Predicting Future Trends On Pet Abandonment

Predicción de Tendencias Futuras en Abandono de Mascotas

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KEYWORDS:

Abandonment of animals, Bacterial Foraging Optimization and Public Polices associated with animals.

ABSTRACT

In biggest metropolis different kind of pets are living together with their masters, but with a limited time to receive food, attention or even a home where it is possible to find shelter for the rest of its lives. Juarez City has a population over 1.2 million of habitants, many families has different pets including dogs, cats, hamsters, birds, fishes or reptiles that some finished being abandoned in a quickly time, forget in the streets or die due starvation, negligence and selfish of their masters. To understand this social behavior we propose a Multivariable optimization associated with the numerical prediction of its abandoned to establish ecological public polices and determine the social consequences to determine the ecological cost benefit related with the replacement of new issues and increase of pets without master in the streets whereby exists many restrictions, although this problem has been studied on several occasions by the literature failed to realize an adequate numerical prediction evaluating various values associated with each kind of pet and compare its individual costs in each species. There are several factors that can influence to abandon or kill a pet, for our research we propose using a novel bio-inspired algorithm named Bacterial Foraging Optimization (BFO) Algorithm which has been proven to be efficient for predicting social behaviors associated with several aspects, in our case is represented as the increase of young population or adequate ecological public polices with the uncertainty of not knowing when will be too late to change our indifference to our pets.

Recibido: 24 de junio de 2014 • Aceptado: 24 de septiembre de 2014 • Publicado en línea: 28 de febrero de 2015

PALABRAS CLAVE:

Abandono de animales, Optimización de búsqueda de alimentos para bacterias y políticas públicas asociadas con animales.

RESUMEN

En las metrópolis más grandes diferentes tipo de mascotas están viviendo junto con sus amos, pero con tiempo limitado para recibir comida, atención o aún un hogar donde sea posible encontrar refugio para el resto de sus vidas. Ciudad Juárez tiene una población de más de 1.2 millones de habitantes, muchas familias tienen diferentes mascotas incluyendo perros, gatos, hámsteres, pájaros, peces o reptiles que en algunos casos terminan siendo abandonados de manera rápida, olvidados en las calles o mueren debido a la inanición, negligencia y egoísmo de sus amos. Para entender este comportamiento social, proponemos una optimización multivariable asociada con la predicción numérica de su abandono para establecer políticas ecológicas públicas y determinar las consecuencias sociales y el costo beneficio ecológico relacionado con el reemplazo de nuevas situaciones y el incremento de mascotas sin amo en las calles donde existen muchas restricciones, aunque este problema ha sido estudiado en varias ocasiones en la literatura falla para realizar una adecuada predicción numérica evaluando varios valores asociados con cada tipo de mascota y comparar su costo individual en cada especie. Hay varios factores que pueden influir para abandonar o matar una mascota, para nuestra investigación proponemos usar un algoritmo bioinspirado novedoso llamado Algoritmo Bacterial Foraging Optimization (BFO) el cual ha sido probado ser eficiente para predecir comportamiento social asociado con varios aspectos, en nuestro caso está representado con el incremento de la población joven o políticas públicas ecológicas adecuadas con la incertidumbre de no conocer cuándo será demasiado tarde para cambiar nuestra indiferencia para con nuestras mascotas.

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1 INTRODUCCIÓN

Abandonment of animals in the care of humans is a world-wide phenomenon. The World Society for the Protection of Animals (WSPA) remarks the failure of proper management of dogs and cats to be the major animal welfare issue which involves all countries of the world. It is a criminal offence in some Mexican cities and in two states to abandon an animal of a species usually kept in a state of confinement or for a domestic purpose. Abandonment of an animal is usually a combination of an attitude where animal ownership is seen as short-term, rather than for the life of an animal, and changes to the owner's life circumstances. Dumping is often the result of unwanted litters due to lack of desexing, especially cats, or impulse buying of animals. Surrendering of an animal is distinguished from abandonment or dumping because the owner of an animal, which is no longer wanted, takes the animal to an animal shelter or municipal pound and legally surrenders all further claim ownership of the animal

Figure 1. A Pet Shop Local in Juarez City

Juarez City rank domestic animals in hierarchical fashion depending on their regard for the particular species as in Figure 1. Dogs are at the top of the list with cats a close second. Many males claim to detest cats so the position of cats on the scale is heavily influenced by that factor. It is therefore no surprise that dogs are the animals most of the reported to authorities as abandoned. In peripheral urban areas of the city are reported inclusive kind of horse, donkey, sheep, and poultry. It is therefore no surprise that dogs are the animals most often reported to authorities as abandoned. Cats are assumed to fend for themselves and are only reported if they become a local nuisance. Birds in cages and all classes of poultry are regularly abandoned but because of lack of human empathy go unreported. The vast majority of cases of abandonment involve a single animal, particularly companion animals. In the case of livestock or wildlife, small groups are usually abandoned. However, in the case of animal hoarding great numbers of animals are abandoned, often involving over one hundred animals of mixed type. The discovery of hoarders is usually by accident, either the owner is struck down with a medical emergency, or municipal or amenity supply inspectors call unexpectedly at the property, discover what is going on and report it.

2. PLANNING HORIZONS: ABANDONED PETS ON THE CITY.

A Planning Horizon determines the groups of actions which constitute a social model that can be represented by diverse locations where pet abandonment with different kind of issues can occur and locate these in a map using our bioinspired algorithm which will be recuperate all data for future prediction. This representation is made mainly on the basis of the relations that exist between the owners of pets whom conforms the society. In this paper, we focused our attention in a practical problem of the Literature related with pets abandonment to locate diverse places where occurs, which allows to include the location that keeps this social behavior in this society and their respective time horizon (2014-2025), the capacity to establish the locations in the Model, allows to establish "the adequate matching with the resultant space to prevent abandonment pets during a time horizon" for the given set of people. The solution to this problem could be provided by a sequence of generations of agents, denoted like "community". The agents, first realize an analysis (economic support, feasibility and viability during the time horizon) related with the possibility of abandonment pets with the space of a place where occurs, this event has different attributes with ranges of intensity and magnitude associated with different attributes when occurs, after using Mahalanobis distance is determinate and corroborate the number of possible abandonment of pets to locate a space where occurs, finally is written a "Narrative Script" and the Intelligent Tool locate the situation in the Model, this justify the selection of people whom can adopt each pet according to specific features, for example "A Siam cat will be adopted by a girl or lass because requires specialized attendances" and representation shown in the Model is kept in a Repository as an Intelligent Tool [1, 2, 3 & 4]. A Model features using issues of each pet by gender and age and put these on the map, where the abandonment will occur and to the location that each one have within the same. The development of this Model requires on one hand, of the conceptual development, and by another one, development of measures of mathematical discreet that allow ontological support to explore the human systems from the data.

But it is necessary to prioritize the conceptual development and categories of the system in the society, and parallel think about the mathematical model which in our case is supported with Mahalanobis distance.

3. IMPLEMENTING BACTERIAL FORAGING ALGORITHM TO PREDICT FUTURE SCENARIOS ABOUT ABANDONMENT PETS.

During foraging of the real bacteria, locomotion is achieved by a set of tensile flagella. Flagella help an E.coli bacterium to tumble or swim, which are two basic operations performed by a bacterium at the time of foraging [9, 10]. When they rotate the flagella in the clockwise direction, each flagellum pulls on the cell. That results in the moving of flagella independently and finally the bacterium tumbles with lesser number of tumbling whereas in a harmful place it tumbles frequently to find a nutrient gradient. Moving the flagella in the counterclockwise direction helps the bacterium to swim at a very fast rate.

In the above-mentioned algorithm the bacteria undergoes chemotaxis, where they like to move towards a nutrient gradient and avoid noxious environment. Generally the bacteria move for a longer distance in a friendly environment. Figure 2 depicts how clockwise and counter clockwise movement of a bacterium take place in a nutrient solution.

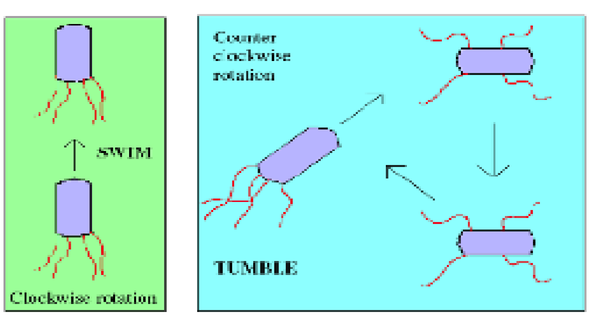

Figure 2. Swim and tumble of a bacterium

When they get food in sufficient, they are increased in length and in presence of suitable temperature they break in the middle to from an exact replica of itself. This phenomenon inspired Passino to introduce an event of reproduction in BFOA. Due to the occurrence of sudden environmental changes or attack, the chemotactic progress may be destroyed and a group of bacteria may move to some other places or some other may be introduced in the swarm of concern. This constitutes the event of elimination-dispersal in the real bacterial population, where all the bacteria in a region are killed or a group is dispersed into a new part of the environment. Now suppose that we want to find the minimum of J(θ) where □□□p(i.e. □ is a p-dimensional vector of real numbers), and we do not have measurements or an analytical description of the gradient□□J(□). BFOA mimics the four principal mechanisms observed in a real bacterial system: chemotaxis, swarming, reproduction, and elimination-dispersal to solve this non-gradient optimization problem. A virtual bacterium is actually one trial solution (may be called a search-agent) that moves on the functional surface (see Figure 2) to locate the global optimum. Let us define a chemotactic step to be a tumble followed by a tumble or a tumble followed by a run. Let j be the index for the chemotactic step. Let k be the index for the reproduction step. Let l be the index of the elimination-dispersal event. Also let

p: Dimension of the search space,
S: Total number of bacteria in the population,
Nc : The number of chemotactic steps,
Ns: The swimming length.
Nre : The number of reproduction steps,
Ned : The number of elimination-dispersal events,
Ped : Elimination-dispersal probability,
C (i): The size of the step taken in the random direction specified by the tumble.

Let P(j, k, l)={θ i (j, k, l) | i 1,2,..., S} represent the position of each member in the population of the S bacteria at the j-th chemotactic step, k-th reproduction step, and l-th elimination-dispersal event. Here, let J (i, j, k, l) denote the cost at the location of the i-th bacterium θ i (j, k, l) □ R p (sometimes we drop the indices and refer to the i-th bacterium position as 0i). Note that we will interchangeably refer to J as being a "cost" (using terminology from optimization theory) and as being a nutrient surface (in reference to the biological connections). For actual bacterial populations, S can be very large (e.g., S =109), but p = 3. In our computer simulations, we will use much smaller population sizes and will keep the population size fixed. BFOA, however, allows p > 3 so that we can apply the method to higher dimensional optimization problems. Below we briefly describe the four prime steps in BFOA.

I) Chemotaxis: This process simulates the movement of an E.coli cell through swimming and tumbling via flagella. Biologically an E.coli bacterium can move in two different ways. It can swim for a period of time in the same direction or it may tumble, and alternate between these two modes of operation for the entire lifetime. Suppose θ i (j, k, l) represents i-th bacterium at j-th chemotactic, k-th reproductive and l-th elimination-dispersal step. C(i) is the size of the step taken in the random direction specified by the tumble (run length unit).

Then in computational chemotaxis the movement of the bacterium may be represented by

$$\theta(j+1,k,l)=\theta^i(j,k,l)+C(i)\ \Delta(i)/\sqrt{\Delta^T(i)\Delta(i)} \quad (1)$$

where Δ indicates a vector in the random direction whose elements lie in [-1, 1].

II) Swarming: An interesting group behavior has been observed for several motile species of bacteria including E.coli and S. typhimurium, where intricate and stable spatio temporal patterns (swarms) are formed in semisolid nutrient medium. A group of E.coli cells arrange themselves in a traveling ring by moving up the nutrient gradient when placed amidst a semisolid matrix with a single nutrient chemo-effecter. The cells when stimulated by a high level of succinate, release an attractant aspertate, which helps them to aggregate into groups and thus move as concentric patterns of swarms with high bacterial density. The cell-to-cell signaling in E. coli swarm may be represented by the following function.

Jcc(θ,P(j,k,l))=∑s^t(i=1Jcc)(θ,θ^i(j,k,l))=∑s^t=i1 [-d attractant exp(-w_attractant∑p^m=1(θm-θm^i)^2)]+ ∑s^i=1^s[h repellant exp(-w repellant∑p^m=1(θm-θm)^2] (2)

where Jcc (θ, P(j, k, l)) is the objective function value to be added to the actual objective function (to be minimized) to present a time varying objective function, S is the total number of bacteria, p is the number of variables to be optimized, which are present in each bacterium and $\theta=[\theta_1,\theta_2,\ldots,\theta_p]^t$ is a point in the p-dimensional search domain. datractant, wattractant, hrepellant,wrepellant are different coefficients that should be chosen properly [9].

III) Reproduction: The least healthy bacteria eventually die while each of the healthier bacteria (those yielding lower value of the objective function) asexually split into two bacteria, which are then placed in the same location. This keeps the swarm size constant.

IV) Elimination and Dispersal: Gradual or sudden changes in the local environment where a bacterium population lives may occur due to various reasons e.g. a significant local rise of temperature may kill a group of bacteria that are currently in a region with a high concentration of nutrient gradients. Events can take place in such a fashion that all the bacteria in a region are killed or a group is dispersed into a new location. To simulate this phenomenon in BFOA some bacteria are liquidated at random with a very small probability while the new replacements are randomly initialized over the search space. The pseudo-code as well as the flow-chart (Figure 3) of the complete algorithm is presented below:

The BFOA Algorithm

Parameters:

[Step 1] Initialize parameters p, S, Nc, Ns, Nre, Ned, Ped, C(i)(i=1,2…S), i.

Algorithm:

[Step 2] Elimination-dispersal loop: l=l+1

[Step 3] Reproduction loop: k=k+1

[Step 4] Chemotaxis loop: j=j+1

[a] For i =1,2…S take a chemotactic step for bacterium i as follows.

[b] Compute fitness function, J (i, j, k, l).

Let, J (i, j, k, l) =J (i, j, k, l)+ J cc (θ i (j, k, l),P(j, k, l)) (i.e. add on the cell-to cell attractant–repellant profile to simulate the swarming behavior) where, Jcc is defined in (2).

[c] Let Jlast=J (i, j, k, l) to save this value since we may find a better cost via a run.

[d] Tumble: generate a random vector D(i)ÎÂp with each element D m(i), m=1,2,..., p, a random number on [-1, 1].

[e] Move: Let

$\theta^i(j+1,k,l)=\theta^i(j,k,l)+C(i)(\Delta(i))/\sqrt{\Delta^t(i)\Delta(i)}$

This results in a step of size C(i) in the direction of the tumble for bacterium i.

[f] Compute J (i, j 1, k, l) and let

J (i, j 1, k, l) J (i, j, k, l) J cc ([] i (j+1, k, l), P(j+1, k, l)).

[g] Swim

i) Let m=0 (counter for swim length).

ii) While m< s N (if have not climbed down too long).

- Let m=m+1.
- If J (i, j+1, k, l) <Jlast (if doing better), let Jlast = J (i, j+1, k, l) and let

$\theta^i(j+1,k,l)=\theta^i(j,k,l)+C(i)(\Delta(i))/\sqrt{\Delta^t(i)\Delta(i)}$

And use this i (j+1, j, k) to compute the new J (i, j+1, k, l) as we did in [f]

- Else, let m= N s. This is the end of the while statement.

[h] Go to next bacterium (i+1) if $i \neq S$ (i.e., go to [b] to process the next bacterium).
[Step 5] If $j < N_c$, go to step 4. In this case continue chemotaxis since the life of the bacteria is not over.
[Step 6] Reproduction:
[a] For the given k and l, and for each i=1,2,..., S , let

$$J_{health}^{i}=\sum_{j=1}^{N_c+1}J(i,j,k,l) \qquad (3)$$

be the health of the bacterium i (a measure of how many nutrients it got over its lifetime and how successful it was at avoiding noxious substances). Sort bacteria and chemotactic parameters C(i) in order of ascending cost health J (higher cost means lower health). [b] The r S bacteria with the highest health J values die and the remaining r S bacteria with the best values split (this process is performed by the copies that are made are placed at the same location as their parent).
[Step 7] If $k < N_{re}$, go to step 3. In this case, we have not reached the number of specified reproduction steps, so we start the next generation of the chemotactic loop.
[Step 8] Elimination-dispersal: For i=1,2..., S with probability P_{ed}, eliminate and disperse each bacterium (this keeps the number of bacteria in the population constant). To do this, if a bacterium is eliminated, simply disperse another one to a random location on the optimization domain. If $l < N_{ed}$, then go to step 2; otherwise end.

4. IMPROVE OUR PROPOSAL MODEL

From the point of view of the agents (bacterial foraging), this problem of improve of location to prevent abandonment pets is very complex because is necessary determine means a multi criterial analysis which each species of pet during a time horizon and locate this on the city, consider select a specific number of features and a location of each one, with respect to the number of locations available where these events will be occur. In the algorithm proposed for the cultural change, the individuals in the space of beliefs (beliefspace) through their better paradigm (BestParadigm) are put to zero to represent the fact that the culture increases the amount of expectations associated with the animal protection, giving an incentive to the behavior associated with the best paradigm (BestParadigm). For it we selected a specific number of locations to simulate, two scenarios associated with 2020 & 2050 and different categories of species described by an Animal Protection Organization and characterized their implementations of life and their social behavior of its owners with base in eight social indicators: productivity, prosperity, knowledge, solidarity, spirituality, social leadership, authority, and creativity; these features allow describing so much to the society as will be see in Figure 3 & 4. The development of this intelligent tool this based on our desire to share the intuitive understanding about the treatment of a new class of systems, individuals able to have empathy, a reserved characteristic in live people, which will be reactive with its decisions.

Formally, the Mahalanobis distance of a multivariate vector $X=(X_1,X_2,X_3,\ldots,X_N)^T$ from a group of values in this case the attributes of each society with mean $\mu=(\mu_1,\mu_2,\mu_3,\ldots,\mu_N)^T$ and covariance matrix S is defined as:

$$D_M(x)=\sqrt{(x-\mu)^T S^{-1}(x-\mu)} \qquad (4)$$

Mahalanobis distance (or "generalized squared inter point distance" for its squared value) can also be defined as a dissimilarity measure between two random vectors and of the same distribution with the covariance matrix S:

$$D_M(\vec{x},\vec{y})=\sqrt{(\vec{x}-\vec{y})^T S^{-1}(\vec{x}-\vec{y})} \qquad (5)$$

If the covariance matrix is the identity matrix, the Mahalanobis distance reduces to the Euclidean distance. If the covariance matrix is diagonal, then the resulting distance measure is called the normalized Euclidean distance:

$$d(\vec{x},\vec{y})=\sqrt{\sum_{i=1}^{N}\frac{(x_i-y_i)^2}{\sigma_i^2}} \qquad (6)$$

Where σ_i is the standard deviation of the x_i over the sample set.

Experiments

Large shelters where statistics are kept, on average 72% of surrendered companion animals was for owner reasons, 12% for economic reasons and 15% for behavioral reasons. It is not unreasonable to suggest that these same statistics drive the abandoned companion animal figures: 47,421 animals of which 46.9% were dogs, 40.5% cats and 12.6% other animals. Given the number of municipal pounds and animal shelters outside of the RSPCA network a figure of 50,000 animals being taken into care per annum in Juarez City is not unreasonable. That a human population of only 1.3 million generates this number of unwanted animals per annum, plus those that go unrecorded because they die of disease or accident before being impounded is simply shameful.

Future strategies for reducing abandonment
Legislation

It is now clear that good legislation alone will not solve the companion animal abandonment/surrender problem. Nonetheless legislation that regulates the acquisition, ownership and disposal of companion animals is both important and necessary. The fundamental principles of the legislation must be uniform across the States and Territories and in turn must be uniformly enforced. This is what the objective of the Government Animal Welfare Strategy is for animal welfare law.

Some new legislative principles worthy of consideration are

•Uniform regulation of all sources of companion animals.
•Behavioral modification for menacing dogs before they become dangerous.
•Seizure of abandoned animals made easier.
•Government encouragement of partnerships or collaboration between all stakeholders in the companion animal area.
•Annual mandatory reporting of animals admitted to a pound or shelter.

Despite these actions, in the case of dogs the number of animals entering shelters and pounds has largely plateaued, but all efforts to reduce numbers further have not been successful. In the case of cats little has been achieved. There is an enormous reluctance for municipal Local laws officers to enforce the law regarding cats despite regular training programs organized by State government. There is also the massive community problem where entire cats are regularly fed without the feeder taking responsibility for the cat e.g. desexing, vaccination and general care, thus keeping them in first class reproductive health with constant production of kittens due to Chihuahua's climatic conditions. Currently, three out of every four unowned kittens delivered to a shelter or pound are euthanized as they cannot be adopted out.

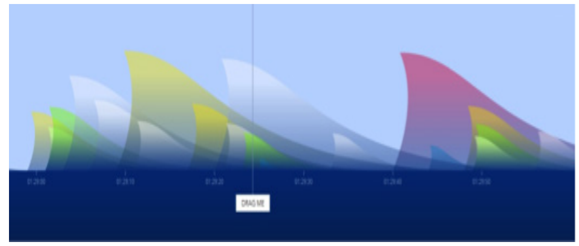

Figure 3. Future Scenario of Abandonment pet to 2020

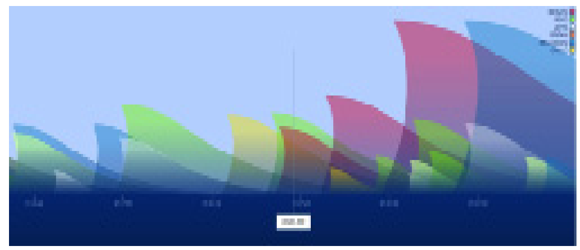

Figure 4. Future Scenario of Abandonment pet to 2050

Education

The traditional classroom/teacher approach to animal welfare education has only limited success in the modern teaching environment. Broad community education programs present better value particularly if government co-ordinated and delivered by community based animal welfare organizations. All those who acquire a companion animal, regardless of source, should be encouraged to attend a local education program. By engaging the community and raising their awareness of their role in the care and protection of animals, there is the potential to reduce abandonment of livestock, companion animals and wildlife. Animal welfare organizations such as the RSPCA in other societies engage the community in education programs designed to teach pet owners about responsible pet ownership, choosing a dog and animal behavior seminars. Furthermore, adoption officers match owners with animals at RSPCA shelters to reduce the number of returned animals.

5. Conclusions

This research shows that it is feasible to provide a hybrid model based on a bacterial foraging architecture.

The results suggest that characterize a search space related with abandonment pet, in our case with vivid issues, particularly if the animals will be model.

Studies show that the behaviors exhibited group in isolation may have an ambiguous effect on the observer's impression of realism about the environment, but when are combined with other behaviors, which react directly to the environment, the use of real data achieves this improvement as in [5, 6 & 7]. The authors are confident that it is possible to describe population patterns constructed in this proposed bio-inspired algorithm, taking as a basis the interaction of autonomous agents with the environment. Further research is necessary to define these guidelines closely. However, initial studies reported involve interesting relationships between the types of behavior and strength of experience. Future work will be performed to characterize more precisely the changes in the behavior of meeting obtained by this extended architecture. The authors plan to validate this work modeling different scenarios on the time, to respond at different changes on wealth, economy or cultural patterns. We believe that our architecture can support extended broadly and more realistic behavior to represents a credible contribution at abandonment of animals based on bio inspired perspective generated in this algorithm. With the use of this innovative application combine Bacterial Foraging and Data Mining using Mahalanobis distance based on a mobile dispositive is possible determine future places where is possible applied public polices to protect animals in Chihuahua's cities by an alert sent to a mobile device with GPS, providing statistical information through a Web server that returns this possible situations in the area consulted [8].

The future research will be to improve the visual representation to a social networking to this we proposed an Intelligent Diorama –An Intelligent display in 3D used on Social Networking- with real on time information of each one of principal species. The most important contribution is prevent more abandonment because the age of pet increase and more food is necessary, our future research is adequate the information to actualize from the central server of State government, to the users, considering that the number of abandonment pets will be increase to 97000 issues to 2020, because animal protection is very high on social networking, this innovative application is possible to use in another different societies in Chihuahua State as Chihuahua City or Parral-with more pets per capita in comparison with Juarez City- with similar conditions of weather, economy and cultural patterns, this Intelligent Tool will be used by different kind of people whom requires protect pets together. In addition this application will be used as Recommender System when travel to another cities or places in different societies [5] and explain different scenarios according time, limited resources and location. Another field topic will be benefited with more adequate organization is Logistics of product or service as in [8] which describes the use of Cultural Algorithms to improve a Logistics networking associated with the deliveries of a bottle product.

ACKNOWLEDGMENT

The authors were supported with funds from Social Research Center in Juarez City University and used data from Animal Protection Organization in Chihuahua whom permits compare the simulation with real data.

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BIOGRAPHIES

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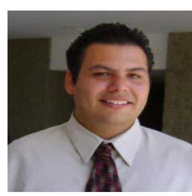

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