Space technologies for the delineation of potential habitats of *Bandicota indica* rodents, Hantavirus hosts in Nakhon Pathom province (Thailand)

Vincent Herbreteau  
Center for Vectors and Vector-borne Diseases  
Faculty of Sciences and Technology, Mahidol University  
Thanon Rama VI, Phyathai, Ratchatevi,  
Bangkok 10400, Thailand  
Email : Vincent.Herbreteau@ird.fr  
Tel : (66) 2 201 5934 (office), (66) 2 201 5931 (center)  
Fax : (66) 2 247 0079

H. Andrianasolo  
Asian Institute of Technology, Thailand - IRD (Institut pour la Recherche et le Développement), UR034, Thailand.

G. Chauvancy  
IRD (Institut pour la Recherche et le Développement), UR034, Thailand.

J.P. Gonzalez  
IRD (Institut pour la Recherche et le Développement), UR034, Thailand.

Abstract

The emerging diseases are mostly caused by viruses and among them hantaviruses regroup some viral species, which have been documented for only a few years. Rodents are vectors and reservoirs of hantaviruses and many other zoonotic diseases. In the frame of a research on emerging diseases, we have then decided to focus this work on a vector approach.

The aim of this study was to realize the delineation of the habitats of *Bandicota indica*, the main rodent with medical interest in Thailand. It allows assessing the potential contacts for humans with this rodent and then the risks of human exposure to the related diseases.

We used space technologies to delimit each rodent habitat by identifying the ecological parameters, which describe the ecology of *Bandicota indica*. The study was realized in Nakhon Pathom province (west of Bangkok, Thailand) where a large sampling has been conducted. From the rodents trapped and the data associated we can define the parameters (physical, demographic, social), which characterize the species and then make its distribution.

This delineation helps now to improve the sampling and adapt the model for other Thai study areas. Furthermore it helps to go on our research on the dynamics of rodents and emerging rodent-borne diseases.

1. Introduction

The historical association of wild animals, especially rodents, with certain human endemic diseases is well documented and was referred to for centuries before the economic and scientific developments since the nineteenth century. However knowledge concerning the enzootic nature of such diseases in relation to the ecology of rodent vectors and even more the understanding of the environmental changes that make a disease emerge has rarely been studied. Rodents are known to carry many diseases and in particular hantaviruses, which have caused several deaths especially in North America.
Deaths caused by hantaviruses have recently been registered in Thailand. The emergence of hantavirus related diseases is now reaching Thailand, where these diseases are still not studied. Little data is then available but this creates a great challenge to describe the present state of hantaviruses.

This study deals with the identification and delineation of the main rodent with medical interest in Thailand in order to assess the human exposure to hantavirus related diseases. It is part of a study on emerging viral diseases realized in cooperation with the Asian Institute of Technology and the unit 34 of IRD (Institut de Recherche pour le Développement) in Salaya (Thailand).

2. Material

We have chosen Nakhon Pathom province as study area, because of its suitable location in the west of Bangkok metropolitan area (56 km) and the large database already collected there. It’s a small Thai province (2168,327 sq. km), composed of 7 districts and 104 tambons (sub-districts).

Rodents have been studied for several years by the unit 34 of IRD in Salaya. The data is huge and tackles ecological, medical and human aspects. This database constitutes a first step in the description of vectors. For each rodent caught, a characterization of the ecology has been made in order to describe the different habitats. The GPS coordinates have also been taken to localize precisely each sample and allow us to integrate this data in a GIS. Among the rodents trapped in Nakhon Pathom province, *Bandicota indica* (Bandiot rat) was the most frequently caught. This species is also known to be vector of the THAI hantavirus. Then we kept it as the studied rodent for this delineation.

We used space technologies to describe the whole province from satellite images. They provide a synoptic view, which allows delineating the land use classes and also their spatial distribution. We processed a LANDSAT 5 TM image acquired on 11th June 1997. The resolution of thus image, which is 30 meters for one pixel, is quite low but convenient relating to the large study area.

3. Methodology

Each parameter, which can describe the presence of one rodent, was considered and integrated as a cover into a GIS. For a given point it will inform the physical, demographic, social and economic parameters, and also their spatial description. The information from the disease survey and especially the rodents survey were associated later. Principles of the spatial analysis of vector biology assessing the vector presence and the risks to get Hantavirus related diseases.

Firstly, we can identify the parameters defining the presence of *Bandicota indica* after describing its
ecology.

Secondly, we modelled the presence of *Bandicota indica* using the rodent sampling data, which show the importance of each parameter. This modelling allows to spatially define its distribution.

Finally, from the regional distribution of *Bandicota indica*, we will be able to evaluate the potential risks for humans. This will involve the knowledge of the hantaviruses presence (from the hantaviruses found in the rodents analysis) and the assessment of the human presence close to these vectors (either field or household contacts).

Then the objectives are to delimit coherent regions, which express same characteristics of the presence of *Bandicota indica* and further the emergence of hantavirus related diseases. Different regions can show different reasons of emergence.

4. Results

*Bandicota indica* is a field rat then the study focused mainly on the description of physical parameters from the satellite images. We analysed the image with Multiscope 3.1, a remote sensing software developed by EADS Matra, which provides also photo interpretation tools and a set of GIS functions. We classified the land use in 14 classes significant for the description of rodent habitats. We vectorized this cover, exported it into a GIS software and rebuilt it in order to obtain one polygon for each category.

Considering the ecology and the description of the catching places of *Bandicota indica*, the presence of this species can be directly assessed from the type of land use. This is a field species, which was rarely found inside (4.5%) or around houses (21%).

The index assessing the presence of *Bandicota indica* was deducted from the percentage of rats found in each class of land use. We realized a buffering around the catching places to describe the close environment of each rat caught. The living area of one rodent is within a one-kilometer radius of the trap. Then by extracting these buffers from the land use cover, we calculated the repartition of each land use category in *Bandicota indica* living area and the index for its potential presence.

Using the map of land use and this index of presence we realized the map of the potential presence of *Bandicota indica* in Nakhon Pathom province. To visualize the results we classified the values in five equidistant classes.
This map clearly shows that *Bandicota indica* is a field rat, which can be found almost everywhere. The "mixed agriculture" class is affected by the index 1, which is meaning a high probability to find *Bandicota indica*. Only three classes are mainly represented. The first one (27.6% of all surfaces), which describes the areas with a low presence of *Bandicota indica*, corresponds to grasslands, plantations and wetlands. The second one (35.7% of all surfaces) groups together the urban and suburban areas. We know that *Bandicota indica* is also attracted by the human presence because humans mean for rodents the possibility to find food. The last class (36.6% of all surfaces) represents the agricultural fields themselves (crops or paddy) and some heterogeneous areas in transition between agricultural and urban classes. These areas are often bare lands or classified into mixed agriculture and are places where rats will find refuge in proximity to large fields.

5. Conclusion

This study has helped in displaying the presence of *Bandicota indica* and was adapted to other rodent species with a medical interest in Thailand (especially Rattus species). We are now working on an extension to other study areas inside the country and enlarging the research to other rodent-borne diseases.

These rodent species carry numerous of diseases and among them hantaviruses have a special importance nowadays because we expect their emergence in south-east Asia. Hantaviruses have already been identified in our samples. That's why a map assessing the presence of rats means also the assessment of the presence of hantaviruses.

This delineation is only valid for Nakhon Pathom province and even within this province further samplings should improve the results. The maps done for each rodent species are and will be useful tools to conduct next researches.

6. References

- Desert Research Institute, USA. Investigating hantavirus from space: http://www.dri.edu/General/Newsletter/1999/winter99/99/Hantavirus.html

© GISdevelopment.net. All rights reserved.