ОЦЕНКА НА РИСКОВИЯ СТАТУС НА ПОРОДИТЕ НА ОСНОВАТА НА ГЕОГРАФСКОТО ИМ РАЗПРЕДЕЛЕНИЕ
ASSESSMENT OF BREEDS RISK STATUS BY INVESTIGATING THEIR GEOGRAPHIC DISTRIBUTION

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Резюме**

Това изследване е част от проект на Европейската фокусна точка (ЕРФП), озаглавен "Разработване на модели за оценка на статуса на застрашеност на породите с използването на популационни и релевантни георефериранни данни". Специфичната цел на изследването е да се разработи географски модел, който да се използва при класифициране на породите според степента им на застрашеност и за вземането на решения, свързани с управлението на генетичните ресурси в животновъдството. Географското разпространение на осем местни породи (6 породи овце и 2 породи говеда от Великобритания, Гърция, Словения и Италия) беше анализирано с ГИС методи. Изчислихме радиуса на буфер, обхващащ 75% от популацията на всяка от изследваните породи; хипотезата е, че 25% от популацията на местна порода е минимумът, който може да гарантира възстановяване след избухване на епидемия. Резултатите от това изследване показват, че географският подход трябва да се използва при определяне на статуса на застрашеност на местните породи.

Abstract

This study is part of the European Regional Focal Point (ERFP) project titled "Development of models assessing the breeds risk status by utilization of population and relevant georeferenced data". The specific aim of this research is to develop a geographical model to be used to classify the breeds according to their degree of endangerment and to make decisions relevant with the management of animal genetic resources. The geographic distribution of eight local breeds (6 sheep and 2 cattle breeds from United Kingdom, Greece, Slovenia and Italy) was analysed with a GIS approach. We calculated the radius of a buffer including 75% of the population of the investigated breeds; the hypothesis is that 25% of the population of a local breed is the minimum percentage able to guarantee the recovery after an epidemiological outbreak. The results of this study showed that the geographical approach should be used for the definition of the risk status of local breeds.

Ключови думи: биоразнообразие при селскостопанските животни, местни породи, ГИС, риск статус.
Key words: livestock biodiversity, local breeds, GIS, risk status.

INTRODUCTION

The conservation of livestock biodiversity is important for several reasons: traditional livestock systems based on local breeds contribute to the livelihoods of 70% of the world's rural poor (Hoffman, 2011). Local breeds provide non-productive services such as the maintenance of grasslands, marginal areas and ecosystems with high natural values (Hoffman, 2011), and the conservation of cultural value (Gandini and Villa, 2003). In Europe, according to EFABIS database (June 2012), 1071 breeds on a total of 2612 breeds (extinct excluded) are considered at risk, with different levels of endangerment (Ligda et al., 2012). The risk status is evaluated with different criteria, on the basis of numbers of heads, breeding females/males, population trend and/or inbreeding. The risk status of local

breeds should be determined also by the geographical isolation or concentration: an outbreak of an epidemiological disease can cause a dramatic decline in livestock population concentrated in small areas, and isolated nucleus of population can experienced critical levels of inbreeding. Nevertheless, until now the geographical distribution is not considered in the definition of risk status.

Geographic Information Systems (GIS) have been designed and developed since the eighties specifically to allow visualization, management and analysis of data having geographical reference (i.e. coordinates information). GIS is used in several fields for scientific investigations, resource management, and development planning. Also in livestock science a growing interest in use of GIS has recently emerged. Topics focusing mainly on relationships between livestock and environment, land use management, disease monitoring, biodiversity and genetic conservation are today fields of active research (Joost et al., 2010).

This study is part of the European Regional Focal Point (ERFP) project titled "Development of models assessing the breeds risk status by utilization of population and relevant georeferenced data". The specific aim of this research is to develop geographical models and indicators to be used to classify the breeds according to their degree of endangerment and to make decisions relevant with the management of animal genetic resources. Our proposal is to integrate population and geographic data for the evaluation of risk status in local breeds, according the criteria presented in Table 1.

According to this hypothesis, a breed with 75% of population included in a buffer with 25 km of radius should be defined as endangered. The proposed distance is taken as reference for the expansion of an epidemiological disease before the measures of control became efficacious (Alderson, 2009). The level of 25% of the population in a local breed is the minimum percentage able to guarantee the recovery after an epidemiological outbreak.

MATERIALS AND METHODS

We used data from 8 local breeds from United Kingdom, Greece, Slovenia and Italy, taken as examples for the application of GIS analyses: Rough Fell sheep (UK), Boreray sheep (UK), Brachykeratiki cattle (Greece), Frizarta sheep (Greece), Bela Krajina sheep (Slovenia), Bovec sheep (Slovenia), Jezerskosolcava sheep (Slovenia), Rendena cattle (Italy).

The examples were selected to be representatives of the different patterns of geographical distribution of local breeds. For each breed we collected population and geographical data: number of breeding females (or at least herd size), farm location expressed as municipality (or village) and geographic coordinates of farms. The best option for geographical data is the availability of the exact geographic coordinates of each farm; if these items of information are not available, the model should be implemented using the geographic coordinates of the centroid of the municipality. In this study, the information at farm level were available for the three examples from Slovenia, in all the other cases we used the geographic coordinates of the centroid of the municipality.

GIS analyses were performed using gvSIG, an open source software (http://www.gvsig.com). When the geographic coordinates were available, each farm was implemented as a point in GIS software. We calculated the mean centre of the geographical distribution of farms, weighted for the number of heads or breeding females reared in each farm. The successive step was the calculation of matrix of distances of each farm from the weighted mean centre. Finally, a buffer including 75% of the population was implemented in GIS. When geographical data at farm level were not available, the analyses were applied at municipality level: we calculated the sum of heads (or breeding females) per municipality, and each municipality was implemented as a point in GIS. The successive steps repeated the same procedure previously described.

Таблица 1. Критерий за дефиниране на степен на застрашеност на локални породи, базиран на популационни и географски данни

Table 1. Criteria for the definition of risk status in local breeds, according to population and geographic data

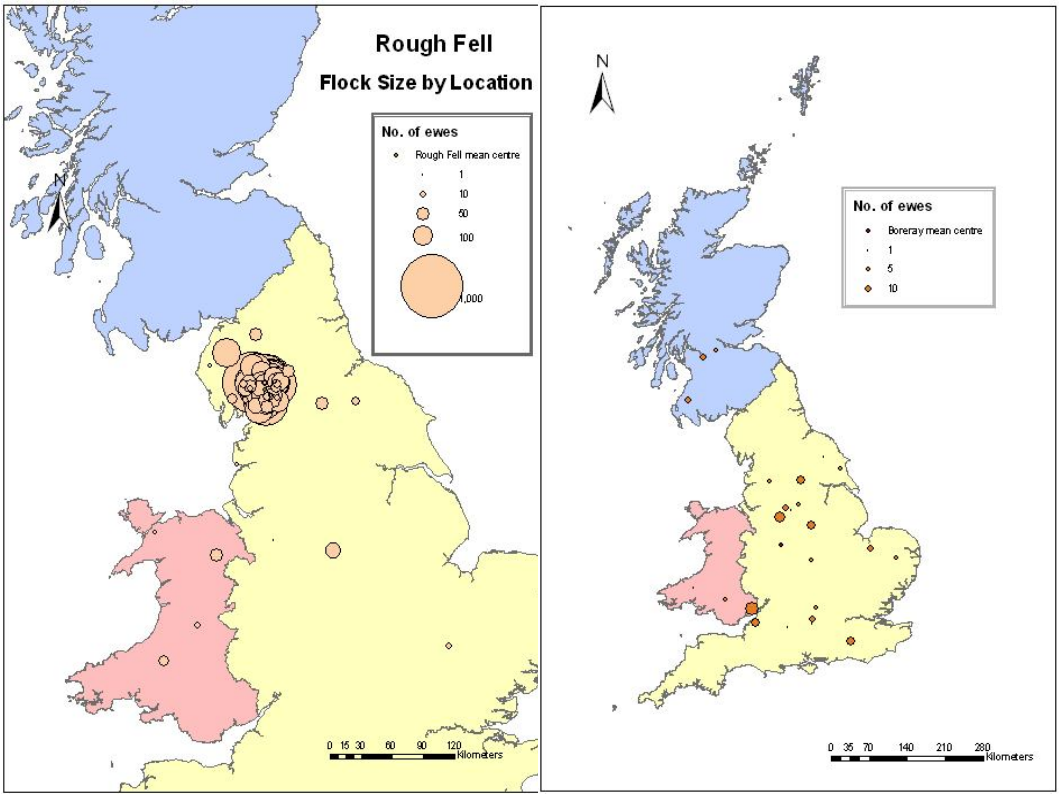
Критерий / Criteria	Уязвима Vulnerable	Застрашена Endangered	Критично застрашена Critical
Числов (женски разплодни животни): Numerical (breeding females) - птици/свине poultry/pigs - говеда/овце/кози/коне cattle/sheep/goats/horses	 2000 6000	 1000 3000	 100 300
Географски (75% от популацията в) Geographical (75% of the population within)	50 km	25 km	12,5 km
Генетичен (нарастване на инбридинга) Genetic (rate of inbreeding)	0,5% - 1%	1%-3%	>3%

RESULTS AND DISCUSSION

The results of the GIS analyses are depicted in Table 2. The breeds considered as examples show a large variability in terms of population size and geographic distribution. The radius of buffer including 75% of population, calculated with the GIS approach, ranged from 8 to 180 km, indicating different level of risk connected to geographic concentration. For Rough Fell sheep the population size is very large, but the flocks are concentrated in a small area. The opposite situation is evidenced by data from Boreray sheep, which is a rare breed with a large distance between flocks (Figure 1). For Brachykeratiki cattle the radius of buffer including 75% of population is 114 km, with no particular risk. For Frizarta sheep the data used referred

Таблица 2. Географско разпространение на изследваните породи
Table 2. Geographical distribution of the investigated breeds

Порода Breed	Страна Country	Размер на популацията (брой женски разплодни животни) Population size (n of breeding females)	Радиус на кръга, включващ 75% от популацията (км) Radius of buffer including 75% of population
Rough Fell sheep	UK / Великобритания	15 000	15
Boreray sheep	UK / Великобритания	300	180
Brachykeratiki cattle	Greece / Гърция	4143	114
Frizarta sheep	Greece / Гърция	50 000	36
Bela Krajina sheep	Slovenia / Словения	695	11
Bovec sheep	Slovenia / Словения	2002	8
Jezerskosolcava sheep	Slovenia / Словения	4469	64
Rendena cattle	Italy / Италия	3998	63



***Фиг. 1**. Географски концентрирана порода овце с голяма популация (Rough Fell, отляво) и широко разпространена порода овце с малка популация (Boreray, отдясно). Всеки кръг представлява стадо, а големината на кръга е пропорционална на размера на стадото*

***Fig. 1.** Geographical concentration of a large population breed (Rough Fell sheep, on the left) and wide distribution of a small population breed (Boreray sheep, on the right). Each circle represent a flock, and the size is proportioned to the flock size*

only to the 10000 sheep over 50000 that are recorded, and the relative small radius of buffer including 75% of population indicate a concentration of the flocks. In this case we were sure that the global distribution of the breed overlaps the results of the analysis on the partial dataset; generally, the completeness of the database is fundamental for the reliability of the results.

The examples from Slovenia were calculated using data at farm level. We have three different situation: Bela Krajina sheep is concentrated in a small area of the South-Eastern part of Slovenia, with few flocks; the flocks rearing Bovec sheep are distributed in different Slovenian regions, but 75% of population is included in a buffer with only 8 km of radius; Jezerskosolcava sheep is the most numerous of the three Slovenian sheep breeds and both the flocks and the heads area widely distributed on the national territory. The last example is the Rendena Cattle, a dual purpose breed of the Eastern Italian Alps. The geographic origin of this breed is a small valley (Val Rendena) on the Alps, but the present distribution of the breed indicate that more than 2/3 of the cows are reared in farms of the lowland, out of the original site. The cattle maintain the adaptation to the mountain, and the expansion in other areas contribute to the sustainability of this breed.

CONCLUSIONS

The results of this study showed that geographical approaches should be used to define the risk status of local breeds. The proposed model, based on basic information and simple to apply, was able to describe the geographical distribution of the eight breeds taken as examples. In our application, the level of risk due to diseases outbreak was evaluated on the base of Euclidean distances between the mean geographical centre of the population and the flocks/herds of the breed. Other features, such as elevation, land use or connectivity were not considered, but for the assessment of epidemiological risk this doesn't represent a source of bias. Another point that should be stressed in order to standardize the process: for some breeds the analysis was performed at farm level, in other cases the municipalities were taken as references. It's evident that the geographical position of each farm is complicated to collect, whereas the address is always available. Also the evaluation of the population distribution was performed using alternately the number of breeding females or the total number of individuals. The simplest option seems to be the use of the total number of individuals per municipality. This approach is efficacious also for non conventional cases, such as breed with large population size, wide distribution, but few farms, or breed with a geographical concentration in more than one area.

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