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The nature of rape places

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ABSTRACT

The objective of this article is to characterise the distribution and the urban landscape in which outdoor rapes happen in Stockholm, the capital of Sweden. Geographical Information Systems (GIS) underlie the methodology of this research that combines crime police records, police protocols and information from fieldwork of a sample of rape places. Rapes are concentrated in the inner city areas but follow a patchy pattern in some parts of the periphery. Rapes happen in places with poor visibility but that offer an easy escape for the offender. A large share of them happen in the weekends, holidays and hot months of the year, which can be associated with unstructured leisure routine activities of individuals. Results show that the role of environment on the occurrence of rape varies over time and space – a fact with important implications for research and safety interventions.

1. Introduction

> *After a night out in the summer a woman in her twenties is on her way home. When she walks through an isolated area she is attacked by a stranger who rapes her there. The woman gets harmed physically. Within a couple of hours she reports the rape to the police and also goes to the hospital. After some time the preliminary investigation is closed due to lack of evidence that can move the enquiry forward*
>
> BRÅ, 2005:31.

This course of events has been described by BRÅ, the National Council for Crime Prevention as a typical case of the rape that takes place outdoors in Sweden. About 6000 cases of rape are recorded by the police in Sweden (including attempts), 1500 cases only in Stockholm County, and between 20 and 30 per cent of rapes happen outdoors, in public places (BRÅ, 2012). Although outdoor rape constitutes the minority of the cases (most rapes take place indoors committed by a person the victim knows), these are the ones that can potentially be affected by the urban landscape. However, not much is known about these rape places. Are they parks, industrial areas or vacant land? Are they concentrated in the periphery? Do these environments lack street illumination? How many cases happen close to a transport node (e.g., a train or bus stop)? Are these places more targeted in the long dark winters? So far, what is known is that some of these rapes happened in a built up area, others, in an isolated spot in the neighbourhood (BRÅ, 2005). What can one learn from the nature of these places to better assess the role of environment in these crime events?

Knowing about places of rape is important for two main reasons. From *the offender's perspective*, acts of rape are an outcome of a perception–choice process initiated by the interaction between the individual's crime propensity and his exposure to a criminogenic place (some of these issues have already been analysed in the north American context, e.g., Beauregard, Rossmo, & Proulx, 2007; Duwe, Donnay, & Tewksbury, 2008). From *the victim's perspective*, knowing about the nature of these places provides informative and practical support for intervention which may have the power to prevent outdoor rapes to occur.

The objective of this study is to characterise the urban landscape in which outdoor rapes take place in the capital of Sweden, Stockholm. By doing that, the article assesses the importance of principles of routine activity crime pattern theory and defensible space theory (Brantingham & Brantingham, 1984; Cohen & Felson, 1979; Newman, 1972) to support the understanding the dynamics of nearly a third of all rapes in Sweden. The study also investigates daily, weekly, and seasonal variations of rape across the urban space. So far, the lack of knowledge about the nature of rape places and its distribution in the Swedish context has provided little basis to understand the role the place has in target selection. By making the crime place the unit of analysis, the focus shifts from the offenders, to the environment that structures, facilitates, and allows the crime to occur (Wortely & Smallbone, 2006).

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What this article does not do is to attempt to explain why rape happens in a particular place. Neither information about offenders' or victims' whereabouts is included in the analysis. These issues are relevant but outside the scope of this article. They are dealt with elsewhere by Ceccato (2012) and Ceccato, Haining, and Guanquan (2014) in other articles.

The Swedish capital is used as a study area for several reasons. First, this analysis is part of the Stockholm rape study, which is three year project funded by The Swedish Research Council FORMAS. One of the goals of this research project is to investigate the spatial dynamics in which outdoor rapes take place, including the victims' whereabouts before the rape. Knowing about the spatial features of these places, as documented in this article, is a way to achieve this goal. At least in the Swedish case, criminologists have not made enough use of available data and methods that, as suggested by LeBau (1987), enhance the description, measurement and explanation of the relationships between space, time and crime.

Second, Sweden constitutes an interesting case since the country has the highest rape reporting figures in Europe, but one of the lowest conviction rates (Lovett & Kelly, 2009). Sweden has a strong reputation for addressing violence against women, which partially explains such high rape reporting rates. These recent reforms were influenced by a tradition of gender equality policy and legislation, as well as an established women's movement, that culminated with the 1990s '*Kvinnofrid*' (The Violence Against Women Act) and changes in the penal code since 1st April 2005. This introduced a holistic package of measures, which intended to address violence against women. These measures include crime definition, improvement of support to victims of rape, knowledge building and public debate about sexual violence. The legal definition of rape has been successively broadened over the last decades. For instance, it means that certain acts previously classified as sexual exploitation are now classified as rape. The definition of rape is forced vaginal intercourse or a comparable sexual act, which is carried out by assault or threat of violence. A rapist is: "A person who, by violence or threat involving or appearing to the threatened person as imminent danger, forces the latter to have sexual intercourse or to engage in a comparable sexual act[1] […] Having intercourse with a person who is unconscious, sleeping, intoxicated, handicapped or in similarly helpless state shall be regarded as equivalent to rape by threat or violence" (Chapter 6§1, Penal code). In this study, the cut-off point victim age is 15 years old. All police records are constituted of outdoor rape cases; in the majority of them, the victim did not know the suspect(s) 24 h before the event.

Finally, another reason of having Stockholm as study area is the lack of evidence from Scandinavian cities. Most of studies on rape draw conclusions from North American and British contexts and very often they are devoted to serial rapists (e.g., Beauregard, Proulx, & Rossmo, 2005; Beauregard et al., 2007, 2010; Belknap, 1987; Canter & Larkin, 1993; Deslauriers & Beauregard, 2010; Erlansson, 1940; LeBeau, 1985; 1987; Mustaine, Tewksbury, & Stengel, 2006).

The article first reviews the literature in sexual assault and environment as a basis for the analysis, then, the description of the study area is presented by some facts about the dataset and method. The final sections present and discuss the results, making suggestions for future research.

[1] Rape is not confined to penetrative act, comprise all sexual behaviour comparable in nature of the violation or the prevailing conditions. The maximum penalty is two to six years in prison, or four to 10 years for 'gross rape', depending on level of violence and whether more than one person assaulted the victim.

2. Theoretical background

2.1. Rape

There has been a vast body of criminological research on rape. While several studies have focused on the rapist, many others have focused on the victim, the law, and rape as a crime (for the last, see Amir, 1971; Basile, 2000; Beauregard et al., 2010; Davies & Dale, 1996; Goodwill & Alison, 2005; Hewitt, Beauregard, & Davies, 2011; Kocsis & Irwin, 1997; LeBau, 1987, 1992; Reboussin, Warren, & Hazelwood, 1995; Rossmo, 2009; Rossmo, Davies, & Patrick, 2004; Warr, 1988; Warren et al., 1998). The literature on places of rape show that rapes are often committed not far from offender's home (e.g., the seminal work by Erlansson, 1940), but he intentionally avoid home range because of the lack of anonymity (e.g., Amir, 1971). The offender's potential target area can be an isolated but familiar spot in his own neighbourhood (Beauregard et al. 2007; Mustaine et al., 2006; Tewsburry & Mustaine, 2006). In studies that looked specifically at places of rape (LeBeau, 1985; Pyle, 1974; Rhodes & Conly, 1981) found that offenders repeatedly use the same geographic and ecological space. This is because most 'potential criminals do not search through a whole city for targets; as suggested by crime pattern theory, they look instead for targets within their more restricted awareness space' (Brantingham & Brantingham, 1984:365), although a few would travel far (Canter & Larkin, 1993). Offenders are likely to decide on a suitable place to offend based on the likelihood of finding suitable targets, the latter being a function of the number of "potential targets" (women) in one location (Bernasco & Nieuwbeerta, 2005). Being close to public transportation can indicate both a source of potential victims as well as an easy escape because these places are areas of convergence (Brantingham & Brantingham, 1995). The ability to escape from the crime scene (by being close to public transportation, for instance), plays an important part in the process of offenders' targeting selection (Beller, Garelik, & Cooper, 1980). In the Stockholm case, it is expected that rape cases are located in areas that allow easy escape and access to public transportation.

Although not much has been documented about possible relationships between the time of the rape and its location, the literature show examples of general time trends that can be related to the variation of people's mobility across the year. The issue of time is relevant because as suggested by Cohen and Felson (1979), an individual's activities and daily habits in different parts of the urban environment are rhythmic and comprised of repetitive patterns, which in turn, affect crime. They suggested that for criminal event to occur, there is not only a need for a criminal, but also a suitable target and the absence of a capable guardian – this constitutes the basis of routine activity theory. For rape, Amir (1971) found that almost half of rapes occurred in the evening and night hours (from 8:00 p.m. to 2:00 a.m.) and two-thirds of rapes up to early morning hours (8:00 p.m. to 8:00 a.m.). In an extensive review of the effect of weather variations on crime, Cohn (1993) indicates also that lack of daylight has been predicative of rape. Therefore, *most cases of rapes in Stockholm are expected to follow some time variation, concentrating in evenings and nights.*

Weekends are often associated with individual's leisure and less structured activities, both in time and space (e.g. Ceccato & Wikström, 2012:183) and rape may occur particularly when victims become more exposed to less familiar places. Amir (1971) found that a quarter of offences occurred on Saturdays, Sundays and Fridays and Warren et al. (1998) indicated that the farthest travel distance of rape offenders occurred at weekends. Changes in people's routine activity are dictated by periods of holidays and vacation. For instance, Gabor and Gottheil (1984) found that the majority of rapes took place during the summer season in Canada,

and that offenders assaulting in the winter season were slightly more mobile than those operating in the summer. Långström (2013) also suggested that indecent exposure in public places in Sweden increases significantly during the hot months of the year, during vacation time, especially in inner city areas. Therefore it *is expected that in Stockholm most cases of rapes happen during weekends and vacation time, when individuals develop unstructured activities and become exposed to unfamiliar places*.

2.2. City structure and rape

Rape tends to occur in areas characterized by construction, urban renewal, fields, streets, paths, parks and temporary lodgings (e.g., Belknap, 1987; Canter & Larkin, 1993; Deslauriers-Varin & Beauregard, 2010; Pyle, 1974; Rhodes & Conly, 1981). In Sweden, evidence indicates isolated, non-guarded places are typical for outdoor rapes (BRÅ, 2005) but information about these specific locations and contexts in the city are often missing in these studies. What does make a place a *rape place*?

In order to answer this question one needs to consider place both as location and as a context. This because as suggested by Brantingham and Brantingham (1995:3), "the urban settings that create crime (and fear) are human constructions … home, parks, factories, transport systems … the ways in which we assemble these large building blocks of routine activity into the urban cloth can have an enormous impact on our fear levels and on the quantities, types and timing of crimes we suffer". In other words, the type of building and their context in the neighbourhood influence what occurs on the streets surrounding them.

Theories especially from Architecture and Urban Planning developed between the 1960s and 1980s highlight the importance of urban environments and their relationship to the whole city in creating opportunities/barriers for social interaction (e.g., Jacobs, 1961; Thomlinson, 1969; Newman, 1972; but see Zelinka & Brennan, 2001). The most prominent scholar from that time, who linked ideas of social control to the way cities are built, was Jane Jacobs. Jacobs (1961) coined the term 'eyes on the street', stressing that the design of the built environment had a role to play in defining opportunities for surveillance and, consequently, crime. Newman (1972) argued for the role of physical design of the buildings in providing surveillance opportunities. Whilst Jacobs focused on the land use of the block and neighbourhood as a unit, Newman was interested in the building's micro-environment and its immediate surroundings. Both agreed, nevertheless, that spaces with adequate surveillance promoted by the environmental features could affect situational conditions for crime. Important to note that there is no deterministic claim that environment 'cause' crime. Newman (1972) suggested the design of buildings and their location has a role to play in defining opportunities for surveillance and, consequently, on choice of the rape place by the offender. Regardless the demographic and socio-economic context of an area, there are environments that provide better surveillance opportunities than others. *Rape places are expected to be secluded, offering poor visibility from outdoor environment.*

Although the activity one performs at a certain place and time is also relevant for rape, Schwartz and Pitts (1995:19) discard any deterministic link between activities and sexual assault ("no lifestyle offers complete protection against rape") and consider instead that there are certain circumstances in space that increase (or decrease) women's risks over time of being attacked. Most places are specialised towards either structured activities (e.g., hospital) or unstructured ones (e.g., bars, street corner). Others are multifunctional and allow both structured, as well as unstructured activities to take place. This partially explains why mixed land use in city centres, with a concentration of bars and restaurants and transport nodes, are more criminogenic places than residential areas (Bromley & Nelson, 2002; Sherman, Gartin, & Buerger, 1989; Smith, 2003; Wikström, 1991). Although licensed alcohol premises attract violence and vandalism (Budd, 2003; Roncek & Maier, 1991; Graham & Homel, 2008), not much is known about their influence on the location of rape events (see e.g., Canter & Larkin, 1993; Deslauriers-Varin & Beauregard, 2010; Wortley & Smallbone, 2006). It is expected that in Stockholm, rapes concentrate in areas of entertaining (including bars and restaurants), because of the routine activities they attract.

In summary, according to the international literature, places at risky of rape are expected to show a convergence of the following space-time situational characteristics: they are secluded (offer poor visibility from outdoor environment), located in areas that allow easy escape from the crime place (close to public transportation and entertaining areas). These conditions are maximised during the evening and night, weekends and hot months of the year, in periods of leisure time, when people are developing unstructured activities and spending time in outdoor environments, particularly in inner city areas. Do these 'expected space-time patterns' fit the ones found for rape in Stockholm?

Based on principles of routine activity, defensible space theory and crime pattern theory the Stockholm case is analysed against the distribution of rape cases across the city (the gradient), the space-time cluster analysis (both based on 415 cases) and inspection of the environment where rape places take place (76 cases). The analysis ends searching for an environmental signature for rape.

3. The study area

Stockholm is the capital of and largest city in Sweden. The case-study area is the County of Stockholm. The municipality of Stockholm had 881 235 inhabitants in 2012, while the Greater Stockholm area had over 2,1 million inhabitants. The study area is an archipelago well connected by bridges, roads and efficient public transportation, composed of a subway network, trams, commuting trains and buses. Contrary to what is found in many North American cities, Stockholm inner city is composed of residences, a mix of rental, cooperatives and private ownerships, where citizens enjoy a good quality of life, with high housing standards.

The 2010 safety survey shows that the majority of the adult population in Stockholm city do not worry about crime even though crime events tend to happen more often in Stockholm municipality than in the rest of the country (total recorded crime was 115 per 1000 inhabitants, whilst the rate for the whole country was 71 per 1000 inhabitants). Despite the fact that the percentage of those who experience anxiety or fear of becoming a victim of crime has decreased (from 18 per cent to 15 percent), there has been an increase in sexual harassment (Stockholm Municipality, 2011). Police statistics show also that total offence rates in Stockholm city increased 10 percent between 1999 and 2009. Of greater concern is the fact that this increase in crime and anxiety is concentrated in some outskirts. Some of these areas report that perceived safety is lower than the rest of the municipality (Stockholm Municipality, 2011) and have recently experienced the occurrence of violent riots.

Rape is one of the crimes that is least reported in Sweden (23 percent of sexual offences). While police reports of sexual offences have increased over several decades, the national victims survey shows that the proportion of people reported to have been victims of sexual offences remained relatively stable, representing approximately 0.8 percent of all respondents (BRÅ, 2011). Young men dominate the statistics of suspects, (98 per cent in 2011) while young women are overrepresented among the victims. Sweden's attrition rate is high compared with other European countries

(Lovett & Kelly, 2009), and in Stockholm is no different. Diesen (2009) shows, for instance, that the prosecution rate for all investigated sexual crimes is low in all police districts and that the quality of the investigations and prosecution vary over time, but also between and within the County districts.

4. Data

Three set of data are used in this study:

1) Police records of outdoor rape (Stockholm police headquarters, $N = 555$)

Police records from 2008 to 2009 were obtained from the police headquarters containing crime code, day and hour of the event and x, y coordinates (total of 555 cases). Cases of rape that took place outside Stockholm County or Sweden (or before 2008) and were recorded by the local police were excluded from the analysis. Using Police trial protocols of the cases, it was possible to eliminate cases that were recorded twice (e.g., when the girl was raped several times, or by different offenders in case of multiple rape). Only two cases had the same suspect, thus no serial rape cases were identified at this stage (which not necessarily means that they were not serial).

2) Police protocols (Prosecutor General's Office, $N = 415$)

Police trial protocols from 2008 to 2009 indicates that the victims are in majority female, two thirds aged 15–30, often single, did not know the suspect 24 h before the event (more than 2/3), Swedish nationals (but often not born in Stockholm), more than a third had consumed alcohol before the assault, 5 percent of cases involved mental disability and 3 assaults took place in the context of prostitution. From all cases, only 124 had some indication of a suspect (7% cases had multiple suspects). They were male, often older than victims, some above 50 years old, ethnic diverse, more than 2/3 non-Swedish citizen (in some cases the protocol was filed with the help of an interpreter), and often non-fixed residence; a few were accused of other offences.

3) Fieldwork on cases rape that reached out court ($N = 76$).

Fieldwork was performed in October and November of 2012 for all cases that reached court 76 cases in total (selected from Prosecutor General's Office, total was 415). These cases were selected as they offered a more complete set of information than those that never reached court. They often have data on the victims, the places of rape as well as some information of the suspects. One of the limitations of this sampling is that is covers only 18 percent of all cases – nevertheless a percentage that reflects those cases that yearly go on trial (Lovett & Kelly, 2009). Another issue is that the sample is not geographically homogenous and tends to underestimate cases that happen in the inner city areas, as these cases more often are closed, than those ones that happen in the periphery (Diesen, 2009). The aim of the field inspection was to indentify environmental clues and possible patterns of environments where outdoor rape occurs. It has to be kept in mind that although the fieldwork was both time and cost demanding, the sample of 76 cases provided only a basis for exploratory analysis on situational factors of rape. For details, see Appendix 1, Table A1.

5. Method

Data acquisition involved the collection of data from the police, police protocols and fieldwork on cases that reached court for 2008-2009. The acquisition of secondary data took nearly a year as both the Police head quarters and the prosecutors demanded a formal request and extra documentation from the university to approve the data usage. With the databases in hand, rapes were mapped by coordinates using GIS. The data from fieldwork was transformed in a database using spreadsheets and later analysed also using GIS. By examining the individual cases, one noticed that a couple of cases were duplicated (same case geocoded twice[2]) or were recorded in Stockholm but happened elsewhere in Sweden or abroad, and were therefore excluded from the analysis. Geocoding process reached all 415 cases.

The fieldwork took about two months and was done in two ways. Firstly, by taking photographs of the place itself and the surrounding areas. Some of these photographs were combined with those taken at the rape place and available in the Police trial protocols files. Secondly, places of rape were inspected by the researcher using a *template* that gathered information about the situational characteristics of the rape place (Fig. 1 and Table A2).

The place of rape was considered being the exact *location of the event* (x,y coordinates in a map and a spot in the field combined with observations performed in the immediate surroundings, from 10 to 30 m from the place of rape) size depending of the type of land use/built up area. For instance, a secluded place in a set of stairs is limited place which allows a field of view of 5–10 m at maximum compared with the area with few key land marks, which would perhaps impose a larger field of observation (e.g. open space from a bus stop close to a park). The template indicated whether the rape place was in a street, walking path, stairs, tunnel, park, whether it was illuminated, had good visibility, offered opportunity for hiding, the relation of the crime place to the surroundings (e.g., distance to public transportation, alcohol selling outlets, schools) and the overall *area characteristics* of the place[3] (e.g., main land use, predominant housing type, signs of vandalism, litter and social disorder). Appendix 1 lists in detail the data used in this study.

Moreover, in order to identify possible common environmental clues around rape places, distance analysis (e.g., buffers) were used in GIS. These measurements provided descriptive information of the location and spatial context of rape places.

Moreover, by using concentric circles in GIS, it was possible to assess the *spatial gradient* of cases of rape in Stockholm based on their frequency across space, from a point in the city centre to the Stockholm's outskirts. Since the gradient is not a standardised measure across space (as it provides an indication of frequency of events), a Standardised Rape Ratio (SRR) was calculated in order to obtain a complementary picture of the distribution of rapes. The SRR for unit i is given in equation (1):

$$\mathrm{SRR}(i) = [O(i)/E(i) \times 100] \quad (1)$$

Where $O(i)$ is the observed number of rapes divided by $E(i)$ which is the expected number of rapes. The number of rapes per female resident at risk was obtained by dividing the total number of rapes in the Stockholm by the total size of the chosen denominator (the female resident population aged 15 years and older). For each area i, this average rate is multiplied by the size of the chosen denominator in area i to yield $E(i)$. $E(i)$ can be interpreted as the expected number of rapes in area i under the assumption of a random distribution of rapes across the whole Stockholm. According to Haining (2003), this measure of relative risk is a way of

[2] If the person was raped twice in the same evening, police records show as different events with the same co-ordinates but different times.

[3] The framework used here was imposed by the land use/built up space of each location. It was believed that observations of the precise crime spot would lead to a limited picture of rape places.

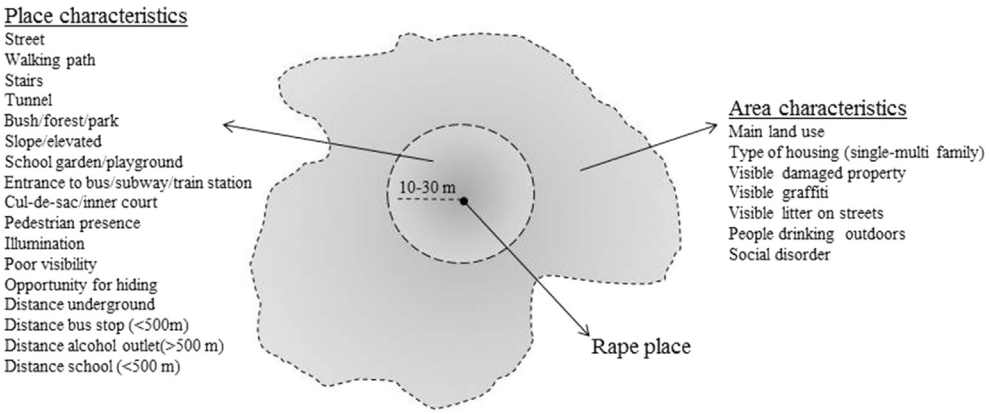

Fig. 1. Fieldwork template - Identification of environmental characteristics of rape place and immediate surroundings.

representing data for a set of areas where the areas differ in size and where it is necessary to account for differences in population characteristics between areas. The result was a map of relative risk taking into account the female resident population aged 15 years and older in each local geographical units in Stockholm County (*basområde*).

Variations of rape locations were checked over time, by searching for patterns over hours of the day, weekdays and weekends, and seasonally using SaTScan (Kulldorff, 2001). The model requires a population base input file, which was derived from the local geographical units in Stockholm County (*basområde*). In this case, the population at risk was female resident population aged 15 years and older. The geocoded points were exported to SaTScan as text input files to detect space-time clusters based on a Poisson model distribution. The temporal window was set to a maximum of 50 per cent of the study period, hereby looking for clusters that fall in a two week period only, but potentially capturing seasonal variations of clusters of rape. Wikström (1991) pointed out the difficulty of defining plausible denominators for crime and rape is no exception. Female resident population may not be the best indicator of women's risk as they do not capture women's movement patterns over space and time. They tend also to underestimate the population of inner city areas even in a city like Stockholm, where the inner city has a large portion of residential land use (Statistics Sweden, 2012). The result of the analysis was a map of space-time clusters of rape taking into account the population at risk was female resident population aged 15 years and older.

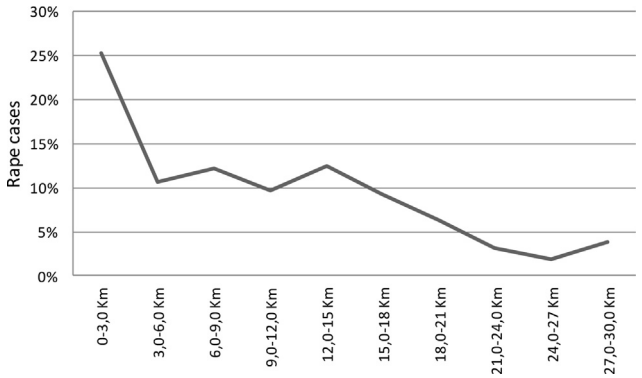

Fig. 2. The gradient of outdoor rape in Stockholm county 2008-2009 (Percentage of cases by distance, distance 0 = city centre, $N = 415$ cases. The boundaries of Stockholm municipality reach 12–15 Km from the city centre.

6. Results

6.1. The distribution of rape

Although the overall measure of relatively rape risk shows a patchy pattern (Fig. 3a, the gradient of cases across the city and the location of significant clusters based on cases of rape by female population at particular space-time windows (Figs. 2 and 3b) show a pattern split into two main areas: the inner city areas and the other, less concentrated, in the periphery.

This polarized pattern of outdoor rape reflects a similar dynamic found for overall crime in Stockholm. Previous research showed that the main urban core of the city contains clusters of both violent and property crimes, after controlling for both residents and/or daily-working population (Ceccato, Haining, & Signoretta, 2002; Uittenbogaard & Ceccato, 2012; Wikström, 1991). This pattern suggests that rapes are just part of other general criminal activity of these areas.

A quarter of all rapes recorded by the police in 2008 and 2009 happened in a relatively small area of the city centre, with a relatively low proportion of resident population, but an area that attracts a large amount of individuals during the day (office hours) and night (entertainment). When these cases are standardised by total female population, the pattern seem less concentrated but still showing concentrations within the municipality borders. Notice that SRR is an overall measure of relative risk that indicates areas with higher than expected counts of rapes, $O(i) > E(i)$, here shown in dark grey.

If one looks at where these rape cases happen over time, a more detailed pattern emerges. One notices that as much as 65 percent of rape cases in the city centre happen in spring but particularly in summer in central areas of the city. Outside the central areas, rape takes place evenly distributed over the year (Table 1). In the summer, the city centre is targeted more by rapists than non-city centre areas, but in both areas, rape does not happen homogenously over time. If one takes summer, for instance; all cases of rape that happen in the city centre take place at evening-night hours and 63 percent of them, at the weekends. Outside the city centre, only 28 percent of cases happen in the summer, often on holidays and weekends and two thirds in the evening or at night.

A map of Kulldorff's scan test shows the significant space-time clusters in Stockholm (Fig. 3b). Note that inner city areas show clusters in the hot months of the year, whilst in the outskirts, clusters are significant in the winter only, which may indicate that the dynamics of rape may be entirely different from the centre to the periphery. City centre clusters would be associated with routine activities of summer and vacation (with unstructured activities,

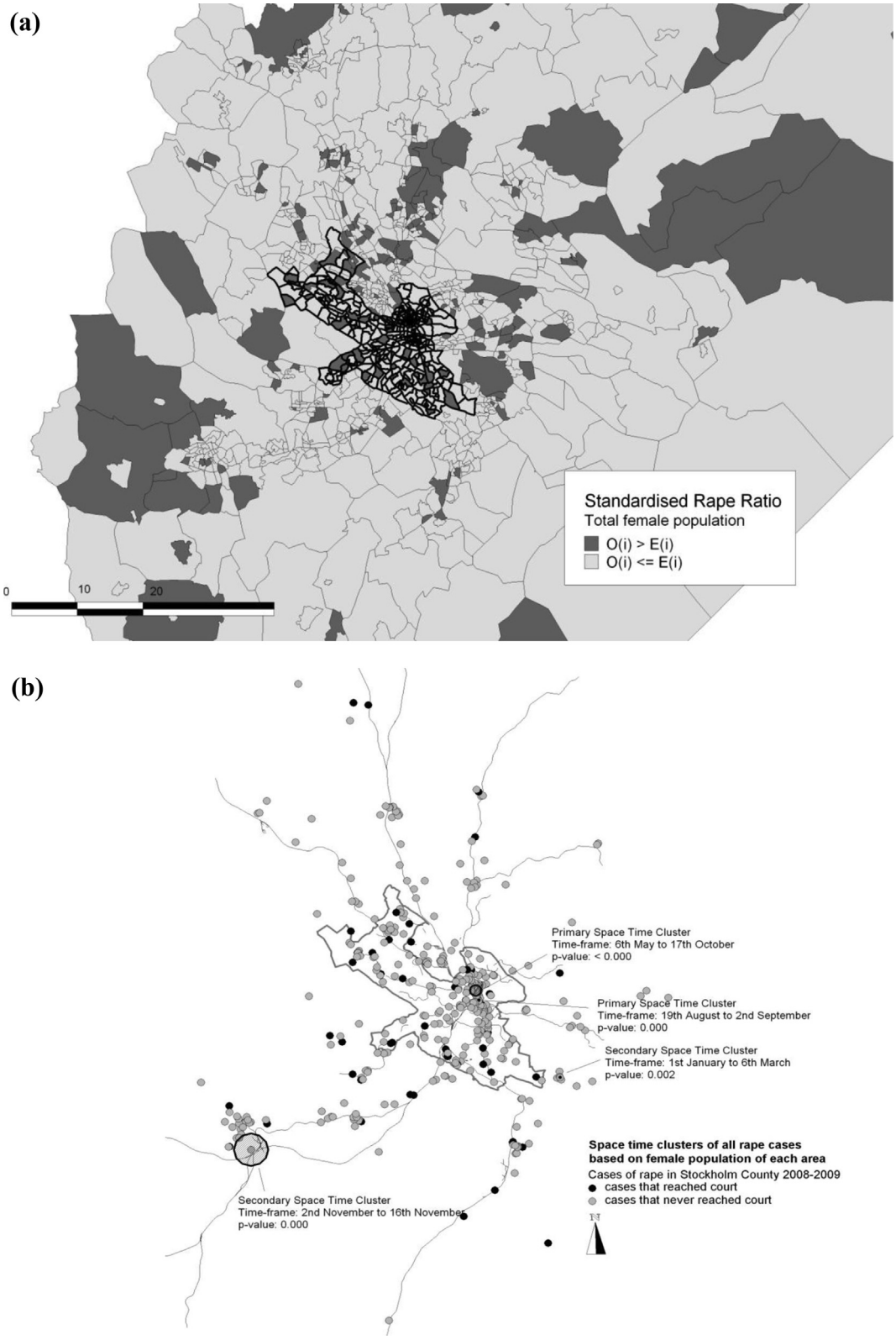

Fig. 3. (a) Standardised Rape Ratio (SRR), highlighting areas with higher than expected counts, $O(i) > E(i)$. (b) Space-time clusters of rape in Stockholm county, 2008–2009, $N = 415$ cases using Kulldorff's scan test. Two circles show two significant clusters, one in the city centre May–October and a secondary one in November, in the periphery.

e.g., leisure, going to bars, parties) whilst the periphery, with women's daily whereabouts in the winter (along daily structured activities such as going from work/school to home/friends' house), reaffirming the importance of principles of routine activity theory to explain the geography of crime. These findings indicate the importance of taking the time dimension into account when assessing patterns of crime over space. In the next section, the characteristics of these rape places are investigated in more detail.

Table 1
Rape events over time by city location in 2008–2009, Stockholm County.

	Inner city	Non-city centre
Spring	24%	21%
Summer	41%	28%
Autumn	16%	25%
Winter	19%	26%
	$N = 118$	$N = 422$
Night	94%	86%
Day	6%	13%
	$N = 110$	$N = 383$
Weekend & holiday (Fri, Sat, Sun)	68%	64%
Weekday (Mon, Tue, Wed, Thu)	32%	36%
	$N = 118$	$N = 422$

N differs depending on data availability of time and location of cases.

6.2. The place of rape

In central areas, rape happens in secluded inner courts between buildings, walkways, hilly areas where visibility from the street is difficult (stairs), ditches, tunnels that link to public transportation, small parks, including cemeteries. The fieldwork also show that these rape places are located in areas with a mix of land use: a combination of residential areas, which keeps the city centre alive over the day, with a visible level of street flow even in non-office hours, with office buildings (including governmental and ministerial buildings), commercial use, with a number of large department stores (Fig. 4a–c). Rape places tend to be isolated spots in a rather dense populated area. Natural surveillance in these areas is not only limited by the immediate surrounding environment by it is also affected by a flow of transient individuals that lack attachment to the area as they are passing through to different destinations. As most rapes happen at evening and nights, visibility of what happens in these secluded spaces is an issue in a Scandinavian city such Stockholm, characterised by long dark nights in the autumn and winter.

In the periphery, the typical locations for rape are forested areas, sometimes interstitial spaces between roads and buildings, often paths or streets with poor surveillance and close to transport nodes, such as train stations, perhaps places that fit well our preconceptions of a 'typical rape place' (Fig. 4d–f).

6.3. The context of rape

According to the protocol trials, rape happens when the victim is on the move, on the way from or to places, often from a bus stop to the victim's residence or from a restaurant to a nightclub, or on the way to/from a subway station. More than half of these cases occur within 1 km of the women's residence – in an environment that women are supposedly familiar with as individuals often spend more time close to home than any other location.[4] Ceccato et al. (2014) show indications that the event may have been planned, since suspect and victim share the 'same spatial awareness' (Brantingham & Brantingham, 1984): in nearly a third of cases the distance between victim's address and offenders' address is less than 2 km.

As expected, rapes are concentrated in areas with mixed land use, with bars and restaurants, and along the routes to them, such as transport nodes and streets (Table 2). The inner city cases fit better this pattern as it contains the major shopping amenities of the city, parks, cinemas, theatres, museums and alcohol selling premises, such as restaurants and bars. In the peripheral areas, rape happen as part of the everyday life activities. These two types of patterns are illustrated by the cases below:

> "I went out to commemorate the end of school year together with my friends. We were in my friend's house first and then we all went to a bar. At three more or less, my boyfriend and me went home for a while, then we went out to smoke. I followed him to the taxi stop. On the way back to my apartment I noticed that a group of men were following me. I crossed over the street but they run after me and nearly at the corner, they pulled me from behind and against the wall. Two hold my arms and my mouth, whilst the others raped me. This was around 4 in the morning" (teenager, full rape)

> "It was a dark winter afternoon; I took the subway from city centre to my mum's home in the Southern suburbs of Stockholm, where I lived most of my life. I left the subway station and walked towards the park which separates my mum's house from the station, which is about 1.5 kilometres. Someone was following me, I increased the pace. When I reached the stairs that link the park and the residential area, and he caught it up, he thrown me to the ground in the middle of overgrown bushes. He tried to pull my clothes off but I pulled him away and ran upwards, towards a neighbour's house, screaming for help, leaving all my belongings there. He left the crime scene in opposite direction, I think it was about 17:30" (women in her twenties, attempt to rape).

For rape, some of these criminogenic areas are close to, or at, either an 'end subway stations' or close to the central station (Ceccato, Uittenbogaard, & Bamzar, 2013) as these stations concentrate crime regardless of type. Some of the peripheral stations are located in places that do not easily allow guardianship and natural surveillance from outside (Fig. 4d, for example). They are usually close to a motorway or are cut off from surrounding land uses by forests, lanes and far from people's view. In the city centre, Ceccato et al. (2013) showed that the central stations concentrate the highest number of recorded crime events in Stockholm, particularly for property crimes, after events are standardised for daily passenger flow.

Alcohol selling premises seem to be relevant for rape occurrence regardless of where they are located. For the sample of rapes inspected in the field, half of them were located less than 500 m from state alcohol selling outlet or a licensed restaurant or bar (Fig. 5).

The study by Ceccato et al. (2014) on the ecology of rape points to the same direction. Results from Poisson model applied to Stockholm flags for the effect of night life dynamics, as the risk of rape increases three times with the variable 'city centre'. The presence of one (or more) stately owned alcohol selling premises in an area increases the risk of a rape incident (Fig. 3a) in that area by 38% (relative to an area with no alcohol outlets located in it). Ceccato et al. (2014) also show that areas with relatively larger female population increase the rape for outdoor rape and that one unit increase in population turnover leads to a twofold rise in risk of rape.

The empirical link between rape risk factors and alcohol consumption has been already investigated by other studies in the Stockholm at individual level, some of them linking with the geography of alcohol consumption. Cannertoft and Sandahl (2011), shows that those living in the inner city drink more alcohol than those residing in the suburbs. Based on interviews with young

[4] Cases with multiple offenders often have at least one suspect that resides 'locally' whilst others will travel to commit rape. As much as 30 per cent of these suspects live far away ($\geq$ 15 km) from the victim, some from outside Stockholm county, and visit Stockholm to spend the weekend with friends.

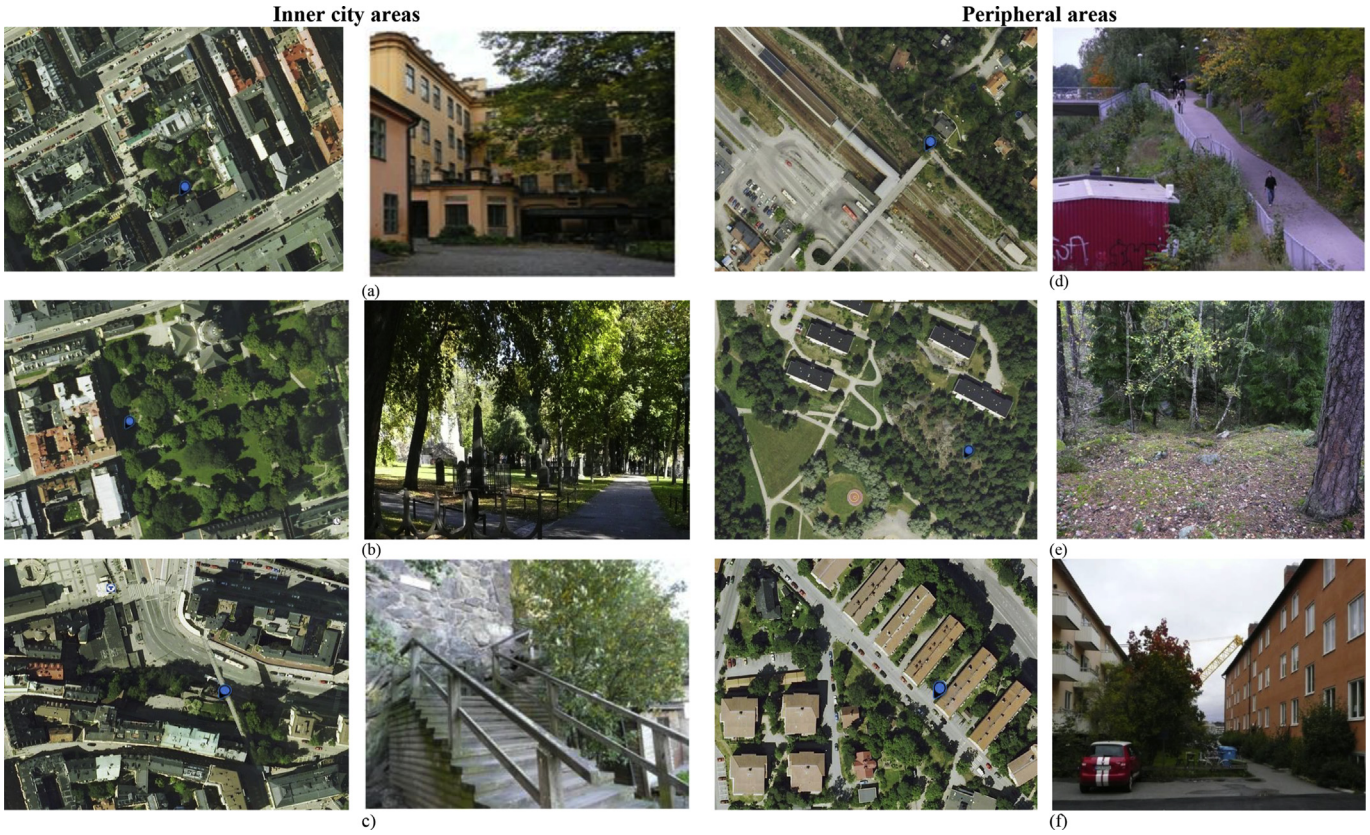

Fig. 4. Centre: Bar (a), cemetery (b) and stairs in a slope (c); Periphery: path from subway station (d), park (e) and interstitial space (f).
Source: Photographs by author, Adriaan Uittenbogaard and eniro.com

people they found that the largest consumption is in the inner city areas. Girls living in some peripheral areas declare a consumption that is half that of young boys living in the inner city areas. Authors also show that exposure to sexual abuse correlates with high alcohol consumption among girls in Stockholm but do not make any reference to where it happened. Important also to note that this study only assess declared consumption of alcohol linked to place of residence and not to where they commonly drink.

Roumeliotis (2010), studying youth behaviour after drinking alcohol in Stockholm, suggested that alcohol is seen as something that is often linked to sexuality and must be regarded in that way, since alcohol has a central place in certain social contexts in which it allows behaviours that would be unthinkable in a sober state. Since alcohol is not sold to youngsters younger than 18 years old in Sweden, the most likely common scenario is that young people get alcohol from friends or friends' siblings before heading out.

Table 2
The space-time signature of the most risky places for rape in Stockholm County.

Rape happens	Percentage of rapes $N = 76$
Evenings and nights (18:00–06:00)	73%
Of which: Weekend or holiday	56%
Place easy to escape	74%
Close to bus stop	68%
Easy to hide (secluded from outsiders view)	59%
Low-medium natural illumination	57%
Close to an alcohol selling outlet (*Systembolaget*)	57%
Mixed-residential land use – multi storey housing	51%
Outside Stockholm	51%
Close to subway/train stations	44%
Bushes/forest/Park/cemetery	44%

Source: 2011's fieldwork of 76 Stockholm's cases that reached court, 2008-2009.

In the next section, a few commonalities shared by rape places are discussed. This does not mean that other areas in the city do not share these qualities; they may do. Note that, a sexual assault may take place only if there is a motivated offender, a potential victim and lack of a guardian at that particular place and time.

6.4. Commonalities of rape places

Police records, trial protocols and particularly the fieldwork on 76 cases show that most rape places share three commonalities. These are places that:

1. Are at or very close to areas with vegetation, in other words, they are composed of parks, forested areas or interstitial places; and are easy to hide in.
2. Constitute an easy escape from the crime scene, since they are located close to public transportation (e.g., bus stops or underground/train stations).
3. Offer poor visibility from the surroundings, secluded (in a tunnel, ditch or stairs). They may be surrounded by multi-storey housing but with poor opportunity for natural surveillance.

Poor visibility at rape places is a recurrent characteristic of crime scene. Observers have long suggested the importance that physical design of the buildings and the surroundings have in providing surveillance opportunities that may impede crime to happen. Of particular importance is the role of paths in the urban landscape. Newman (1972) suggested, for instance, that paths with bushes placed in many locations might give suspects' places to hide and affect the visibility from outsiders, whom potentially had the capacity to intervene if anything happened. As suggested by Michael,

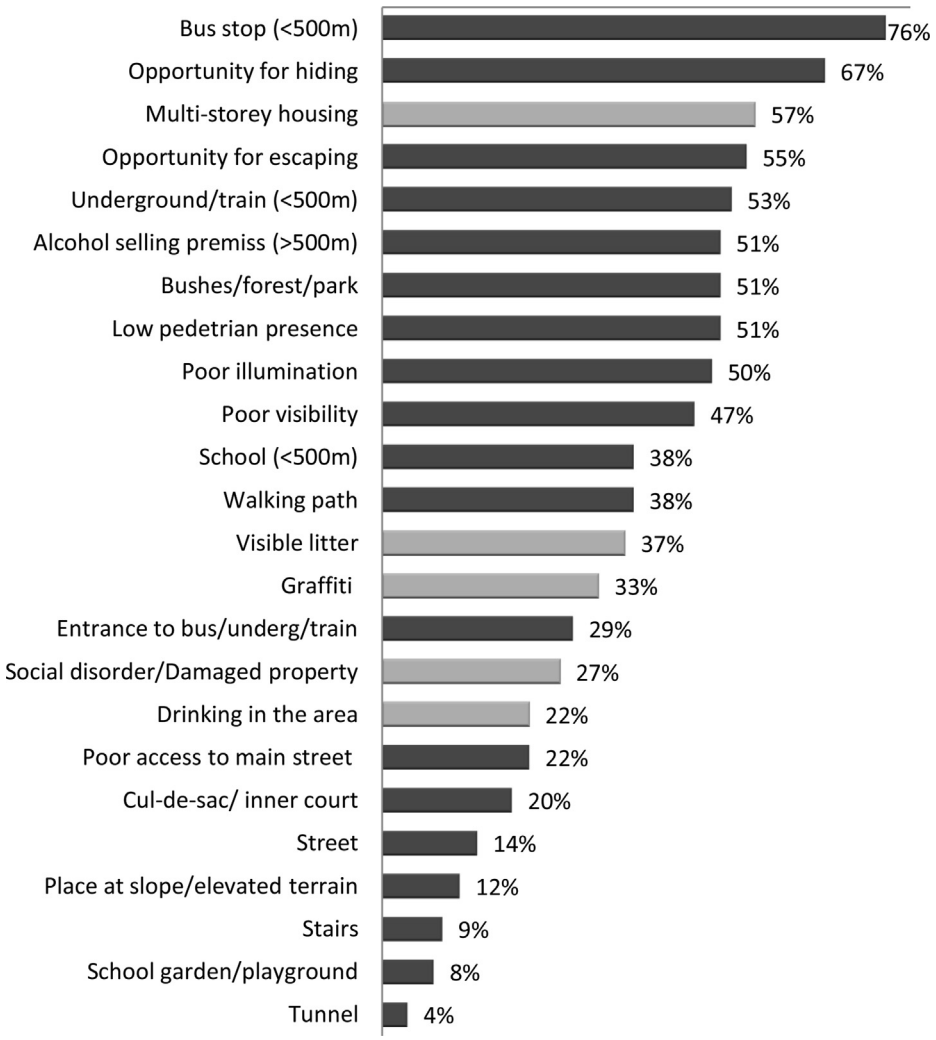

Fig. 5. Place characteristics (dark grey) and area characteristics (light grey) of rape locations (and attempts), 2012. Data source: 2011's fieldwork on rapes cases that reached court, 2008-2009, $N = 76$.

Hull, and Zahm (2001), offenders can use green areas to facilitate their activities, including target selection. One of the women mentioned that the area where she was attacked was poorly maintained:

> "The spot was dark, with overgrown bushes … growing up in the neighbourhood I knew that someone was already raped in that area" (women attacked in southern Stockholm).

Half of the rape places visited in the fieldwork was located in some sort of green area. Nearly all places are in an area where it is easy to attack, to hide or wait for a victim, and then easy to escape from, with good access to public transportation (Fig. 5). Police protocols indicate that it is in the transportation system that often the offender meets the potential victim for the first time. In the Stockholm sample (Fig. 5), two-thirds of all rape cases were less than half a km from a bus stop and half of the cases close to a train or subway station.

Evenings and nights is when two-thirds of these rapes take place. Of which, a bit more than half of cases happens in the weekend or holidays and are constituted by places that are secluded, with poor natural illumination and, at same time, easy to escape from (either because of the environmental layout of the area or of the easy access to public transportation from the rape place). Of course, not all places that share these commonalities will facilitate rape (just because of their location, characteristics and context at those particular times); nevertheless, if they do, knowing about their characteristics and distribution in the city may help one narrows down the number of possible 'risky' outdoors spaces targeted by rapists, which were until recently unknown.

7. Final considerations

The objective of this study was to characterise the environment in which outdoor rape takes place by using 2008-2009's cases of rape in the capital of Sweden, Stockholm. The research combines crime police records, police protocols and information from fieldwork of all rape places that reached court. Drawing upon assumptions from routine activity theory and defensible space principles, the study investigates daily, weekly, and seasonal variations of rape across the urban space. What does this study tell us about the distribution and place of rape in the Swedish capital?

Overall, the pattern of outdoor rape reflects a similar dynamic found for overall crime in Stockholm, with a concentration in inner city areas and patchy pattern with a few concentrations in the periphery. When the rape dataset is split in time windows, findings are indicative that the role of environment varies over time and space. These findings have implications for both research and

practice. For research, these findings mean that general measures of relative risk may lead to wrong conclusions if the time dimension is not taken into account. For crime prevention, if space-time dimension of rape is not considered as relevant, police forces may running the risk of 'chasing ghosts' (Ratcliffe & McCullagh, 2001) and wasting resources.

Not surprisingly, most rape places share commonalities in terms of environmental features and contexts; and they become particularly criminogenic at certain time windows. Although the map of relative risk show a patchy pattern across the city, two concentrations of rape show up when time is take into account. The inner city areas and some of the most peripheral parts of the city, located in municipalities of the county: despite all or the large majority of rapes happening in the darkest hours of the day (evenings and nights), rapes in the inner city areas are dependent of routine activities during summer time, which is the time of the year with longer days. In the outskirts, clusters of rape are significant in the winter only.

Findings indicate that place selection in inner city areas can be different from those in the outskirts (and possibly, by offender type and *modus operandis*). In central areas, rape happens in secluded inner courts between buildings, walkways, hilly areas where visibility from the street is difficult (stairs), ditches, tunnels that link to public transportation and small parks, including cemeteries. In the Stockholm outskirts, forested and isolated areas provide potential places to hide and attack the victim, but this is particularly true for rape. In the periphery, the typical locations for rape are forested desolate areas, interstitial spaces between roads and buildings, paths or streets with poor surveillance. As already suggested by Rossmo (1995) geographical barriers, such as arterial roads and highways, hills, physical and psychological boundaries may influence movements of offenders, and consequently the rape location (Fig. 4 c and d). If residential areas are close by, the design of buildings does not allow good visibility from outdoors, and therefore provides poor surveillance. In the most peripheral areas of the city, rapes occur in areas (but not in all) with visible physical damage in buildings and public property, litter and social disorder (inspected during the time of the fieldwork and by the statistical analysis using secondary data), which indicates low informal and formal social control of the area.

Environmental features of rape places can be linked to defensible space theory. Rapes occur often at places that have, or are close to, vegetation (hedges, parks, trees, and bushes, often poorly maintained); they are places with poor visibility from the surroundings (low pedestrian flow, close to a big road, cut off by a railway) and offer an easy escape from the crime scene (close to a bus stop, subway or commuting train station). The investigation files (police protocols) show that suspects of cases of rape were on foot (took of a bus or train station). This indicates the suspects dependence on public transportation either to identify potential victims or for their escape.

Stockholm findings corroborate also international evidence that licensed alcohol premises and rapes are concentrated, at least at ecological level, in areas with mixed land use, where alcohol selling premises (e.g., bars and restaurants) are located. This is evident in central districts, where alcohol consumption by youth is the greatest in Stockholm, but also along the routes to them (e.g., transport nodes and streets). One way forward is to reflect upon the roles that transport nodes, alcohol selling premises and maintenance of public spaces have on the committal of outdoor rapes. Then, discuss practical implications for situational crime prevention strategies by pointing out ways these environments can be planned to maximise safety in the Stockholm context. Actions based on behaviour avoidance still put the responsibility on women for stopping sexual violence (Neame, 2003) and as well pointed out by Schwartz and Pitts (1995), the solution to decrease sexual assault in these areas is not to keep women away from alcohol and bars, rather, to demand social, economic and legal changes in society, which go far beyond 'quick fixes' of the built environment. However, this is not the same to say that urban environments do not affect the situational conditions of rape.

The physical environment and building design of neighbourhoods has a role to play in crime causation as they affect, for instance, natural surveillance and potential guardianship. Note that some of the rape cases in Stockholm occurred in interstitial green areas between buildings (Fig. 4f). Although it could be expected that residents would be alert and aware of the attack, surveillance may be hampered by the darkness of the autumn and winter in Scandinavia. Windows are hermetically sealed to hinder cold air entering the building, but they do so at the expense of blocking outside noise, making it difficult to hear if someone outside screams for help. Housing companies should be aware of international experiences of building that maximises natural surveillance. For instance, kitchens, may face different directions; with transparent materials that facilitate views of outdoor common areas and public spaces (for a review of international examples, see Dymen & Ceccato, 2012).

While information about offenders is not the focus of the paper, knowing their location can be helpful to explain why certain places, despite having all risky environmental characteristics, never become a rape place. This might also help to check whether those who commit rape in the city centre differ from the ones in the periphery. Likewise, information about their *modus operandis* could shed light on rape place selection. The indications are that some offenders go to where they can find victims, while others may be operating close to where they live. Thus it could be that the locations of the rapes are not a major influence because of their design but either because they are close to where victims are or to where the offender has a base. The study does not link in detail nature of rape places with offenders and victims' awareness space, and as it is suggested here, they may overlap in some of these cases. These 'overlapping spaces' and, possibly, 'shared routine activities' of victims and offenders have to be further assessed for their role in crime causation at individual level. On top of that, one of the main remaining challenges is to further evaluate ecological factors using multi-level modelling to assess whether the geography of rape (at various levels) affects the victim's vulnerability to being sexual assaulted. Equally important is to investigate how the urban landscape and socio-economic context of an area impact on offender's decision to commit rape.

Despite the above limitations, the study is innovative as it combines data from different sources and makes use of the spatial characteristics of rape places by using GIS and spatial statistic techniques. In doing so, it characterises the space-time dynamics of outdoor rapes in a Scandinavian capital, Stockholm, Sweden, which was so far lacking in the international literature.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.jenvp.2014.05.006.

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