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# WILDLIFE CRIME AND RHINO POACHING IN SOUTH AFRICA: A QUALITATIVE DOCUMENT ANALYSIS OF PATTERNS AND FREQUENCY OF VISITATIONS OF ADVENTURERS

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**Abstract**

The study describes rhino poaching as an illicit anti-social behaviour that has constantly been on increase in South Africa. Predominantly, KwaZulu-Natal, and specifically Hluhluwe-iMfolozi Park, became a highly protected zone for biota and wildlife sustainability. However, with environmental crime becoming more sophisticated in this province, criminal justice and anti-poaching teams need to be more equipped continuously with the necessary tools and strategies, required to stand united against wildlife crime. The study adopted document analysis to explore the use of cell phone data records as a forensic investigative instrument for tracing the frequency and patterns of activities of the two largest syndicate groups of rhino poachers from Mpumalanga and Winterveld to Hluhluwe-imfolozi park. Findings unfolded that cell phone records are a viable cellular geographic tool for tracing the footprints, patterns of movement and activities of illegal rhino hunters, affecting the poaching levels at Hluhluwe-imfolozi Park. The study's findings were incredibly insightful into the behavioural activities of poachers, being one of the first to broaden the lens of cell phone data analysis on this scale. Evidence from the movement analysis revealed that poaching depends on a multitude of factors, such as global pandemic, border control measures, poaching levels rising in reserves, decreased policing measures and a lack of proactive strategies. The study concludes that cell phone data records, considered in isolation, cannot be reflected upon accurately, as a panacea for wildlife crime, without supporting facts from police procedures of intelligence gathering, local knowledge and partnership with local communities. Lastly, within the specific study area, it allows a unique view and perspective of the travel patterns of very sophisticated and advanced syndicate groups, as well as creating room for additional deeply rooted studies of poaching activity and incursions in South Africa.

**Keywords:** Cell phone data analysis, Environmental crime, KZN Wildlife reserve, Rhino poaching, Wildlife crime, Wildlife trafficking.

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## 1. Introduction

Wildlife trafficking is a purge, of which some estimate is worth 523 billion USD annually; it spreads across and beyond 120 countries globally and involves the illicit trade of many species, including mammals, reptiles, marine life, such as bony fish and abalone, birds, and corals [1]. This trade has dire effects on wildlife and ecosystems as it moves from source and transit across destination countries, through wildlife trafficking networks. The consequences of this type of trafficking stretch beyond direct impacts, which is the loss of biodiversity. Experts have largely begun to notice the effects on the economic and social spheres of regions. Interpol experts proclaim illegal wildlife transactions can generate illegal profits between ten and twenty billion dollars annually, pushing wildlife crime up the crime ladder to be placed second to the trade of drugs [2].

Although wildlife trafficking is occurring in at least 120 countries around the world, Africa is home to many high-profile species, protected areas and people, touched by the global criminal econo-

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my (for example, Pangolin scales to Asia; African grey parrots to Europe; cheetah cubs to the Middle East; African vulture brains from Cameroon to South Africa) [3]. Poaching diminished Africa's wildlife species by the millions and now the remaining wildlife populations are dangerously small-scale compared to the steadily growing illegal trade and the changes in sophistication. Africa, while megadiverse, continues to be a central place for global wildlife trafficking exploration, policy and program; as well as widespread vulnerabilities in African regions [1]. Law enforcement, border and customs control authorities, coupled with the corruption, entrenched throughout public and private sectors, well establish transnational criminal networks and further deepen the illegal trade in illegal animal and plant species [1].

In southern African regions, core species, such as the elephant and rhino populations, have never been more threatened than they are currently [4]. Organised groups with heavy powered weapons and ruthless killing techniques, united with the profits from trading, are leading to an advanced era of faster trafficking to demand centres. According to the Foundation, pangolin scales, elephant ivory, rhino horns, lion and zebra skin, not sparing live animals, such as baby chimpanzees and cheetahs, are among the many at-risk species and commodities that are more easily finding a way into the global trade network.

Rhino poaching is ever on the increase. We are actively fighting the war against poaching daily, attempting to stay one step ahead of the novel and sophisticated poaching groups within the country. Rhinos have been around for millions of years and play a vital role in their ecosystem [5]. They are vital grazers, consuming large amounts of flora, which helps form the African landscape. This benefits other animals and keeps a healthy balance within the ecosystem [5]. Rhinos are an umbrella species, which signifies that their survival impacts other animals too. Due to understanding the importance of an umbrella species, we also learn how to conserve nature for our own survival by protecting the larger environments. As one of Africa's Big Five, rhinos are amongst the most marvelled by all and are a key part of ecotourism, which can be an important source of income for local people. Rhinos are our heritage, and as South Africans, we have a duty to protect and preserve our heritage for future generations [5].

This study centres on the Hluhluwe-iMfolozi Park (HiP). The HiP was "established in 1895 and is one of the oldest game reserves in Africa" [6]. The HiP provides sanctity to a variety of species and was declared a protected area in 1897 to prevent the mass slaughtering of species, such as the white rhinoceros [6]. In the core of the Zulu Kingdom towards the last century, the last ten existing southern white rhinos clung on for their survival, and in the years that followed, trophy hunting and poaching for horns made a significant dent in this sub-species of the white rhino [7]. The species held on and survived the brutal attacks. Presently, it is the HiP that became the haven for the last remaining southern white rhinos.

The HiP also became a sanctuary for the endangered black rhinos, which marked the beginning of an era that emphatically promoted rhino preservation. "Operation Rhino is one of the great conservation success stories of the 20th century and perhaps partly explains the deep emotional attachment and pride that many South Africans feel for their rhinos" [7]. According to Sterne, Operation Rhino revived the southern white rhino populations and by 2010, made up almost 90 % of all rhino species in Africa.

Outside of the well-known Kruger National Park, the HiP faces an anti-poaching battle daily. Security in the Kruger National Park has been fortified by the establishment of an "intensive protection zone" which has lowered the total amount of killings [8]. However, as an unexpected counter-effect, the poaching scourge has altered its focus and position. KwaZulu-Natal (KZN) encompasses smaller wildlife havens and reserves as well as private game reserves. According to Somerville, most of these reserves have rhino populations that have been on the increase over the years and these populations have become the target for poaching syndicates that organise the illegal trade. "The ability of criminal syndicates to evolve their operations to take account of improvements in security in some areas suggests a shifting and complex war between anti-poaching units and the poachers, weighted in favour of the killers and smugglers" [8]. The year 2017 brought a rise in poaching statistics in KZN; the 48 % rise was linked to the Mpumalanga poaching syndicates who were accessing the Kruger National Parks' large reserves. These poachers began targeting Zululand reserves because of increased security efforts and anti-poaching strategies, implemented in their own provinces [8].

Investigations into wildlife-related offences uncovered that cell phones and emails have become significant and key instruments for poachers, who now rely greatly on the internet to co-or-

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dinate their movements and activities. In addition, they employ global positioning system tracing in pinpointing their poaching targets [9]. Over the years, a lot of work and research has been conducted in relating cell data records to the field of wildlife trafficking as a whole and rhino crimes in particular. Crime mapping and spatial analysis plays a vital part in identifying and shaping new forms of analytical representations and visualisations to understand these crimes better and to respond adequately to the problems that arise from criminality. The need for a tool to understand its causes at a local level turned to decisions in support of geographic information systems and other similar technologies to find better solutions [10].

With the emergence of geographic information technology and its successful use as a tool for crime analysis and forecasting, the study uncovered that modelling of historical or current crime data to identify spatial crime patterns has emerged as a new research area [11]. Geographic information system tools and similar technological software have been used to track crime patterns over time and place to be able to harness this data information into predictive models that help prevent the next incursion or the next environmental crime. A current map of criminality has been used by enforcement agencies to analyse threats and conduct spatial analysis thereby identifying vulnerable areas, for example, roads along the boundaries of reserves that are routinely traversed by poachers. Crimes of this nature were analysed spatially, taking into account any social and demographic variables that would contribute to the trafficking [10].

The roads and villages around reserves together with the empirical data, supported by cell phone records, assist wildlife enforcement personnel in forming strategic decisions based on which areas needed additional security monitoring. By supplementing empirical data with the added cultural components of a given area or node, cell phone data and mapping proved extremely useful in preparing resources around data charting to reduce invasions into any protected area. For the South African Police Service (SAPS) cell data records aided investigation techniques and the SAPS uses these records to determine the activity space of suspects using both active tracking methods (live and current placement) and retrospective analysis (past records of movement to determine activity nodes and travel routes); these findings are always supported by local knowledge of an area [12]. "The analysis offers the investigative team an effective method to brief a new unacquainted investigating officer who joined the investigation with regard to the suspect's activity space, anchor points and the suspect's day/night activity" [13]. In 2018, a major wildlife trafficking case was tried and finalised in the Grahamstown High Court (Eastern Cape).

Most poachers of the organised category travel to KZN from other provinces. Gauteng and Mpumalanga poaching groups form the two largest groups, travelling in and out of the wildlife reserve. Although cell phone data analysis has been used over many years in South Africa, nationally and provincially, there is a great necessity to conduct research and to produce empirical findings in recognition of the use as a support tool for anti-poaching strategies within KZN specifically. Furthermore, as supported by literature thus far, KZN is showing increased levels of incursions and rhino poaching. Through embarking on an analytical journey to meet the objectives of this paper, the gap in research will expectantly be filled with incredibly valuable information, starting with identifying patterns of movements and visitations to the HiP and the suspects behind these activities to theoretically unmask the demographics and typical nature of those involved in these illicit activities, establishing a nexus between what has been published and how these findings can aid in predictive policing. In current pandemic times, it is of vital importance to also include the need for an understanding of how global problems can have an impact on every sphere of the world, right down to wildlife trafficking and the consequential effects on the livelihoods of environments and biota. By using the data, obtained from cell phone records, in conjunction with applying the results, acquired by a well-rounded study approach, examining both present and retrospective material, this report will greatly aid anti-poaching strategies and help curb the possibility of an entire species, facing extinction due to human greed and poaching.

The study essentially aimed at describing the cellular geographic footprint as a forensic investigation tool for tracing the patterns of activities of rhino poachers from Mpumalanga and Winterveld to HiP. The scope of this study set out to gather qualitative data that were collected using the cell phone data of two of the largest syndicate groups, affecting KZN, namely, the known Mpumalanga and Winterveld groups.

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## 2. Materials and Methods

Document analysis is a form of qualitative research that uses a methodical technique to analyse documented evidence and respond to particular research questions. Like other techniques of analysis in qualitative research, document analysis involves recurrent examination, analysis, clarification, and interpretation of the files to elicit responses of significance and pragmatic knowledge of the concept being studied [13]. Content analysis is the study of documents and communication artefacts, which might be texts of various formats. Social scientists use content analysis to study patterns in communication in a replicable and methodical manner [14]. Content analysis is a research tool, used to delineate the existence of certain themes within a source of qualitative data such as cell phone records.

There were no active participants in this study. The cell phone data analysed was current data, from 2017 to 2019. Data was approximately 10 % of the DFFEs larger cell phone data pool, which consisted of a total of approximately 400 cell phone records, this total included suspects from KZN and the outer provinces. The Mpumalanga and Winterveld (Gauteng) suspect groups, as mentioned above, are the two largest groups, affecting poaching levels in KwaZulu-Natal. The study focused on five suspects from Winterveld and ten from Mpumalanga, encompassing a total of 15 phones. The greater threat to the HiP is from the Mpumalanga syndicates, therefore ten suspects were selected in comparison to the five from Winterveld suspects whose focus is still on the Northwest Province predominately and a minor pressure on the HiP's western and south-western boundaries. The suspects from each grouping were chosen based on their notoriety and higher levels of criminal activity and connections, well known to have links to KZN; ergo analysis of their records yielded more accurate results since they had been known, through intelligence, to frequent KZN reserves. An analysis will still be done in this phase, to determine if other devices were used. The investigators further reduced the analysis node to include one reserve only in KZN (the biggest, most affected by poaching), namely, the HiP. The analysis and investigation involved a study of routes and locations, traversed by these two groups of poachers, to and from the HiP. By focusing research on one location, using specified data sets, the researcher could anticipate more accurate results that can be generalised and compared to infer notable conclusions and greater understandings. The names and cell phone numbers of offenders were kept anonymous to ensure the necessary security measures were followed.

The investigators chose the sample data, retrieved directly from network providers (MTN, Cell C, Vodacom and Telkom), subpoenaed by the DFFE through the SAPS, which are the two of above-mentioned sets. These files were input by the researcher in software, developed and tested to analyse/map cell phone data of this magnitude. The software is a first for KZN and has been developed with the guidance of the Wildlife Crime Data Manager. The software is named Vimbela, which is a Zulu word meaning to block, prevent, hinder or prohibit. The software enabled the researcher to identify patterns of movement and to draw out relevant conclusions based on the patterns visible. Since the investigators already had all the data, needed for the study, the analysis of this information as well as drawing of meaningful results was the essence of the investigation phase. As discussed above, document analysis was adopted as a methodological approach to investigate this phenomenon in relation to the existing literature. Finally, the data information obtained was analysed by content analysis and findings were discussed within the confine of crime pattern hypothesis.

**Ethical Approval**

This study was conducted according to ethical standards. A successful ethical clearance certificate was received from the University of KwaZulu-Natal's Research and Ethical Clearance Department, which clarified that no ethical concerns were tied to the research and structure of this research.

**A Crime Pattern Hypothesis to the Understanding of Rhino Poachers' Patterns and Frequency of Visitations**

Crime Pattern Theory (CPT), developed by Paul and Patricia Brantingham in 1984, was considered an important theoretical approach to the understanding of rhino poaching in South Africa. This theory is also closely associated with the rational choice and routine activity theories. It was thought, that there was a much sturdier physical geographic resonation within the cognitive process of committing a crime. Labelled the *action space*, it is theorised, that movement from one

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area, or node, to another creates an awareness space: places and pathways that have a general familiarity to offenders due to the rate of the frequency, with which they are traversed. Town structure and means of transportation can also affect the development of offenders' cognitive maps. All this movement, from one node to another, creates a cognitive map: a mental visualisation of all familiar places and paths [15].

As implied above regarding the familiarity of geographic space, rhino poachers, travelling from Mpumalanga and Winterveld to KZN, are travelling interprovincially rather than between countries and this makes learned routes much more suitable. If poachers are travelling along the same routes, through the same areas, stopping over at almost the same locations or vicinities, it constructs stronger cognitive maps and a perceived confidence of travelling on known routes and roads. This can also be applied when nearing the HiP and exiting the HiP. If these routes are known to be safer for poachers, they are more likely to go on using them and creating footprints of patterns as they do. Safe-houses may exist along routes towards suitable targets, which could be possibly identified through retrospective analysis of the poachers' traversed pathways. A means of transportation when exiting a reserve can create a motivated offender if it is perceived to be one of the mitigating factors when weighing out possible risks versus the rewards in comparison. Offenders are more likely to use routes familiar to them, which makes it vital for the researcher to attempt to identify these hotspots and disturb the motivation of these offenders. Using the CPT to understand environmental crimes should be considered in conjunction with the routine activities theory and the rational choice theory of crime. Exploring the decision to use a specific route and becoming familiar with any given node is based on its ease of access and the establishment of routine activities for all role-players involved. The CPT is often brought into this dimension of environmental crimes to determine physical or social boundaries that may allow or inhibit a crime to occur with ease. For instance, a weak fence around a reserve, located close to a roadway that allows free and easy access, will likely become the first preference for potential poachers [16]. A border post near a reserve with enforcement officials, easily swayed by bribes through corruption, can turn a suitable target into a desired pin on an offender's cognitive map. These spaces, activity focus points and pathways, all work in cohesion to contribute positively to a poachers' awareness space.

In turn, the offender's familiarity and comfortability with the surrounding areas or routes become fixed in their cognitive maps and dictate the directions of their awareness space. With time elapsing and an offender successfully poaching, escaping, and being able to access the same areas leads to these spatial patterns, being embedded in the offenders' crime template [17]. In engaging areas of their cognitive maps with the routine activities of targets and the rational choice of crime over perceived risks, offenders become more aware of signs in spatial situations that can indicate when the best time to commit a crime. The CPT can help understand the unique flow of wildlife trafficking and help possibly forecast how offenders seek out opportunities to commit crimes, while simultaneously exploring why certain areas experience more criminality than others do. Crime distribution in terms of poaching can be largely concentrated and not dispersed randomly. Contradictorily, the collection of animals within a single reserve creates a hot spot in itself to provide ease of access to potential poachers.

A study conducted by Stanislawski [18], discusses three pivotal factors that help define *black spot,* which are advantage points for offenders to commit crimes: "(1) they are outside of effective governmental control, (2) they are controlled by alternative, mostly illicit, social structures, and (3) they are capable of breeding and exporting insecurity (for example, illicit drugs, weapons)." Borders, roads, less routinely patrolled, pathways away from the public eye, across bridges and water masses that enter into an animal's habitat, create opportunities to move through reserves without detection. In unification with rangers and military personnel who double as spotters and sellers of commodities, offenders can blend into illicit social structures, which creates a space for moving the commodity out of reserves, towards a country's borders with minimal risk of apprehension. The CPT can describe transnational movements of commodities, as certain transit routes may offer more protection than others may, which in turn provides traffickers with common routes to smuggle a variety of contraband to destination countries. For example, in a study on the illegal networks of poachers using the CPT, by Nan in the year 2015, it was found, that ivory smugglers preferred to transport the commodity into China through a neighbouring country, such as Vietnam, and found it riskier to transport it directly from Africa, the source country.

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This is an interesting conundrum for further research, as horns and ivory are often smuggled together and both types of products can be converted into easily sized, portable commodities, such as jewellery, figurines, and powder. Considering an individual's activity space should not only map out areas of proximity to reserves, but it should also include an expanded view of the entirety of a person's journey, as described in the rational choice model, the journey space of an offender. By consistently analysing the route choices of offenders (inner roads versus national or main roads) hot spots can also be broadened to feature roads and areas, routinely traversed. With a further in-depth look at a larger map of patterns, it may be possible to infer a person's behavioural trends, for example, where does a person most stopover on a journey? A casino, a lodge, a service station? Does a person prefer to travel directly to a border, or does the offender stop in a location to hand over a commodity to the level 3 transporter, who then takes the product to a local buyer? These may be educated assumptions in painting a larger picture of a person's nature and illicit activities. The possible answers to these questions, supported by empirical evidence, pave a way for the CPT to lead discursive paradigms on environmental crimes and their contributors.

A theory of delinquency should be flexible enough to mould it against the diverse contributors in the foreground, such as the scene, setting, motivational factors, suitable targets, current trends and times. Theories should be measured and deliberated together to understand individual and group-level decisions, operating across syndicates and space. Shaping patterns of criminality and producing an all-inclusive solution to environmental crimes, as well as building on existing theories present researchers with the ability to aid or direct policy formulation.

## 3. Results

By analysing the movement patterns of rhino poachers from two of the largest syndicate groupings, affecting poaching levels at the HiP, it was unravelled, that the Eastgate and Westend suspects preferred using national, provincial and regional routes when travelling to and from the HiP, and commonly entering northern KZN through Pongola and using the N2 national road to travel within and around KZN as shown in **Fig. 1–3**.


**Fig. 1.** Syndicate distribution

Eastgate suspects mostly left from Mkhuhlu or Shabalala Trust and Hazyview during the early morning hours and travelled along the N4 and N11, passing through Emahushu Mpuma-

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langa, Casterbridge and Nelspruit. Thereafter using the R38 and R40 during the day, joining the N2, mostly from Ermelo and travelling further south towards Piet Retief in Mpumalanga, passing through Potgietershoop and thereafter reaching Pongola, KZN in the evening, maintaining travel on the N2. The duration for a regular trip to KZN from Mpumalanga is just over six hours. These suspects proved this consistently and mostly travelled through the day without staying over for long period mid-journey. Although 20 % of this sample did branch off towards Vryheid after reaching Piet Retief, the majority of suspects in this grouping travelled to Pongola after passing through Piet Retief via the N2.

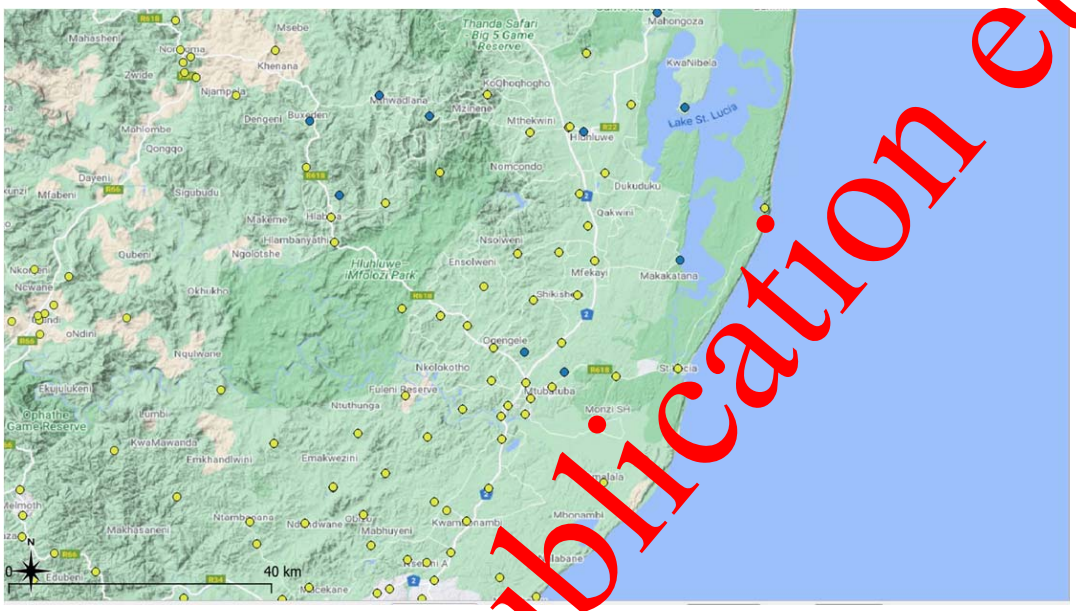


**Fig. 2.** Eastgate route preferences

The Westend suspects, although maintaining similar activity patterns once in KZN, had comparatively and distinctly clear travel patterns to and from KZN. They mostly left from Winterveld, a town in Gauteng, and travelled to KZN using one of two routes. The first is the N4 and N12. With both routes out of Gauteng, this grouping preferred to travel at night. As mentioned, the Westend suspects used the N4 and N12 out of Gauteng, joining the N11 at Ermelo and finally making the journey down towards Piet Retief, maintaining travel on the N2 south to Pongola during day. This sample of the Westend grouping did not branch off towards Vryheid upon arrival in KZN but stayed in the vicinity and proximity of the HiP for the duration of the stay. The second route used was along the N17 through Bethal, thereafter, joining the N2 at Ermelo and journeying down south towards Piet Retief, following the N2 route, entering KZN through Pongola.

Although exhibiting similar travel patterns as the rest of the grouping, these suspects left Gauteng at night, reached KZN in the day or early evening, and left KZN either on the same night or early the next morning, travelling back to Gauteng through Ermelo, which was the route, used to enter KZN. Both suspect groups remained in the local villages and communities, which closely surrounded reserves and they rarely travelled out of these smaller towns and villages, except for traversing to the Durban tourist destinations. Although both groupings have distinctly similar and different trends to note in terms of moon phases, coupled with time categories when both groups are in and around the HiP, the details are the same. The syndicate distribution closest to the reserve, overlaid with moon phases, revealed that most movements occurred under the waxing and waning gibbous moon phase, secondary to this was the full moon and waning crescent.

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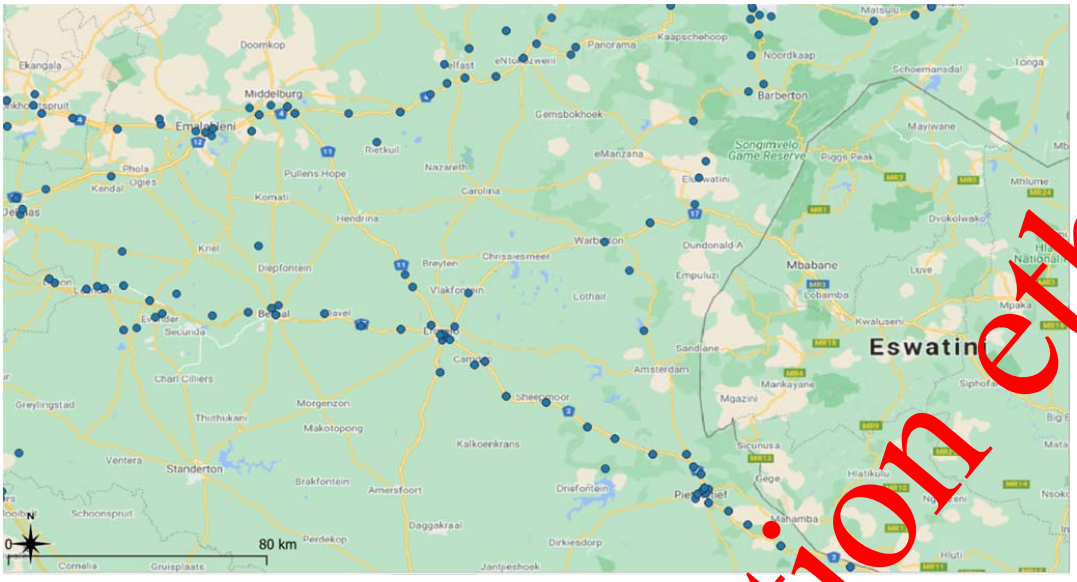


**Fig. 3.** Westgate route preferences

**4. Discussion**

By delving deeper into the movement patterns of rhino poachers from two of the largest syndicate groups, affecting poaching levels at the HiP, the insights were incredible and unanticipated. Syndicate groups displayed similarities and stark differences when their movement patterns were analysed. Both groups remained within the vicinity of the HiP for most of their stay in KZN, in areas very close to the reserve, such as Hluhluwe town, Mtubatuba, St Lucia, Nkatha, Ocilwane and Hlabisa. Both groups also ventured further south and stopped over in common tourist destinations in Durban, such as Ushaka Marine World and the beachfront. The Eastgate and Westend suspects also preferred to use national, provincial and regional routes when travelling to and from the HiP, commonly entering northern KZN through Pongola and using the N2 national road to travel within and around KZN. Suspects from these two syndicates differed in terms of the duration of stay. While Eastgate members remained in KZN for longer periods and across months, Westend suspects stayed for several days in between their journeying to and from the HiP. Westend suspects mostly travelled at night, reaching KZN during the day, whereas Eastgate suspects travelled predominately during the day. Although travel times and durations differed, both groups were in the vicinity of the HiP mostly at night and during similar lunar phases, which were the waxing or waning gibbous and the full moon. These phases provided the best illumination in comparison to the other moon phases, which as previously theorised by those working in law enforcement, is one of the key needs of a likely poacher planning to spend a significant amount of time in a remote area with no artificial lighting. These findings were incredibly insightful into the behavioural activities of poachers, being one of the first to broaden the lens of cell phone data analysis on this scale. Within the specific study area, it allowed a unique view and perspective of the travel patterns of very sophisticated and advanced syndicate groupings, which also created room for additional deeply rooted studies of poaching activity and incursions at the HiP in KZN.

The limitations can be improved in future studies. These include: Any assumptions derived from the data, for instance, although we can delineate the movement of suspects, we cannot assume the motivation for a visit to a game reserve, purely based on the cell phone or movement records, we also cannot impose a meaning behind a suspect stopping over at a given location. Larger gaps in communication (long periods between phone calls) lead to gaps in the records as well, which can reduce the probability of consistent movement analysis if a location could not be detected. In tandem with this notion, those suspects who are knowledgeable on the uses of cell phone records can opt to use their device less, leading to limited record detail. Where there are no frequent visits to a specific location, such as the HiP, patterns may not be helpful to understand the activities, leading to poaching at a specific game reserve, but may still be useful in general movement analysis. Last-

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ly, cell phone data records alone, considered in isolation, cannot be reflected upon accurately, as a panacea against wildlife crime, without support from local knowledge and gathered intelligence. These records should work in tandem with police procedures and informer knowledge, rather than being considered independently without supporting facts.

## 5. Conclusion

The study brought to the fore the importance of using and developing forensic tools, in specific cell phone data records, as a tool that can be adapted and applied to meet the requirements of investigations into rhino poaching and related crimes. Although these records have been touched upon by previous research, this paper aimed to bridge the gap between previous work, focusing on cell phone records, used predominantly for 'hot-spot' and crime mapping, as compared to this hypothesis, which explored the indispensable use of cell phone data records to determine movement and behaviour patterns of rhino poachers, a research topic, rarely explored in comparison to other environmental crimes. Based on the findings of the research conducted, it can be asserted, that rhino poachers, like other types of sophisticated groups do, and as previous research and criminological theories have delineated, develop their own cognitive maps, rational actions, routine activities, and modus operandi when planning to execute a poaching. These can be seen when analysing their movement patterns over time. Rhino poachers from this sample preferred national and regional routes and exhibited patterns of time and place. The movement analysis revealed that movement patterns also do exist within wildlife trafficking groups and poaching may be dependent on a multitude of factors, such as the global pandemic, border control measures, poaching levels rising in smaller reserves due to the implementation of increased policing measures in larger reserves and various proactive strategies.

Although this ties up with empirical evidence, it is important to note, that different groups of syndicates or networks may evolve and develop their own modus operandi. Therefore, it is important for future research studies to go deeper into the study of poaching related crimes, as other crime types have been explored, and to use cell phone data records with other syndicate networks, demographic groups, and within different geographical nodes to develop new criminological theories, which can be used as a baseline for crime prevention.

## Conflict of Interest

The authors declare no conflicts of interest.

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