

# Study of the Fear of Crime in the Municipality of Trbovlje Using Crime Mapping Tools

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The purpose of the article is to show the crime rate in the year 2012 in the municipality of Trbovlje using the mapping program ArcGIS and to identify a possible link between density of crime and the level of fear of crime in local communities in Trbovlje. The analysis was conducted using official police statistics and geo-data on crime, and additionally, a descriptive method was used for the explanation of basic concepts and review of past studies. The bulk of the research is marked by a case study in the municipality of Trbovlje, where a questionnaire was used to assess fear of crime. In the municipality of Trbovlje, the prevalent crime is crimes against property. The findings and the comparison of the area of distribution of fear of crime in local communities and of crime density show that the level of fear among the population of individual local communities is proportionate to the distribution of crime. The results showed that gender does not have a significant effect on the perceptions of fear of crime; on the contrary, the main differences were identified in two factors: consequences of possible victimization and the capability of property insurance. The distribution of fear of crime by age groups differs from the distribution in conventional models, as the highest levels were observed in the group of middle-aged individuals (26–45 years), followed by the oldest group of the population, those over 75. The applicability of the findings is in assisting the police in identifying crime hot spots and hot areas and locations with a higher level of the fear of crime. On the basis of these results, the police can take appropriate action in the municipality of Trbovlje.

**Keywords:** crime mapping, fear of crime, municipality of Trbovlje, local communities

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## 1 Introduction

The development of crime mapping in Slovenia intensified in the 1990's, and over the last two decades, Geographical information systems (GIS) developed into the main crime mapping tool, through which advanced functions enable the creation of manageable maps and detailed analyses of criminal acts. The present study focuses on studying the connections between crime rates and the perception of safety by the population in the municipality of Trbovlje. The study aims to combine crime mapping with the study of fear of crime, which stands for the fear of people of acts creating fear. The article defines the basic concepts, includes a review of past crime mapping research, fear of crime mapping, and crime mapping in Slovenia. The main part of the article focuses on the case study carried out in the municipality of Trbovlje, where police statistics and a questionnaire on the perception of safety was used among the population to identify crime clusters and

levels of fear of crime in local communities, and presented the identified occurrences on crime maps using the software tool ArcGIS. The review of results at the end of the article also includes proposals for the improvement of the situation in local communities in the municipality of Trbovlje.

## 2 Studying Fear of Crime

Studies on the fear of crime date back to the 1960's, when "The Challenge of Crime in a Free Society"<sup>3</sup> was published. Variables, such as race, social status, gender, age and prior victimisation were found to have an impact on the fear of crime. Brooks (1974) claims that fighting the fear of crime is more difficult than fighting crime itself due to the irrational characteristics of fear itself (Doran & Burgess, 2012).

The fear of crime has an important impact on the quality of life. How fear impacts the reactions of an individual is visible in physical and psychological changes as well as behav-

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<sup>3</sup> The Challenge of Crime in a Free Society – a collection of research on the fear of crime in the USA conducted by several American researchers. The results showed that the fear of crime has a negative impact on the quality of life in the USA (Doran & Burgess, 2012: 1).

ioural adaptations, such as avoidance and protective behaviour, which affect the individual and society in the economic area. The theoretical connection between fear of crime on the one hand, and chaos and crime on the other was established with the Broken Windows Theory<sup>4</sup> (Wilson & Kelling, 1982) and the Disorder and Decline Theory<sup>5</sup> (Doran & Burgess, 2012; Skogan, 1990).

Criminology includes four groups of theories (victimisation, demographic, social and environmental theories), which explain reasons for the occurrence of the fear of crime. Victimisation theory (Routine Activities Theory) surmises that a rationally motivated offender commits a crime against a potential victim if the opportunity (time, space) arises and in the absence of a capable guardian (Cohen & Felson, 1979). Demographic theories study the fear of crime based on past experiences with crime or feelings of vulnerability. Demographic theories are divided into: 1) Direct victimisation theory, 2) Indirect victimisation theory (media and fear of crime, interpersonal communication and fear of crime), and 3) Vulnerability theory (Doran & Burgess, 2012: 25). Social theories explain the fear of crime as a reflection of the general state of anxiety caused by a sudden change in society or a change in its factors. This state is evident in feelings of insecurity or uncertainty, fear of destruction of the social organization of community, fear of the unknown, fear of poor social integration and the deterioration of the community, as well as fears caused by rapid social changes.

Social theories are divided into: 1) Risk Society Theory, and 2) Social Disorganization Theory (subculture diversity, social integration/cohesion in the community, concern for the community and social change) (Doran & Burgess, 2012). Environmental theories focus on external environmental factors that cause fear of crime. Signs of disorder and other factors in dangerous/disorderly environments may cause fear of crime. Environmental theories include: 1) Disorder and decline theory, 2) Crime signs theory, and 3) Theory of dan-

gerous/disorderly and safe/orderly environments (Doran & Burgess, 2012).

The conventional models of police activities do not focus on fear of crime. Consequently, this area is covered by problem-oriented, zero-tolerance and community-oriented models. According to the problem-oriented model, police work focuses primarily on prevention (annulment of problems before crime occurs).

The prevention process is carried out on the basis of the SARA model (scanning, analysis, response and assessment) in cooperation with public agencies and the private sector. Police activity based on the zero-tolerance model aims to prevent disorder from escalating into crime or causing fear of crime, and assumes that police intervention against disorder reduces criminal activities and the deterioration of the community. Community-oriented police activity is evident in a partnership between the police and the community, proactive problem solving, and the inclusion of the community in the settlement of problems associated with crime, fear of crime and other problems in the community (Doran & Burgess, 2012: 51–56).

The Crime Prevention Through Environmental Design (CPTED) strategies are based on the theory that the “correct” design/architecture and effective use of the physical environment reduces the possibility of incidents and the emergence of fear of crime, and contribute to a better quality of life (Crowe, 1991: 81). The goals of the strategies are to change the physical environment in a way that reduces criminal activity (and consequently reduces fear of crime) and to encourage individuals to use public space, which they avoided in the past (Doran & Burgess, 2012: 61).

Fear of crime is defined as an emotional reaction – concern about crime or a reaction to symbols an individual associates with crime. This definition of fear of crime alludes to the fact that certain forms of recognizing potential danger, called perceived risks, are necessary for evoking fear (Ferraro, 1995). Defining fear as an emotion is important for differentiating between otherwise related emotional and cognitive reactions to crime, which are conceptually different. Carlson and Hatfield (1992) define emotion as a specific mental state, which includes physical responses that stimulate or slow down motivated behaviour. Skogan (1999) understands cognitive evaluation as an individual’s judgments of crime (assessment of personal risk and general concern about crime). Ferraro and LaGrange (1987) were the first to present the difference between emotional and cognitive perceptions in their Taxonomy (see Table 1) (Doran & Burgess, 2012: 67–68).

<sup>4</sup> Broken windows theory – is a criminological theory of the norm-setting and signalling effect of urban disorder and vandalism on the development of crime and asocial behaviour. The theory states that monitoring and preserving an urban environment might prevent vandalism and escalation into more serious crime (Doran & Burgess, 2012: 11–13).

<sup>5</sup> Disorder and decline theory – a criminological theory that studies the concept of disorder referring to minor offences and other forms of disturbing behaviour and conditions with a potential impact on the quality of life in the community. The theory states that minor offences, which are overlooked, could escalate into more serious crime that would result in the fear of crime among residents and could lead to the destabilization of the community due to adapted behaviour by residents (Doran & Burgess, 2012: 13–16).

**Table 1:** Taxonomy of crime perceptions

Type of perception: cognitive and affective			
Level	Judgment	Values	Emotions
General	A. Risk for others: crime or safety evaluations	B. Fear of how crime affects others	C. Fear of the victimisation of others
Personal	D. Personal risk: personal safety	E. Fear of how crime affects the individual: personal intolerance	F. Fear of personal victimisation

Source: Ferraro & LaGrange (1987)

Fear of crime manifests itself in two dimensions, whereby the first refers to the type of victimisation (personal or property), and the second focuses on the subject of victimisation (personal or altruistic). Garofalo (1981) claims that the level of fear and reactions to fear vary, based on physical threats that affect an individual or property (Doran & Burgess, 2012: 71–72).

Research on fear of crime is based on three approaches: cognitive, affective and behavioural. The cognitive approach consists of the global measurement, based on the perception of risks, and the measurement of values and fears, which evaluates opinions of individuals on the gravity of crime in their communities. In contrast to the cognitive approach, which is based on an individual's perception of safety, the affective approach focuses on the emotional reaction and tries to measure the fear of crime in the "literal sense". Lastly, the behavioural approach is an emotion-based measurement focusing on the specific type of crime. The behavioural approach studies protective measures and avoidance strategies of individuals, who try to reduce their fear of crime. Protective measures include strategies of personal control and collective action. Avoidance strategies, on the other hand, include actions that reduce exposure to crime by distancing oneself from situations that represent high victimisation risks (Doran & Burgess, 2012).

Traditional statistical techniques, including bivariate analyses, Pearson correlation coefficient, Spearman's correlation coefficient, and Chi-squared test and complex analyses, are used for analysing fear of crime (Doran & Burgess, 2012). Due to the need for visual presentations of areas with a high occurrence of crime, the first attempts at crime mapping (including fear of crime) took place in the mid 19<sup>th</sup> century.

### 3 Crime Mapping – Advantages and Weaknesses

Mapping crime and other deviations dates back to the 19<sup>th</sup> century, when criminologists of the Cartographic School studied regions in connection with social factors and socio-

economic status. Adriano Balbi and André Michael Guerry prepared the first map that showed crime against health in France (Weisburd & McEwen, 1997). In the same period, Adolpho Quetelet used maps to analyse the connection between crime, trade routes, and education levels, as well as ethnic and cultural variations (Boba Santos, 2013: 10). The first complex spatial crime analysis was carried out by urban sociologists in the 1920's and 1930's in Chicago. By combining crime mapping with other demographic characteristics of the population, researchers tried to find a link between crime, criminal activities and social factors (Shaw & McKay, 1942). Phillips (1972) presents in detail, the development of mapping among sociologists and criminologists, and classifies the spatial research of deviation since 1830 into three main schools: cartography/geographic school<sup>6</sup>, typological school<sup>7</sup> and socio-environmental school<sup>8</sup>.

In the 1980's, Brantingham and Brantingham (1991) developed the environmental crime approach that focuses on the physical and social environment, and research within the environmental criminology approach led to the development of computational criminology.<sup>9</sup> Eck and Liu (2008) claim that environmental criminology relies heavily on computational criminology, which they define as the application of computer

<sup>6</sup> Cartography/geographic school – dominated in the period from 1830 to 1880, started in France (André Michael Guerry) and developed further in England (Henry Mayhew). The school is based on social data collected by governments. Research focused on the impact of variables, such as wealth and density of population on the crime rate (Phillips, 1972).

<sup>7</sup> Typological school – dominated in the period around 1880 and at the beginning of the 20<sup>th</sup> century. The school focused on the relation between mental and physical features of people and crime.

<sup>8</sup> Socio-environmental school – focuses on geographic differences in social conditions based on the assumption that they are related to crime patterns (Phillips, 1972).

<sup>9</sup> Computational criminology – an approach that tries to solve criminological problems with the application of mathematics, computer science and criminology. Methods include algorithms, data research, data structure and software development (Phillips, 1972).

simulation of crime patterns that reveals hidden crime processes in urban environments, whereby the interdisciplinary approach combines criminology, computing and geographical information system into an extensive data source. Within criminology, supporters of computational criminology divide themselves into two branches: 1) criminologists, who use the methods of computer simulations for justifying and developing theory (Brantingham & Brantingham, 2004; Eck, 2005; Groff, 2007) and, 2) criminologists, who use the methods of computer simulations to support police activities (Perez et al., 2005). In their study, Brantingham and Brantingham (1998) compared maps with the distribution of violent crime in cities in British Columbia based on three characteristics of crime: 1) number, 2) level, and 3) local quotients of crime (LQC)<sup>10</sup>. The study revealed the advantages of using local quotients of crime as opposed to using the number of criminal acts, which is based on official police statistics that often deviates. The local quotient of crime was calculated using the following formula:

$$LQC_{in} = \frac{C_{in}}{C_{rn}} / \frac{\sum_{n=1}^N C_{in}}{\sum_{n=1}^N C_{rn}}$$

where  $n$  = research area,  $N$  = all areas,  $C_{in}$  = number of criminal activities included in the research, and  $C_{rn}$  = number of all criminal activities (Brantingham & Brantingham, 1998). The “hot spots” analysis<sup>11</sup> became an important part of criminology, analyses and crime prevention, which was also confirmed by Brantingham and Brantingham (1999) in their study that on the basis of information from the Vancouver police (Canada) exposes specific elements of hot spots based on the characteristics of the living environment, Routine Activities theory (Cohen & Felson, 1979), the Life style theory (Hindelang, Gottfredson, & Garofalo, 1978), Rational choice theory (Coleman & Ferraro, 1992) and crime sample theory (Brantingham & Brantingham, 1999). Crime mapping and hot spots discussions took the hot spots theory (Block, 1998) to a different level. Brantingham and Brantingham (2008) analysed crime on multiple levels of integration by applying the topological organisation technique<sup>12</sup> (Uludag, Lui, Nahrstedt, & Brewster, 2007).

The study exposed the issue of standardized artificial borders of spatial units, which limit the implementation of detailed analyses of spatial samples and algorithms of soft/blurred topology<sup>13</sup> (Brantingham & Brantingham, 2008). The results of the study stressed the importance of initiating crime analysis in small spatial units (individual address), and a progressive transition to larger units (streets, neighbourhoods, cities, regions, states). This is necessary due to the occurrence of unaccountable factors in large unit analyses. Frank et al. (2010) presented the TOPO sampling model, which uses an algorithm to integrate the geographic approach and cognitive psychology in criminology. The application of topology enables spatial identification of crime concentration, deviations of crime and gradual fusion with bordering areas. The results revealed the applicability of the new TOPO model and confirmed prior findings that the majority of crime is concentrated in border areas between neighbourhoods. Song, Frank, Brantingham, and LeBeau (2012) developed the visualisation technique, which enables the display of entire paths made by delinquents based on which samples are determined (connection between the residence of delinquents and locations of crime). The results of the study showed that delinquents focus on major transport routes, and their movements are concentrated to the city centre and a rather high frequency of movements between cities (for delinquents, who do not perform crime only in their city).

When studying the geographic characteristics of crime, criminologists use geographic information systems (hereinafter: GIS), which is a computer tool used to establish the studied characteristics of crime and enables the testing of criminological theories as well as the planning of police activities within the framework of problem-oriented police work (Cordner & Perkins Biebel, 2005). Burrough and McDonnell (1998) define GIS as a set of tools that enables the capture, storage, search, transformation and presentation of spatial data. By applying the geographic approach to crime mapping, GIS systems enable the identification of: 1) the place of residence of the perpetrators, 2) the location of the most vulnerable communities, 3) the movement/transport patterns of perpetrators to their targets, 4) reasons for the occurrence of crime in specific areas, and 5) problematic areas with a high crime rate (Chainey, 2001). Information on crime is presented as thematic maps divided into quantitative (showing numeric information on studied locations) and qualitative (indicating qualitative characteristics of individual locations) data. The second classification divides thematic maps into statistical (which show raw data by individual units), point (uses points to show individual

<sup>10</sup> LQC (Local quotients of Crime) – quotients of crime locations, show data on differences between areas, for the purpose of research and introduction of prevention and control (Brantingham & Brantingham, 1998).

<sup>11</sup> Crime hot spot – location or small area with significant crime concentration and a more or less identifiable border (point, line or area) (Anselin, Cohen, Cook, Gorr, & Tita, 2000).

<sup>12</sup> Topological organisation technique – technique that enables the understanding of target selection by perpetrators during their movement through urban settlements (Uludag et al., 2007).

<sup>13</sup> Soft topology – mathematical science studying sets (in which an element can be a partial part of a series, contrary to traditional topology, in which an element either is or is not a part of a series), connection, no connection (Brantingham & Brantingham, 2008).

crimes or combines crimes that occur more frequently), hoplet (which show separate distributions for specific administrative areas), izoplet (which connect areas of equal values with lines), and linear maps (which show linear symbols presented with a different lines) (Klinkon & Meško, 2005). In regards to crime mapping, Clarke and Eck (2008) distinguish between acute and chronic crime hot spots, whereby they determined three basic forms of chronic crime hot spots, which were defined in detailed by Ratcliffe (2004): 1) hot dots, 2) hot lines, and 3) hot areas. Crime mapping is a supporting activity, which facilitates the implementation of police activities: 1) call response, 2) collecting information at crime locations, 3) use of patrols and focused response, 4) analysis and acquisition of police intelligence, 5) data exchange with partner agencies, and 6) reassuring the public (Home Office, 2005).

The advantages of crime mapping are: 1) support for the implementation of police activities, 2) visual presentation and communication, 3) overcoming inaccurate perceptions of problem areas, 4) developing a comprehensive approach to crime analysis in an integrated police information system, 5) easier establishment of connections between crime and other factors (demographics, location characteristics, socio-economic situation), and 6) the knowledge-based crime prevention in the future (Home Office, 2005; Klinkon & Meško, 2005). Despite numerous advantages of this approach, there are several weaknesses or possible errors, among them: 1) generalization errors, 2) irregularities in the preparation of maps with the aim to conceal certain information, 3) manipulation of statistical data, 4) irregularities in the preparation of maps due to the poor quality of data obtained from selective submission of data, and 5) the so-called "GIGO" (Garbage In, Garbage Out)<sup>14</sup> phenomenon (Quinion, 2005). All advantages and weaknesses are noticeable while mapping crime and fear of crime.

#### 4 Mapping Crime and the Fear of Crime

Crime mapping has a long tradition, while mapping fear of crime was only introduced recently. Numerous methodological issues, which affected the development of crime mapping, also represent a challenge for mapping fear of crime that represents an even larger problem from the point of view of validity and reliability. This is because it comes before crime as an emotional response; concern about crime or a reaction to symbols an individual associates with crime (Ferraro, 1995). This defi-

nition of the fear of crime communicates that the perception of a victimization risk is necessary for the occurrence of fear of a specific form of potential danger. The review of studies on the fear of crime revealed that there are only a handful on mapping fear of crime. Park et al. (2011) studied ways of measuring fear of crime, whereby we find the use of a virtual environment and studying behavioural reactions of studied persons interesting. The experiment was carried out on a sample of elderly people, which could choose different paths through China town (a known problem area in Vancouver) to reach their destination in the virtual world. The results showed the applicability of the new method, above all with regards to the measurement of the fear of crime among the elderly, because the experiment highlighted which signs of a potential threat participants paid more attention to and which had a considerable impact on their path selection (behavioural adaptation).

Doran and Burgess (2012) provided insight into the dimensions of the fear of crime and the characteristics of the local environment through the application of GIS in conjunction with behavioural geography techniques (cognitive mapping), and analyses of dairies of activities of the participants in the research. The analysis was carried out using four approaches: 1) questionnaire and an analysis of the fear of crime, 2) disorder evaluation, 3) spatial analysis of crime, and 4) combinatorial spatial analysis. These established that an individual's cognitive map affect his/her behaviour. This part of the study revealed characteristics of collective behavioural forms, which point to avoidance strategies. Activity dairies disclosed the time dimension of movements of people in specific areas and their self-protective behaviour. In combination with data on reported crime and the perception of social<sup>15</sup> and physical disorder,<sup>16</sup> they established that crime hot spots and reactions of people have different patterns, which differ over the course of a work day. In the study carried out in the King Cross area in Sydney, Doran and Burgess (2012) continued to develop techniques for the mapping of perceptions of social and physical disorder in combination with the behaviour of people (avoidance of dangerous areas due to the belief on possible victimisation), in which they studied spatial and time-related data on an individual's fear of physical injuries, personal assault and robbery. Their study reviewed environmental factors, which cause fear among people and trigger an avoidance reaction, because they sought to determine if spatial avoidance visualisation provides new insights into the

<sup>14</sup> Garbage In, Garbage Out (GIGO) – process from the field of computer science, information and communication technology, which refers to the fact that computers will blindly process unintended/nonsensical data entries (Garbage In) and produce undesired/nonsensical data (Garbage Out) (Quinion, 2005).

<sup>15</sup> Social disorder – form of disorder usually visible as: public drinking, vagrancy, begging, groups of adolescents roaming the city, harassment, sale and use of drugs in public places (Meško, 2006).

<sup>16</sup> Physical disorder – form of disorder usually visible as: uncleanness, rundown buildings, trash, graffiti, vandalism and abandoned cars (Meško, 2006).

fear of crime in public places. The occurrence of a different fear level among studied individuals due to different environmental factors and more intensive avoidance behaviour during the night was confirmed on two-dimensional maps. These maps, which present avoidance behaviour, confirmed that environmental factors match the locations of crime hotspots. Behavioural patterns presented in the maps indicate that roads/streets are an important marker between safe and dangerous areas. On the basis of four environmental factors: 1) drug users, 2) prostitutes, 3) areas offering hideouts, and 4) gangs, 3D maps of avoidance behaviour were prepared and show the differences in avoidance patterns at a micro level, based on the impacts of environmental factors.

The results were presented in separate maps for men/women and residents/visitors of King Cross. Researchers at University College London, through the application of spatial and time data on the perception of safety in the urban environment (London), are currently carrying out a study in which they are attempting to identify the characteristics and a connection between fear of crime and other factors on everyday routes used by people in London (University College London, 2013).

The first attempt at crime mapping in Slovenia was made by Bajt (1951), who geographically presented the distribution of crime in the Socialist republic of Slovenia for the period 1948–1950, and explained the causes for its origin. In 1975, Pečar (1975) researched the increase of deviant occurrences in Ljubljana, whereby he tried to establish why the increase of individual acts took place in specific areas. He looked into the mutual correlation between studied occurrences and physical and demographic factors by using cartograms. The

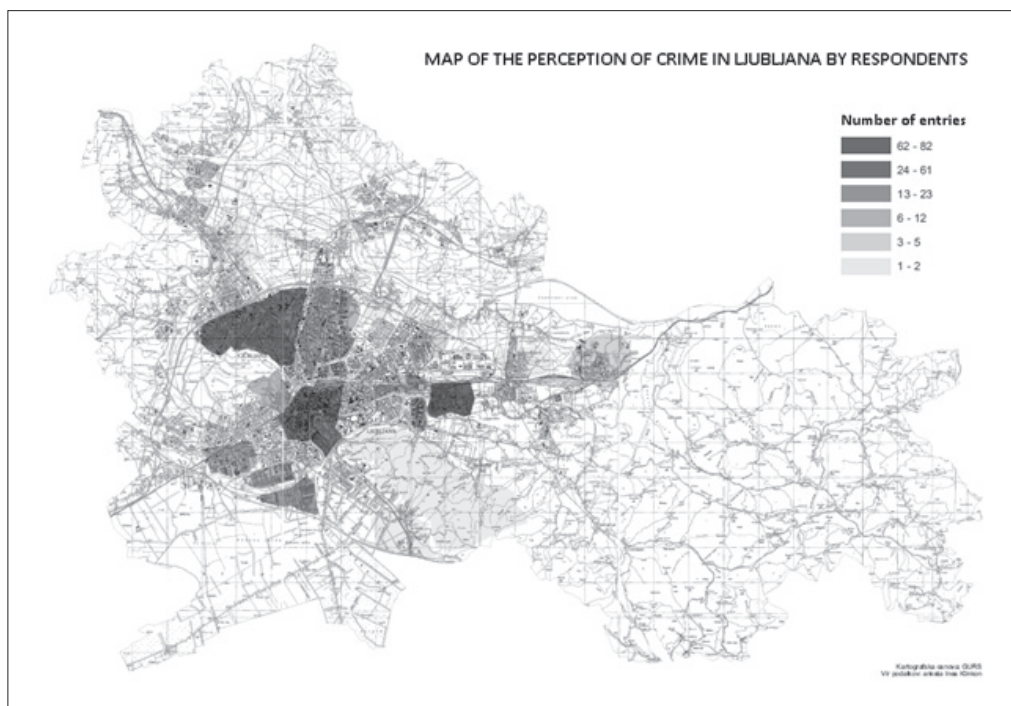
results revealed: 1) a huge safety problem concerning alcoholics residing in areas with old buildings in the city centre, 2) problems faced by suburbs with a higher concentration of crime perpetrators, and 3) increase of deviance among younger perpetrators and violations of public peace and order especially, in residential areas and in remote areas, such as the Ljubljana marshes. In his study, Pečar (1975) established that the Ljubljana area was unequally burdened with crime and perpetrators. Zemljič et al. (1979) identified four main factors contributing to the general problem of road safety in the Socialist republic of Slovenia in their study “Determining black spots”: 1) people, 2) vehicle, 3) roads, and 4) environment. They identified dangerous sections/parts of main roads by using the critical level of accidents method by calculating the number of accidents in a specific area and their distribution according to Poisson, which was also previously used in the USA and Sweden. The map of the Socialist Republic of Slovenia displayed 323 identified dangerous road sections. Meško, Dobovšek, and Bohinc (2003) analysed the distribution of deviant behaviour in Ljubljana for the Municipality of Ljubljana and used GIS for the first time. The results of the study showed the distribution of reported crimes in the area of Ljubljana, whereby areas of three police stations with crime hot spots stood out: Ljubljana-Centre, Ljubljana Moste and Ljubljana-Šiška. The crime hot spots were strongly correlated with a higher number of bars, discotheques and night clubs. Klinkon, Meško, and Rebernik (2004) studied the impact of socio-demographic factors on the development of crime in Ljubljana. By using GIS, a spatial distribution of crime in Ljubljana was prepared, which formed the basis for examining correlations between crime rates and socio-demographic factors (see Figure 1).



**Figure 1:** Reported crimes in Ljubljana  
Source: Klinkon, Meško, & Rebernik (2004)

Researchers compared the results with the opinion of respondents and tried to determine areas with a higher crime rate (see Figure 2), based the perception of the problem among residents. Results revealed different crime levels in individual areas of the Municipality of Ljubljana, and the impact of the socio-demographic structure in Ljubljana on different levels and types of crimes (Meško, Dvoršek, Dobovšek, Umek, & Bohinc, 2003).

tion of people; in the city centre with the main railway and bus stations, in park Tivoli (park and sports objects), in Tabor (neighbourhood in the city centre, close to the methadone centre and a known gathering place for young people) and in other neighbourhoods on the outskirts of the city, like Remiza, Trnovski pristan and Nove Fužine. Eman, Meško, and Ivančič (2012) looked into forms of environmental crime in the area of police administration Murska Sobota. Using



**Figure 2:** Map of the perception of crime in Ljubljana by respondents  
Source: Klinkon, Meško, & Rebernik (2004)

Meško, Maver, and Klinkon (2010), by using crime mapping for the purpose of crime investigation, analysed the increase in the number of specific crimes (theft, burglary, robbery) in Ljubljana in 2003 and 2004. They used the Kernel density estimation,<sup>17</sup> which revealed the increase of these specific crimes in the centre of the Slovenian capital and their expansion towards the outskirts of the city. A concentration of crime was determined in the shopping and entertainment area, which features large parking places and a high fluctua-

<sup>17</sup> Kernel density estimation – a statistical method for estimating the probability density function of a random variable (Botev, Grotowski, & Kroese, 2010).

GIS and prepared maps of concentrations of environmental crime in Pomurje, they analysed this based on police statistics for the period 2008–2010. The results showed that the highest numbers of environmental crimes are concentrated in remote areas close to the border, in the Mura river basin and in the proximity of settlements located next to the main traffic routes between Gornja Radgona and Lendava. The latest research in Slovenia on crime mapping by Eman, Györkös, Lukman, and Meško (2013), presents GIS use in Slovenia in two studies: 1) analysis of hot spots of crimes against property in Ljubljana and Maribor in 2010, and 2) project *krimistat.si*. The results of the first study revealed a concentration of crimes against property in city centres and their expansion

via the main roads towards the outskirts of the cities. At the same time, they detected a higher number of crimes against property in shopping centres and entertainment areas. Project *Krimistat.si* is an online application, which combines data from police statistics using the Google maps application. The purpose of the project was to create an application which would be widely accessible and user-friendly, but the protection of personal data prevents the use of the online application *Krimistat.si*. General dilemmas in detecting crime are evident in the lack of knowledge of administrative units by people and the strength of connecting the perception of crime with the residence and daily activities.

A study to attempt to measure crime and the fear of crime in Slovenia was carried out by Klinkon, Meško, and Rebernik (2004), while other studies measured only crime itself. By using crime mapping, we studied crime and the fear of crime in the municipality of Trbovlje, where we looked for a connection between the distribution of crime in local communities in 2012, and the level of the fear of crime among those residents. We also identified locations which raise the highest fear of crime levels among residents.

## 5 Study in the Municipality of Trbovlje

The Zasavje region consists of three formerly industrial towns: Zagorje ob Savi, Trbovlje, and Hrastnik. We decided to perform the study in a difficult environment such as Trbovlje, because the poor economic and social standard in the cities of the Zasavje region is most visible here. Compared to the other two cities, Trbovlje has the highest crime rate<sup>18</sup> (Trbovlje: 292.5, Zagorje ob Savi: 213.0 and Hrastnik: 172.9), the highest number of criminal offences (Trbovlje: 494, Zagorje ob Savi: 360 and Hrastnik: 170) and the highest unemployment level (Trbovlje: 16%, Zagorje ob Savi: 10.7% and Hrastnik: 13.5%) (Statistical Office of the Republic of Slovenia, 2013).

The municipality of Trbovlje, which is controlled by Police station Trbovlje, is part of Police Administration Ljubljana and encompasses 57.6 km<sup>2</sup>. The municipality has 10 local communities (Alojz Hohkraut, Center, Franc Fakin, Franc Salamon, Ivan Keše, Fric Keršič, Klek, Zasavje, Čeče, Dobovec) with 16.888 residents (Municipality of Trbovlje, 2013). The majority of the population lives in the urban area, in the 7 km-long valley of the stream Trboveljščica, which flows into the river Sava. Only 10% of the population lives in suburban areas.

Because the recognition of patterns and crime hot spots is an important factor in the prevention of crime and the implementation of prevention activities, crime mapping is becoming one of the most important police tasks. Experience of foreign security bodies (other police forces) confirm the central role of crime mapping in the prevention of crime and provision of valuable experience and models/methods for mapping fear of crime. Based on the results of former studies, we prepared a study on crime mapping and mapping fear of crime in the municipality of Trbovlje. We were interested in the visualisation and actual distribution of crime in the local communities within the municipality of Trbovlje in 2012; therefore, we analysed data on crime in the area of the municipality and transferred it onto the map of the municipality using GIS. The study of the perception of safety among the population in the municipality was carried out using a questionnaire that also identified local communities with the highest detected level of fear of crime. Through GIS, we transferred the data onto a map of the municipality and compared it to the distribution of crime in local communities, as presented below.

### 5.1 The Process of Data Gathering and Processing

From the crime data base for 2012, we selected criminal offences that occurred in the municipality of Trbovlje, and analysed the general classification with regard to the local communities. The coordinates of criminal offences were transferred onto the map of the municipality by using software tool *ArcGIS*. We analysed the data and also defined the areas in those local communities with the highest number of criminal offences. Due to imperfections in provided coordinates on criminal offences, we were unable to define around five per cent of detected criminal offences in crime mapping, and could not show them on the map. They were, however, included in the analysis of crime in the municipality of Trbovlje.

The study included all local communities in the municipality, and the sample included 350 adult respondents from ten local communities. The results of the questionnaire were analysed by using a statistical software tool, presented on the map of the municipality and compared with the distribution of crime in local communities.

### 5.2 Presentation of Results

Statistics on crime in the municipality of Trbovlje show that 494 criminal offences (see Table 2) were recorded in 2012. The classification of criminal offences by area followed the classification of the Statistical Office of the Republic of Slovenia, which is based on the provisions of the Penal Code of the Republic of Slovenia (Jacović, 2005).

<sup>18</sup> The crime rate is calculated using the formula no. of criminal offences/no. of population x 10,000 residents.



**Table 2:** Number of crimes per resident and crime rate in the municipality of Trbovlje and the entire country in 2012

	Municipality Trbovlje (no. of criminal offences)	Municipality Trbovlje (crime rate)**	Slovenia (no. of criminal offences)	Slovenia (crime rate)**	Criminal offences in the municipality compared to the entire Slovenia (%)
Crime against human rights	31	18.4	2652	12.8	1.17
Crime against human health	16	9.5	1812	8.8	0.88
Crime against employment and social security	2	1.9	908	4.4	0.22
Crime against economy	8	4.7	5400	26.2	0.15
Crime against public peace and order	6	3.6	1087	5.3	0.55
Crime against legal transactions	5	2.9	1706	8.3	0.29
Crime against justice administration	3	1.8	299	1.5	1.00
Crime against property	320	189.5	66600	320.6	0.48
Crime against the general safety of people and property	3	1.8	337	1.6	0.89
Crime against inviolability of sexual integrity	3	1.8	472	2.3	0.64
Crime against official duty and powers conferred by public law	2	1.9	282	1.4	0.71
Crime against marriage, family and youth	76	45.0	2574	12.5	2.95
Crime against life and person	19	11.3	2864	13.9	0.66
<b>TOTAL</b>	494	292.5	90700*	440.5	0.54

\* The number shows all criminal offences that occurred in Slovenia in 2012.

\*\* The crime rate is calculated according to the formula no. of criminal offences/no. of residents x 10,000.

Source: General Police Directorate, Department for Planning and Analytics (2013); Jacović (2005)

Table 2 shows the distribution and types of criminal offences in 2012 in the municipality of Trbovlje. It is evident that criminal offences against property and criminal offences against marriage, family and youth are predominant, but the number of considered cases on the annual level is low.<sup>19</sup> The

table also includes data for all considered criminal offences in Slovenia, which were compared to data on all types of criminal offences committed in the municipality of Trbovlje. When compared to the entire country, around 0.54 per cent

<sup>19</sup> In 2012, the municipalities of Škofja Loka, Murska Sobota, Izola and Jesenice, which are comparable to the municipality of Trbov-

lje as regards size and population, recorded a higher number of criminal offences (Škofja Loka – 662, Murska Sobota – 996, Izola – 601 and Jesenice – 506).

of all criminal offences are committed in the municipality of Trbovlje. The comparison of crime rates for individual groups of criminal offences in the municipality of Trbovlje and the entire country shows that the crime rate in the municipality of Trbovlje is higher in nearly 50% of cases. Trbovlje also records high crime rates of crimes against property (189.5), crimes against marriage, family and youth (45.0) and crimes against human rights (18.4). The crime rate for crimes against marriage, family and youth in Trbovlje is nearly four times higher than for the entire Slovenia. On the other hand, we established

that the crime rate for crimes against the economy is nearly six times lower in Trbovlje (4.7) than in Slovenia (26.2).

In addition to the presented ratios between the number of crimes in the municipality of Trbovlje and Slovenia as a whole, we also compared the distribution of individual crimes, classified according to the Penal Code of the Republic of Slovenia (Jacović, 2005) for local communities in the municipality of Trbovlje, as shown in Table 3 below.

**Table 3:** Number of crimes in local communities in the municipality of Trbovlje in 2012

	Alojz Hohkraut	Center	Čeče	Dobovec	Franc Fakin	Franc Salamon	Fric Keršič	Ivan Keše	Klek	Zasavje	TOTAL
Crime against human rights		15			8		4	3		1	31
Crime against human health	2	3			2		2	6		1	16
Crime against employment and social security		1								1	2
Crime against economy		5				1	2				8
Crime against public peace and order		1			2		1	2			6
Crime against legal transactions		3							1	1	5
Crime against justice administration		2			1						3
Crime against property	30	131	4	3	36	21	30	14	5	46	320
Crime against the general safety of people and property	1				2						3
Crime against inviolability of sexual integrity		2				1					3
Crime against official duty and powers conferred by public law		2									2
Crime against marriage, family and youth	13	5			5		19	33		1	76
Crime against life and person	2	4	2		2		3	2	1	3	19
TOTAL	48	174	6	3	58	23	61	60	7	54	494
Crime rate*	264.2	503.2	115.1	64.8	164.1	404.2	219.0	234.4	113.8	954.1	292.5

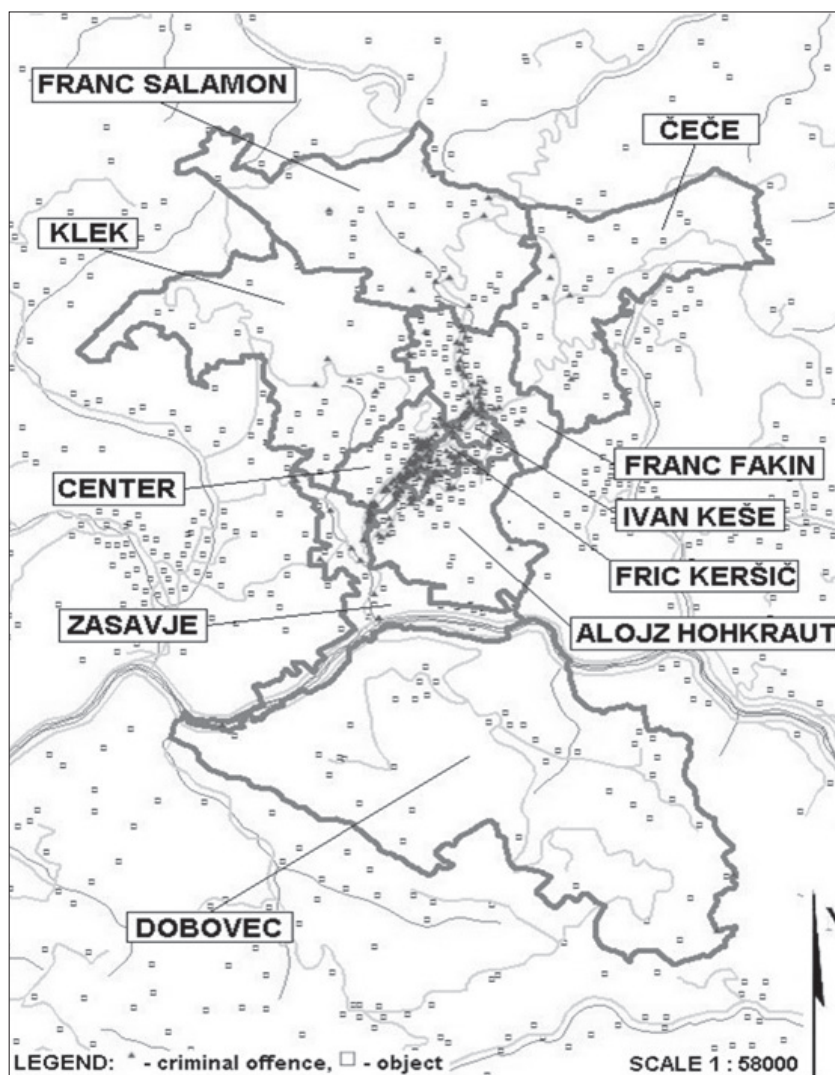
\* The crime rate is calculated according to the formula no. of criminal offences/no. of residents x 10,000.

Source: General Police Directorate, Department for Planning and Analytics (2013); Jacović (2005)

Table 3 reveals the pattern of reported crime in the municipality of Trbovlje. Next to crimes against property, the main crimes include crimes against marriage, family and youth, as well as crimes against human rights. Of all the crimes, those against employment and social security as well as crimes against official duty and powers conferred by public law, were the least frequent in 2012. The majority of criminal offences was recorded in the area of local community (hereinafter: LC) Center, followed by LC Fric Keršič and Ivan Kerše. All three local communities are located in a more urban part of the municipality. Of all the local communities, the lowest frequency of criminal

offences was recorded in Dobovec and Čeče, which are more rural settlements on the outskirts of the municipality. The crime rate is the highest in LC Center, LC Franc Salamon and LC Zasavje. Local communities Franc Salamon and Zasavje are not ranked high as regards the number of registered criminal acts, but the crime rate is high due to a small number of residents.

All criminal offences mentioned above were presented on a map of the municipality of Trbovlje using GIS. The visual presentation of crime in the municipality in 2012 yielded the following figure.



Legend: ▲ - criminal offence, □ - objects

Figure 3: Crime distribution in the local communities in the municipality of Trbovlje in 2012

In the research on the feelings of safety among the residents of the municipality of Trbovlje, we used an adapted questionnaire that was previously used in the pilot study on fear of crime in Ljubljana (Meško & Šifrer, 2008; Meško, Šifrer, & Vošnjak, 2012; Vošnjak, 2011). The questionnaire includes three sets of questions: 1) a modified integral model, 2) modi-

tion, health condition, physical fitness, consequences of victimisation, previous victimisation, and shared victimisation. The number of criminal offences, the crime rate and average values of answers provided by respondents regarding the fear of crime are presented in Table 5 by local community.

**Table 4:** Share of respondents per local community in the municipality of Trbovlje

Local community	No. of respondents	No. of residents	Share (%)
KS Alojz Hohkraut	43	1817	2.37
KS Center	59	3458	1.71
KS Čeče	8	521	1.54
KS Dobovec	9	463	1.94
KS Franc Fakin	67	3534	1.89
KS Franc Salamon	19	569	3.33
KS Fric Keršič	50	2785	1.79
KS Ivan Keše	60	2560	2.34
KS Klek	20	615	3.25
KS Zasavje	15	566	2.65
SKUPAJ	350	16888	2.07

Source: Statistical Office of the Republic of Slovenia (2013)

fied Van der Wurff socio-demographic model and the socio-psychological model, and 3) demographic data (Hirtenlehner, Meško, & Vošnjak, 2009). The sample consisted of 350 adult respondents from ten local communities in the municipality of Trbovlje (see Table 4), who answered questions on social cohesion in the neighbourhood, physical and social disorder

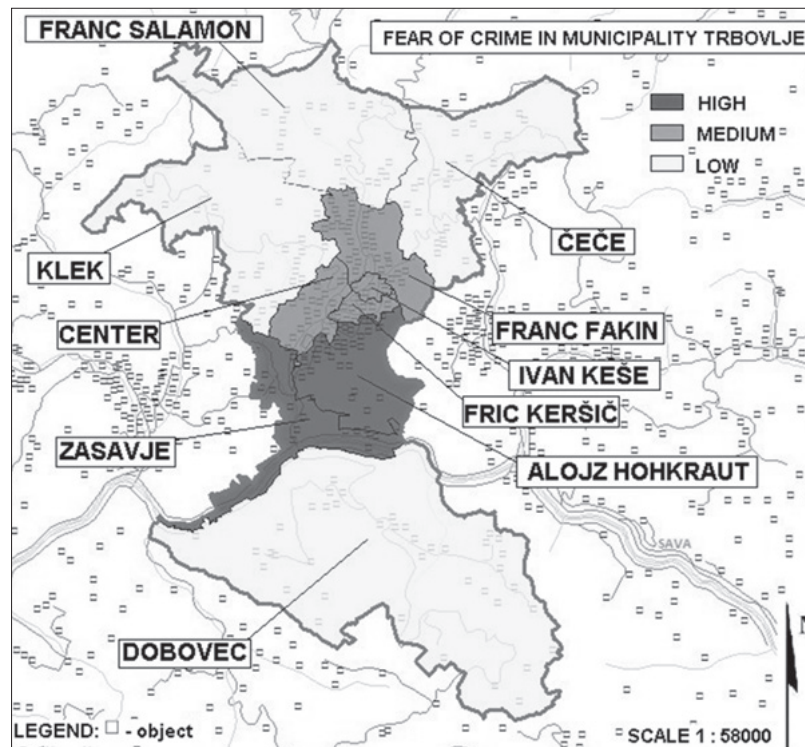
Table 4 includes data on the number of respondents by local community and the calculated shares with regard to the overall number of residents. In continuation, we will present the crime rate and the rate of fear among residents of local communities (Table 5).

**Table 5:** Crime rate and the rate of fear among residents of local communities in the municipality of Trbovlje

Local community	Number of criminal offences	Crime rate	Average values of the fear of crime (M)	Standard deviation
KS Alojz Hohkraut	48	264.2	2.0051	0.5174
KS Center	174	503.2	1.9368	0.5466
KS Čeče	6	115.1	1.7487	0.5452
KS Dobovec	3	64.8	1.6352	0.4883
KS Franc Fakin	58	164.1	1.9112	0.5699
KS Franc Salamon	23	404.2	1.7948	0.5768
KS Fric Keršič	61	219.0	1.9147	0.5554
KS Ivan Keše	60	234.4	1.9349	0.5512
KS Klek	7	113.8	1.7694	0.5265
KS Zasavje	54	954.1	2.0806	0.4745
POVPREČJE	494	292.5	1.8732	0.5352

in the neighbourhood, feeling of safety at night, safety of locations in Trbovlje, victimisation possibilities, property protec-

Data in Table 6 on the rate of the fear of crime by local community is presented in Figure 4.



Legend: □ - objects

**Figure 4:** Rate of the fear of crime in the local communities in the municipality of Trbovlje in 2013

The intensity of the fear of crime is presented with different colours: 1) red – high fear of crime (average values of the crime rate exceed 2.0000), 2) orange – medium fear of crime (average values of the crime rate range between 1.9000 and 2.0000) and yellow – low fear of crime (average values of the fear of crime range between 1.6000 and 1.8999).

## 6 Discussion

By analysing the collected data, we presented the results on a map showing the fear levels in the local communities of the municipality of Trbovlje. Findings show that the presence of fear in local communities on the outskirts of the municipality (LC Čeče, LC Dobovec, LC Franc Salamon and LC Klek) was lower than in those local communities located closer to the centre. We identified a higher presence of the fear of crime in local communities with a higher crime rate (Alojz Hohkraut, Center, Ivan Keše and Zasavje). The highest fear of crime rates were recorded in local communities Alojz Hohkraut and Zasavje, both show signs of physical and social disorder as they are full of decrepit and abandoned buildings,

mostly factories and warehouses. At the same time, these local communities have many apartment buildings built during the socialist period, which enabled entry to everyone and which lack burglary prevention facilities. By using discriminant analysis, we established that the indexes, which were inquiring about the protection of property (average value of the index: 2.3000) and consequences of likely victimisation (average value of the index: 2.7100), differentiated the most between fear of crime. The indexes of past victimisation (overall average of the index: 1.0746) and the safety of locations at night (overall average of the index: 1.2607) differentiated the least between fear of crime.

When asked which location respondents deemed the most dangerous in Trbovlje, 29.7% said no location seems dangerous, 12.6% said the city park was the most dangerous location in the city, followed by locations with forests (11.1%) and bars (9.4%). The results also showed that 72% of respondents believe the city is safe at night and that they would not fear to go alone anywhere. At the same time, 6.5% of respondents think the city park is the location they would not dare to visit alone at night. The results of further analyses showed that fear

was higher among the female population of the municipality of Trbovlje (average value of the fear of crime: 1.9331) than among the male population (average value of the fear of crime: 1.8927). The considerable difference among the two groups is also the result of indexes: 1) feeling of safety at night, 2) possibility of victimisation and 3) consequences of possible victimisation. No differences between the male and female populations (both provided approximately the same answers) were noticed for the other indexes. The analysis of fear of crime by age groups revealed the highest among the age group 26-45 (average value of the fear of crime rate: 1.9676), followed by age group above 75 (average value of the fear of crime rate: 1.9452) and age group 61-75 (average value of the fear of crime rate: 1.9207). The age groups 46-60 (average value of the fear of crime rate: 1.8662) and 18-25 (average value of the fear of crime rate: 1.8921) are at the bottom of the ranking, because the fear of crime is the lowest in these age groups.

We must emphasise that this is a pilot study<sup>20</sup> of mapping fear of crime, because the previous studies in Slovenia focused only on measuring fear of crime or mapping crime respectively specific criminal offences. The present study represents a step forward compared to the research conducted by Klinkon, Meško and Rebernik in Ljubljana in 2004, which studied the impact of socio-demographic factors on the development of crime in Ljubljana, as it focused on the impact of the crime rate on the fear of crime among residents of local communities in the municipality of Trbovlje. Similarities with the above-mentioned research can be seen in the application of GIS tools for the preparation of a spatial distribution of crime.

## 7 Conclusion

Mapping fear of crime is different from other areas of studying crime, as it combines an objective technical side evident in the formation of maps, and a subjective element identified in the answers provided by residents or, in our case, respondents. Due to the lack of research on crime mapping, we could not rely on the results or findings from previous researches, while at the same time we could be innovative in our reviews and presentation of data. The graphic presentation of identified areas with higher crime rates and the distribution of the fear of crime, however, facilitates their comparison (for instance: search for overlapping), which contributes to existing research in the field of studying fear of crime. The interpretation of findings presented on the maps is simpler and more comprehensible, just like mapping also enables the pre-

sentation of different factors on selected maps. This facilitates comparison and the establishment of mutual impacts of demographic, environmental and other factors for researchers.

The study in the municipality of Trbovlje showed that a higher crime rate coincides with a higher fear of crime. The graphic presentation of distribution of the fear of crime revealed that the fear of crime is lower in suburban local communities with lower urbanization levels and fewer residents compared to local communities closer to the city centre. The area of the city park was defined as the most dangerous location in the municipality by the residents. We explain this occurrence with the presence of signs of social disorder factors (alcohol consumption by young people gathering in the city park) and physical disorder (broken glass, garbage left behind by young people). We also established that gender is a factor that does not have a considerable impact on the fear of crime in the municipality. The factors of property insurance and consequences of possible victimisation had the largest impact on the differences in the fear of crime in individual local communities. The rate of property insurance was relatively high in local communities with perceived highest rate of the fear of crime, as these two local communities have residents with a lower social status, who cannot afford dispossession, destruction or damage to property. The consequences of possible victimisation is an index that has considerable impact on differentiation among groups as residents of local communities with a higher living standard would have fewer problems continuing their lives if they were victims of robbery or theft. All groups have in common that residents would have a difficult time continuing with their life if they were victims of any form of physical attack. Last but not least, the maps depicting the distribution of crime and fear of crime in Trbovlje represent a good starting point for the continuation of mapping of the fear of crime and for the planning of subsequent work of police officers in the municipality. A greater emphasis should be given on formal social control and prevention or in other words community-oriented police work (Meško, 2001; Meško, 2002). Police officers should focus on their visibility, accessibility and predictability (Meško et al., 2000). With regard on the theory we argue that focusing on community-oriented police work would significantly contribute to the reduction of the fear of crime in general and in local communities (Meško, 1999; Meško & Areh, 2003; Meško, Fallshore, & Jevšek, 2007). Future in-depth research would enable analyses on the distribution of crime for a longer period of time and increased focus on residential quarters as opposed to local communities. A higher validity of results could be assured with repetition and studies of bigger samples.

<sup>20</sup> Due to the unpreparedness of residents of individual local communities in the municipality of Trbovlje to answer the questionnaire the analysed sample includes only 350 people.

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## **Študija o strahu pred kriminaliteto v občini Trbovlje z uporabo orodja za kartiranje kriminalitete**

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Namen članka je prikazati stopnjo kriminalitete v občini Trbovlje v letu 2012 z uporabo programskega orodja ArcGIS za kartiranje ter ugotoviti morebitno povezavo med gostoto pojava kriminalitete in stopnjo strahu pred kriminaliteto v lokalnih skupnostih v Trbovljah. Analizirali smo uradne statistične podatke policije in geolokacijske podatke o kriminaliteti ter nadalje uporabili opisno metodo za razlago osnovnih pojmov in pregled preteklih študij. Večina raziskav je označena kot študija primera. V občini Trbovlje smo za ocenjevanje strahu pred kriminaliteto uporabili anketni vprašalnik. V občini Trbovlje prevladujočo obliko kriminalitete predstavljajo kazniva dejanja zoper premoženje. Ugotovitve in primerjava območij distribucije strahu pred kriminaliteto v lokalnih skupnostih in gostitve kriminalitete kažejo, da je stopnja strahu prebivalcev posameznih lokalnih skupnosti sorazmerna z distribucijo kriminalitete. Rezultati kažejo, da spol nima pomembnega vpliva na dožemanje strahu pred kriminaliteto. Ravno nasprotno pa smo identificirali glavne razlike pri dveh dejavnikih: posledice morebitne viktimizacije ter sposobnost zavarovanja premoženja. Porazdelitev strahu pred kriminaliteto glede na starostne skupine se razlikuje od distribucije običajnih modelov. Najvišja stopnja je bila identificirana pri skupini posameznikov srednjih let (26–45 let), kateri sledi najstarejša skupina prebivalcev, starih nad 75 let. Avtorji uporabnost ugotovitev vidijo z vidika pomoči policiji pri odkrivanju kriminalnih žarišč in območij gostitev kaznivih dejanj ter območij z višjo stopnjo strahu pred kriminaliteto. Na podlagi teh rezultatov lahko policija sprejme ustrezne ukrepe v občini Trbovlje.

**Ključne besede:** kartiranje kriminalitete, strah pred kriminaliteto, občina Trbovlje, lokalne skupnosti

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