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SPATIALIZATION OF OCCURRENCES ON THE DEPARTMENT OF ENVIRONMENTAL PROTECTION POLICE (COPPA), THROUGH THE USE OF GEOTECHNOLOGIES

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Abstract: The purpose of this article is to show the spatial distribution of occurrences registered in Environmental Police Company in Salvador and more 12 cities of its Metropolitan Region in the year 2012, using Geotechnologies. Initially, data was collected and inserted into a Geographical Information System-WEB (GIS-WEB). These records contained a nearly geographic location of the occurrence. Thus it was possible to specalize them and systemaize them using an specific geoprocesing software – the ArcGIS. Lately the Kernel density Estimator was apllied to data to become possible visualizing the spots of higher concentration of point. Then it was possible to idenify and analyze areas with larger rates of requests upon social insects, sylvan animals and even environmental crimes denounces. It is expected that the resulting maps can give a support on the planning of actions to this company.

Key-words: Environmental police, Geotechnology, Kernel Map.

Resumo : O objetivo deste trabalho é mostrar a distribuição espacial das ocorrências registadas na Companhia de Policia e Proteção Ambiental – COPPA, em Salvador e mais 12 municípios da Região Metropolitana, no ano de 2012, utilizando as Geotecnologias. Inicialmente foi feita a coleta dos dados, através da digitalização das fichas de ocorrência da COPPA em um Sistema de Informações Geográficas – WEB (SIG-WEB), e como esses dados continham a localização geográfica da ocorrência, foi possível especializa-los e sistematiza-los num *software* específico de Geoprocessamento – o ArcGIS. Posteriormente, foi aplicada a Estimativa de Densidade de Kernel para poder visualizar onde há maior concentração desses pontos, então foi possível identificar e analisar áreas onde ocorre o maior número de solicitações para atender chamados de insetos sociais, animais silvestres e também denúncias de crimes ambientais. Espera-se que os mapas resultantes possam oferecer um apoio para o planejamento de ações desta Companhia.

Palavras-chave: Polícia Ambiental, Geotecnologias, Mapa de Kernel.

Résumé: L'objectif de ce travail est de montrer la répartition spatiale d'occurrences enregistrées dans la compagnie de police de protection de l'environnement – COPPA, à Salvador et en 12 municipalités de la région métropolitaine, en l'an de 2012, à l'aide de la géotechnique. Initialement a

été fait un recueille des informations par la digitalization des dossiers d'occurrences de la COPPA dans un Système d'Information Géographique - WEB (Web-SIG), et comment ces informations contenaient la localisation géographique de l'occurrence, il était possible de les spécialiser et de les systématiser dans un logiciel spécifique de géotraitement SIG - ArcGIS. Par la suite, cela a appliquée un montant estime de densité de Kernel pour pouvoir visualiser où il y a une plus grande concentration de ces points, ainsi c'était possible d'identifier et d'analyser les zones où les demandes pour répondre aux appels d'occurrences d'insectes sociaux, des animaux sauvages et aussi des allégations de crimes contre l'environnement étaient plus grandes. Il est prévu que les cartes qui en résultent puissent fournir un soutien pour la planification des actions de la Compagnie.

Mots-clés: police de l'environnement, la géotechnique, la carte de Kernel.

1. INTRODUCTION

The usage of geotechnologies is becoming increasingly common within many fields such as health, environment, geomarketing, local administration, transportation, agriculture, security and many others that benefit themselves with the tools provided by geoprocessing.

These computational tools for geoprocessing, also called Geographic Information System (GIS), consist of a set of elements oriented for data process and spatial reference analyze. Therefore, GIS is the operational support that materializes geoprocessing. It becomes a significant tool, for one can better know an area through mapped spaces. Thus, it enables the provision of subsidies that makes easier the future decisions making.

Both in public and private management GIS is already a reality. Environments can now be used as generating centers of information, essential in planning and working for specific institutions (such as public safety).

The introduction of GIS in public safety came to replace the maps of pins. GIS makes possible to visualize the correlations between different phenomena within the same area with a single glance (SAURET, 2012, p.72).

Given the importance of using geotechnologies and, linked to that, the necessity to plan and implement actions that improve the performance of some specialized companies, the main goal of this project is to show the utilization of GIS on cartographing occurrences registered in the Companhia de Polícia de Proteção Ambiental (Department of Environmental Protection Police) – COPPA –, in the city of Salvador and its Metropolitan Area, through the use of Geotechnologies. Based on this one can create mechanisms that allow new strategies of management.

COPPA receives several daily calls to attend occurrences of sylvan animals and social insects that "invade" residences. In the year of 2012 more than 50% of the requests were to attend calls made because of bees and wasps attack. Most of them stemmed from the displacement of insects in warm periods, for these insects seek for colder places. On contrary of sylvan animals, like serpents, that seek for warmer places.

COPPA is subordinate to the Comando de Policiamento Especializado (Specialized Command Police) and was created in august 8 of 1979. Over the state of Bahia it is responsible for the uniformed, preventive and repressive policing, aiming at the prevention of life in the environment throughout the territory.

Although COPPA has equips well defined for each operation, it has numerous difficulties in performing daily activities. They have operational and managerial issues that hinder the adoption of efficient and effective measures to expedite the tasks directed to this company.

2. MATERIALS AND METHODS

The elaboration of this project occurred in several stages. Initially it was done the data collection through the records provided by COPPA. Those records contain all the occurrences requested to COPPA during the year of 2012, with the following information: date of request, who requested, type of request, address and some reference to this address. The records were typed into a GIS-WEB produced within the context of Geographic Information System for Environmental Police, performed by Universidade Católica do Salvador (UCSal) in partnership with COPPA, financed by the Fundação de Amparo à Pesquisa do Estado da Bahia (FAPESB).

After typing the records, the information were attached to a database in which, posteriorly, a *dbf* was generate. Altogether COPPA registered 1.005 requests in 2012.

After generating this *dbf* it was made the processing of such data. With the help of COPPA agents some inconsistencies were verified in the database. There were occurrences requested to COPPA registered more than once for the same area, by the same requestor or others. Hence the duplicity of requests was eliminated from the database, remaining 914 occurrences.

It is important to point out that these incidents were sorted in three types: social insects, sylvan animals and denounces. Of the 914 occurrences, 481 were about social insects, 250 about sylvan animals and 183 denounces.

During the typing of these information the GIS-WEB allowed to access the *Google Maps* website. In this website were captured the geographical coordinate for each street where the attendance of the occurrence was requested. Of some requests it was possible to identify with more accuracy the exact location throughout references attached to information. Thus the coordinate becomes no longer the center of the street but the reference point located on the website.

After the systematization of the *dbf* table a file of points in the *shp* form was generated. It was put on the ArcGis software for a better data evaluation.

If one needs to represent the exact location of an occurrence or the intensity of a phenomenon, they can be represented as a maps of points. The point analysis, in such case, is the

most indicated to have the point location of the event, using the coordinates shown on the records. In this kind of representation some characteristics are important: like distance between points, density of the points and its spatial distribution.

Using the map of points it is possible to calculate the density of the occurrences. Our analyze verified that a map of density would be of extreme importance to evaluate how the espatialization of the phenomenon occurs. So we opted for the Kernel Density Estimative to visualize where the concentration of points was more frequent.

The Kernel Density is an exploratory interpolation technique that generates a surface of density that allows one a visual identification of “hot areas”. The occurrence of hot areas is comprehended as the concentration of events that indicates, somehow, the agglomeration in an spatial distribution. The Kernel estimator is not a method of detection agglomerates per se, but it is a method to show and explore the pattern created by the points of events. It is useful because it generates a continuous surface from each individual data (BARCELLOS; SILVA; ANDRADE, 2007).

Kernel Estimator produces a continuous surface with calculated densities in all the localities. This technique presents the advantage of allowing a rapid visualization of those areas that deserves attention. So the density estimator is a good alternative to evaluate the behavior of the points pattern in a determinate area of study, being considered very useful to provide a general vision of the distribution of first class events (CÂMARA, CARVALHO, 2004)

Finally, after these studies, maps of density were elaborated with all occurrences and others isolated variables (social insects, sylvan animals and denounces).

3. RESULTS AND ARGUMENTS

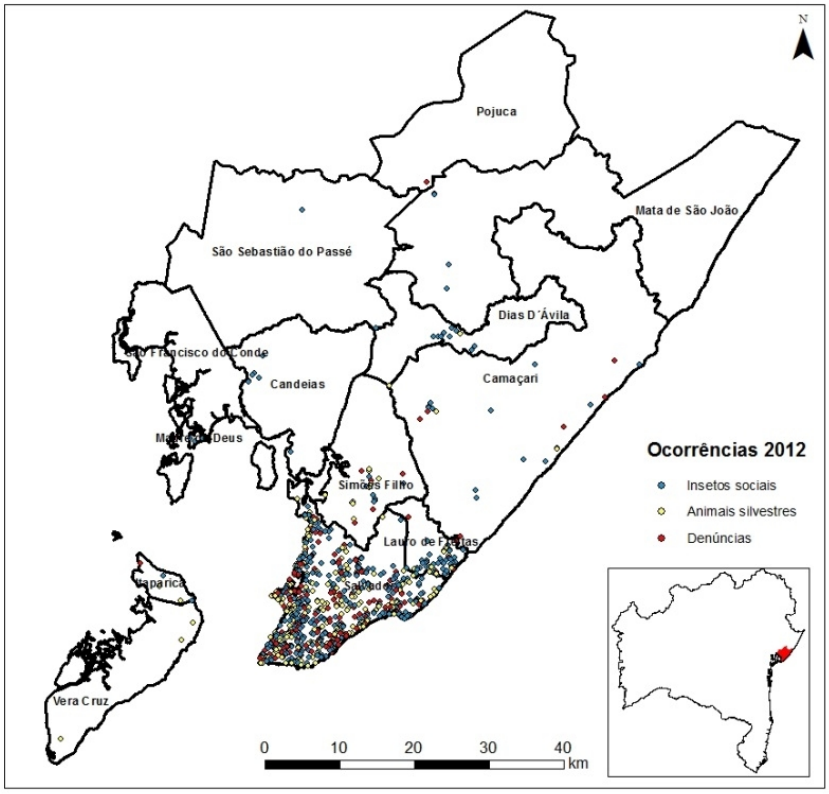
The ostensive deforestation taking place in Salvador and its Metropolitan Area over the last years leads animals to migrate from their natural habitat to other places, even to residences or areas close to them. Animals feel in danger and move up without knowing where they are going exactly.
According to the survey data of 2012, COPPA registered 1.005 incidents distributed all over Salvador and its Metropolitan Area. As previously informed only 914 records were selected for this research.

Both Salvador as areas within its Metropolitan Region are constantly shifted by environmental changes provoked by property speculation. Thus animals that lived there are forced to adapt to others environment. Perhaps this situation can explain the high rates of requests, registered by COPPA, originated from the population of the Metropolitan Area soliciting to capture and maneuver sylvan animals and social insects.

Adding the coordinates to these records it was possible to spatialize the distribution of

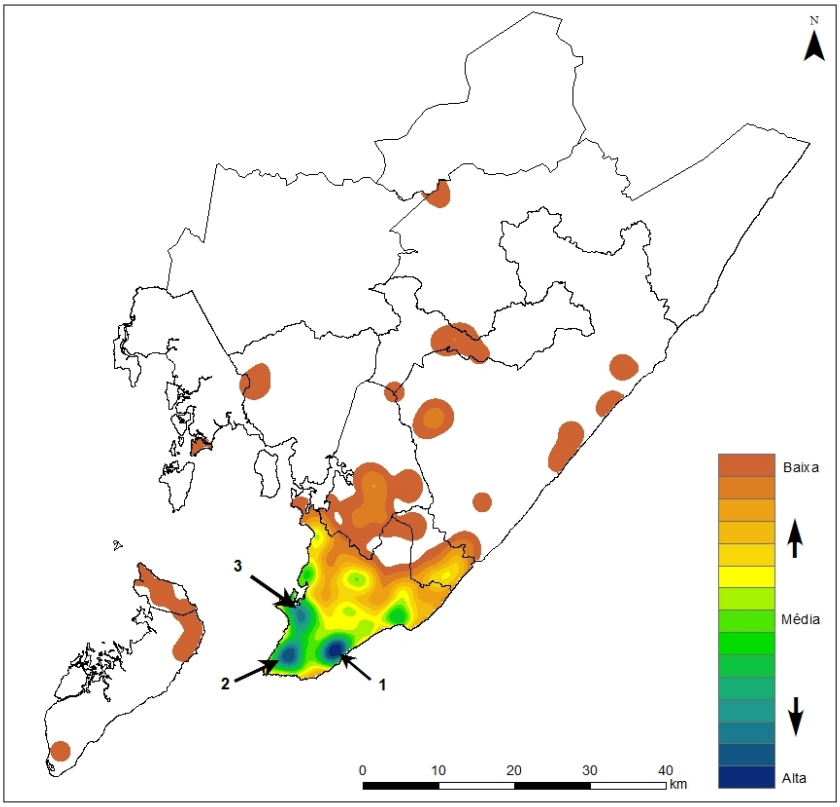
events. This distribution is shown on the map of the Metropolitan Area on figure 1.

Figure 1 – Map of points with the occurrences registered in 2012
Source: SIGAPA, 2012 – Elaboration: SANT´ANA, 2013



The points analyses allows one to observe where the occurrences are distributed. Besides Salvador, where 84% of the incidents are concentrated, towns of Metropolitan Area are belong those that have the highest rates: Lauro de Freitas (7%), Simões Filho (2,5%) and Camaçari (2,4%). Based on the maps of dots we created a density map of points using the Kernel method of density. In English Kernel means “core”. Kernel is used to estimate density and to generate a quick visualization that identify where there is a higher concentration of points. The figure 2 shows the application of Kernel method for the set of all COPPA´s occurrences in 2012.

Figure 2 – Kernel Map with occurrences registered in 2012
Source: SIGAPA, 2012 – Elaboration: SANT´ANA, 2013

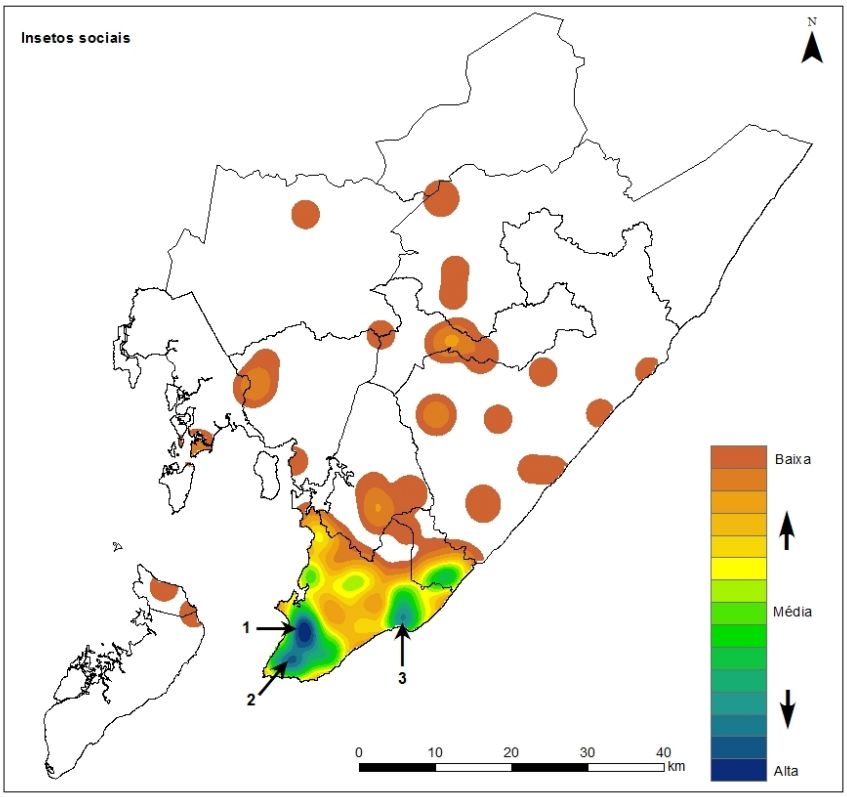


The points density registered varies from low to high density. The high concentration of events is located further south of Salvador. The three most affected areas were divided accordingly to density, from highest to lowest. The sites where requests occurs mostly are: (1) Stiep, Jardim Armação, Imbuí; (2) Engenho Velho de Brotas, Federação, Boa Vista de Brotas e Tororó; (3) Curuzu, Fazenda Grande do Retiro, São Caetano e Liberdade. In more isolated sites (like Itapõa, Cajazeiras e Plataforma) there is an average density of concentration.

Following, the application of kernel density for each data type occurrence recorded in COPPA will be shown: social insects (figure 3), sylvan animals (figure 4) e denounces of environmental crimes (Figure 5).

Of all occurrences registered in COPPA´s records, attacks by swarms of bees, wasps and even *arapuá* bees are the most common related. Depending on the proportion and if they feel danger, these kinds of insects becomes very nocuous to population. In 2012 more than 52% of the records were about requests to capture one of these insects.

Figure 3 – Kernel Map – Occurrences of social insects - 1012
Source: SIGAPA, 2012 – Elaboration: SANT´ANA, 2013



The highest density of social insects befalls at these sites: (1) IAPI, Santa Mônica, Pero Vaz, Pau Miúdo, Cidade Nova, Caixa D´água; (2) Engenho Velho de Brotas e Acupe; (3) Itapuã. It is also noteworthy the incidence of social insects attacks in the town of Lauro de Freitas.

Most of calls requests the capture of bees. In those previously mentioned localities there´s a great concentration of bees. Bees, given the uncontrolled growth of urban centers, lose their spaces and begin to occupy urbanized areas, causing troubles to population. The most aggressive kind are the Afrikaner bee - a louder noise or a more heavier scent is enough to stir them. They are common in summer. Highs temperatures make them more aggressive. They are important pollinators (essential to environmental preservation). They are responsible for the proliferation of both natives and cultivated plants and increase the incomes of some producers.

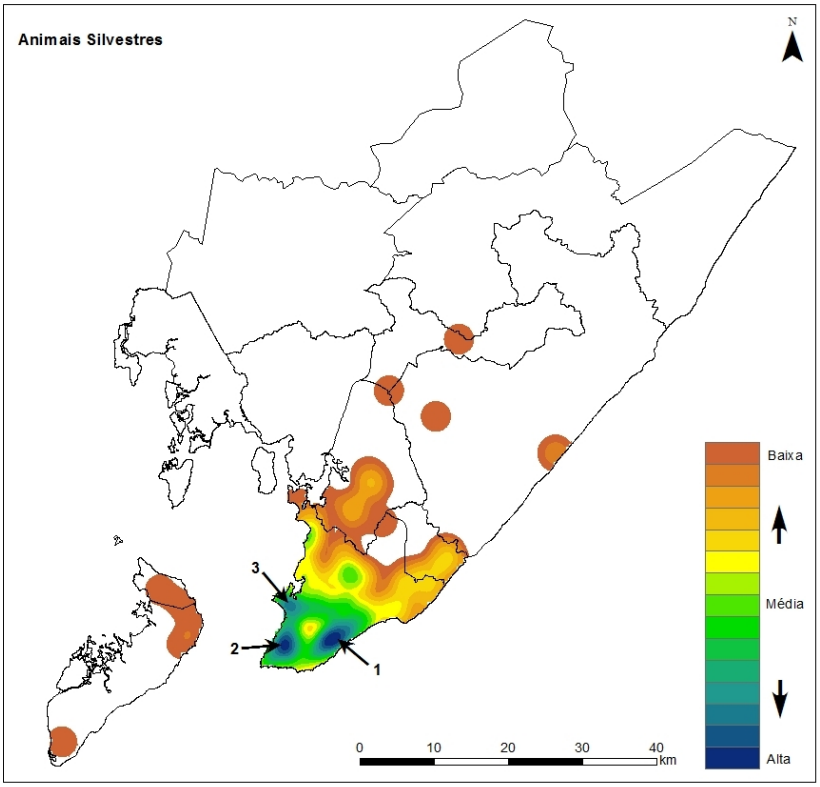
Another function assumed by COPPA in recent years was to carry out the displacement of sylvan animals found in urban environments.

All those which live or are born into a natural ecosystem – such as forests, rivers and oceans – are considered sylvan (or savages) animals. An increasing number of sylvan animals keeps on appearing in urban areas. Due to deforestation they are attracted by the large amount of food. In

many neighborhoods of Salvador is becoming usual to find snakes (between boas and anacondas), birds and even foxes. These animals, when captured, are forwarded to the Center of Triage of Sylvan Animals of IBAMA (CETAS),at Cabula, Salvador.

Apart from snakes, monkeys, owls and hawks are also among the most found animals inside residences or streets of Salvador. Many animals arrive at CETAS injured. The most impaired are those apprehended in counter-trafficking of animals operations. The meekest animals are taken to zoos or research institutions because, according to biologists, they have no condition to feed themselves on nature and would be easy prey for other species.

Figure 4 – Kernel Map – occurrences of sylvan animals – 2012
Souce: SIGAPA, 2012 – Elaboration: SANT´ANA, 2013



In Figure 5 it is possible to analyze the sites in Salvador and Metropolitan Area where most of animals are found.

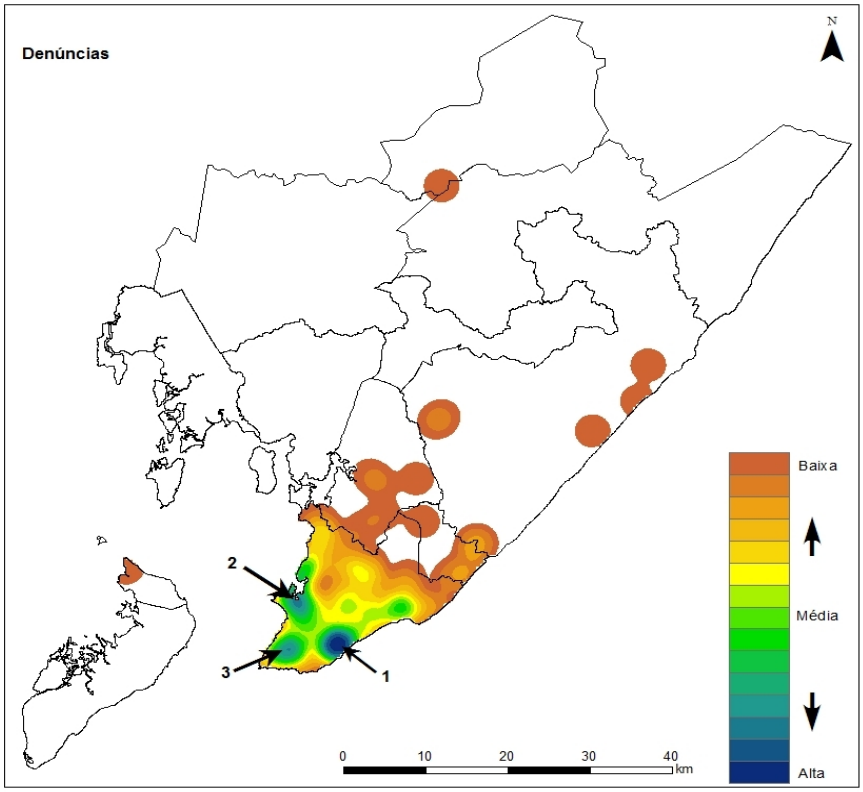
The densest areas are represented in bluish tones, where exist a higher number of occurrences. In (1) are located the neighborhoods of Imbuí, Stiep, Boca do Rio and Caminho das Árvores; (2) Engenho Velho de Brotas, Boa Vista de Brotas, Tororó, Nazaré, Matatu; (3) Uruguai, Vila Rui Barbosa, Calçada and São Caetano.

Certain localities also match with the areas where services were requested for social insects. This contributes to the hypothesis that relates the appearing of such animals to anthropogenic and

environmental factors.

Finally, denounces are likewise very frequents among all calls requesting COPPA´s attendance. They are complaints of citizens reporting animals´ incarceration, mistreatment and illegal commerce of endangered species, besides blast fishing.

Figure 5 – Kernel Map – environmental crimes denounces – 2012
Source: SIGAPA, 2012 – Elaboration: SANT´ANA, 2013



The sites where most of calls are originated from, in this case, are: (1) Stiep, Jardim and Armação, Imbuí, Boca do Rio and Caminho das Árvores; (2) Santa Luzia, Uruguai, São Caetano Capelinha; (3) Engenho Velho de Brotas, Tororó and Boa Vista de Brotas.

In 2012, COPPA counted 183 denounces. This number could be even larger if population denounces more. There are many cases in which animals are apprehended by the population. Therefore many cases of environmental crimes are not related to COPPA.

4. CONCLUSION

The using of geotechnologies is indispensable for spatial analysis. It brings significant progress for research development and several other actions management and planning. COPPA and others groups whose objective is to develop actions that benefit society needs to follow and

incorporate new technologies in their routines.

The amount of data provided by the Company can now help as support on planning new actions for more efficient attending of requests; it can help on the population solicitation to prevent insects attacks; can be used on the removal of sylvan animals from urban areas and against environmental crimes, animal control, illegal commerce and maltreatment of sylvan animals at street fairs.

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