2008 and 2009, however, there was a significant decrease in illegal activities detected during monthly patrols (KIA:  $U=27.5$ ,  $p<.01$ ; C/E:  $U=23.0$ ,  $p<.01$ ). The results based on the C/E index are of particular interest, here, in that despite the increase in man-days of patrol in 2009, and the greater number of kilometers walked in that particular year when there were more officers patrolling, there is still indication of fewer illegal hunting activities detected in that year, relative to the two previous years.

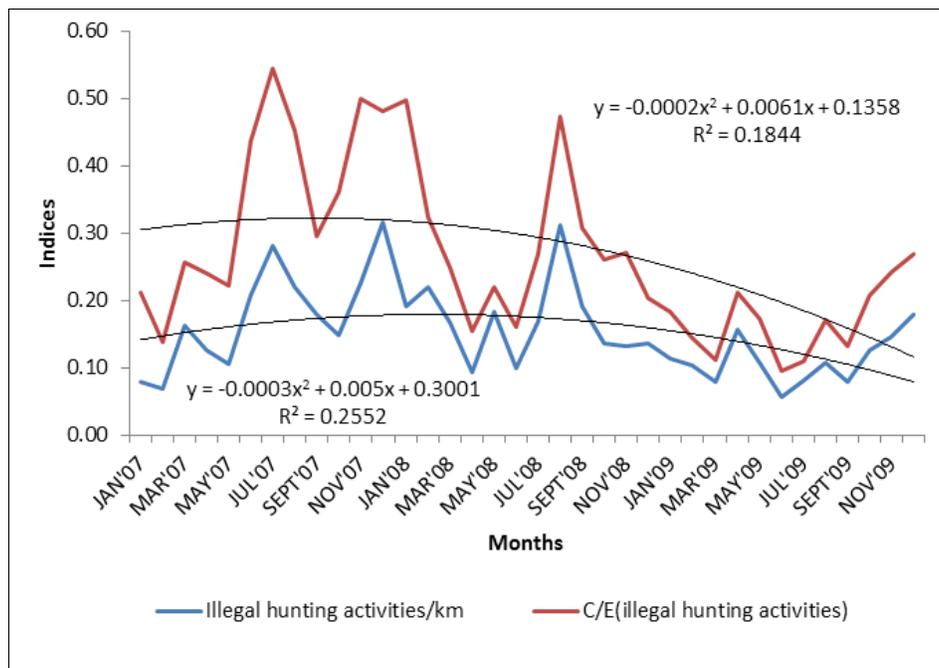


Figure 4. Trends of indices (KIA and C/E) of illegal activities detected from January 2007 to December 2009.

### *Potential Importance of the Results to Conservation Efforts*

The analyses discussed above indicate that the monitoring efforts over the three-year period detected no significant change in number of primate groups sighted, but did record a decline in illegal activities encountered. These results might be interpreted as a positive outcome for the law enforcement efforts at Kakum Conservation Area if, as could be suggested, patrol efforts have produced an actual decline in illegal activities. As both patrol man-days and kilometers walked by larger patrols increased in 2009, yet fewer illegal activities were detected by either measure of effort, the presumed decrease in illegal activity appears to be supported. It also is positive that no significant difference in primate group sightings occurred over time, aside from an increased level of detection in the last year of the study resulting from a greater investment of man-days and associated increase in kilometers walked during monthly patrols.

The lack of any correlation between primate groups sighted and illegal activities encountered, by either measure of effort, overall or in any year of the study, does not support a potential observation that declines in hunting activities are associated with increased sightings of primates, although such a relationship might not be expected to be seen over a short period of time. Absence of a positive correlation also suggests that patrol officers did not simply increase their overall detection ability (perception) over time, or in particular months. And although it could be that hunting activities are concentrated in areas of high primate density, or in particular months of the year, this, too, was not indicated, given the absence of any significant correlations between encounters with primates and evidence of illegal activities.

If the law enforcement efforts at KCA are effective in reducing illegal hunting 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 well as in the major cocoa 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 in order 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/primates, should contribute to continued discouragement of illegal hunting activities.

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*Lowe's monkey Cercopithecus campbelli lowei - Kakum Conservation Area.  
Photograph by Edward D. Wiafe.*

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