



**ИНДИКАТОРИ ЗА БИОРАЗНООБРАЗИЕ ПРИ СЕЛСКОСТОПАНСКИТЕ ЖИВОТНИ:
ПРИМЕР ЗА ПОРОДИТЕ ОВЦЕ В ГЪРЦИЯ
LIVESTOCK DIVERSITY INDICATORS: AN EXAMPLE ON SHEEP BREEDS IN GREECE**

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Резюме**

Научната общност вече призна значението на разнообразието при селскостопанските животни. В Глобалния план за действие в областта на генетичните ресурси в животновъдството специално внимание е отделено на стойността на биоразнообразието и необходимостта от повишаване на осведомеността за запазването на това разнообразие. В този контекст разработването и използването на индикатори за мониторинг ще позволи както описание на текущата ситуация, така и оценка на измененията и тенденциите на национално, регионално и световно ниво. Тази статия е насочена към изследването на възможността за разработка и използване на подходящи индикатори с цел мониторинг на биоразнообразието на селскостопанските животни в Гърция. За тази цел са използвани данни за популациите на гръцки породи овце, върху които са приложени различни групи индикатори с цел анализ на текущото биоразнообразие и формулиране на предложение за подходящи индикатори.

Abstract

The scientific community has recognized the importance of livestock diversity. In the Global Plan of Action for Animal Genetic Resources, the value of livestock diversity and the need to increase the awareness on preserving this diversity is underlined. In this context the development and use of monitoring indicators, will allow the description of the current situation and estimate the changes and trends at national, regional and international level. This paper aims to investigate the possibility of development and use of appropriate indicators in order to monitor the biodiversity of farm animal breeds in Greece. For this purpose, the population data of Greek sheep breeds were used and different sets of indicators were implemented aiming at analyzing the current situation of biodiversity and formulating proposals on appropriate indicators.

Ключови думи: индикатори за биоразнообразие, генетично разнообразие в животновъдството, породи овце.

Key words: biodiversity indicators, livestock genetic diversity, sheep breeds.

INTRODUCTION

Livestock genetic diversity is the result of both natural and directed selection by smallholders, farmers, pastoralists and breeders, throughout the world, over generations (FAO, 2007). For this reason it constitutes a wide source of genes of indigenous livestock. The uniqueness and the variety of these genes as well as their combinations can be proved, in the future, useful tools for the improvement of production. Furthermore, breeding of local breeds contribute to food security, to the efficient use of environmental resources and to establish sustainable agricultural systems. Breeding of local animal breeds is

based in traditional agricultural management practices, which allow the exploitation of the breeds and the habitats in the best way, with respect to the animals and the environment. The indigenous breeds are adapted in marginal and less favored areas, satisfied with less food, both in quantity and quality; they are also resistant to a wider range of climate changes, like temperatures and rainfalls, and to many diseases. Therefore, livestock diversity provides safeguards to food security, climate changes, diseases, changes of society and environment and reduces pressure of agriculture in vulnerable areas.

Genetic erosion has been spread universally. In contrast to many plant species, there is only a very limited genetic resource-base in wild populations of animal species that is of interest for farm animal breeding (Hiemstra et al., 2006a). It is estimated that over 30% of livestock breeds are at risk of extinction and that six breeds are lost each month (FAO, 2005). It is extremely important to understand the value of livestock genetic diversity and to increase the awareness on the importance of maintaining this diversity, as it is underlined in the Global Plan of Action for Animal Genetic Resources (Strategic Priority Area 1) (FAO, 2007). For this purpose the harmonization of the definition of criteria and thresholds is required. The recognition of the importance of the protection of biodiversity resulted to the development and use of monitoring indicators, which allow the description of the current situation and estimate the changes and trends at national, regional and international level.

Indicators are specific measurements or parameters, or sets of parameters, selected to provide information about the functioning of a specific system, for a specific purpose, so an indicator can help us to understand where we are, where we are going and how far we are from the goal (Baldi, 2001). An indicator quantifies and aggregates data and it can be a sign, a number or a graphic that is searching a phenomenon occurring within a complex system (Quintin, 2001) by summarizing the characteristics of systems or highlighting the changes that take place. According to the OECD an indicator can be defined as 'a parameter, or a value derived from parameters, which points to/provides information about/describes the state of a phenomenon/environment/area with a significance extending beyond that directly associated with a parameter value' (OECD, 1993) and must serve four basic functions: simplification, quantification, standardization and communication (EEA, 2007).

The use of indicators as a tool for policy decision-making in the agri-biodiversity context is a relatively recent phenomenon and still a developing field, however, indicators are perceived to have considerable potential as policy tools (Parris, 2001) because they contribute to transmit information to decision-makers and to the general public at the same time that they facilitate monitoring and evaluation of the state of biodiversity (Garcia et al., 2001). Furthermore, the advantage of using indicators, in relation to other methods, is that they condense information and facilitate the understanding of the complex phenomenon they survey by simplifying it (Garcia et al., 2001). Indicators are powerful means of information and analysis of data and they can be used at various levels: local, national, regional and international (Baldi, 2001). As indicators are used for varying purposes it is necessary to define general criteria for the selection of indicators (OECD, 1993). The basic criteria that must be used for the evaluation of indicators are: a. policy

relevance, b. analytical soundness, c. measurability and d. interpretation (Hiemstra et al., 2006b).

MATERIALS AND METHODS

In this paper we analysed the biodiversity indicators for sheep breeds in Greece, as the sheep sector is a dynamic and traditional livestock industry, with considerable economic importance to the country and rich genetic material. Greece has a significant number of indigenous sheep breeds, which is the result of long-term natural and zootechnical selection. The data used in this study is provided from the national database of livestock breeds in Greece, which is part of the European network EFABIS (www.efabis-greece.gr). The data used refers to four different periods: 1996, 2001, 2007 and 2011 and the results are presented in separated tables and figures, for the mainstream breeds and the breeds at risk. In mainstream breeds the following sheep breeds are included: Karagouniko, Karystou, Kefallinias, Lesvos, Sfakia, Frizarta, Chios, Serres. While, in the endangered breeds, the following: Agrinio, Zakynthos, Kalarritiko, Katsika, Kymi, Pelio, Sarakatsaniko, Skopelos, Florina. The distinction in the two categories has been made according to the thresholds set by the European Commission.

The parameters used as indicators for the estimation of genetic diversity of Greek sheep breeds at national level are: the number of native breeds, the number of endangered native breeds, the number of endangered native breeds in in situ conservation, the number of endangered native breeds in cryo- conservation programs and the indicators at breed level are: the number of breeding males, the number of breeding females, the number of females registered in the herdbook, the percentage of the total number of pure breeding females and the total number of flocks. Furthermore, the genetic parameters were estimated: the effective population size (N_e), the inbreeding rate (Δf), the inbreeding rate per year ($\Delta f/\text{year}$) and sex ratio, in order to determine the trends at degree of endangerment. The formulas used were: $N_e = (4MF/M+F) \times 0,7$, $\Delta F = 1/2 N_e$, $\Delta f/\text{year} = \Delta F/2,5$ and $\text{sex ratio} = M/F$, where M and F are respectively the number of breeding males and females animals.

RESULTS AND DISCUSSION

In the following table and figures the results of the data analysis are presented, providing the current situation of sheep breeds genetic diversity in Greece. The status of sheep breeds diversity is presented in Table 1, while in the following figures the results on the mainstream (figure 1), and endangered breeds (figures 2, 3) are presented. The estimation of genetic parameters is presented in figures 4 and 5.

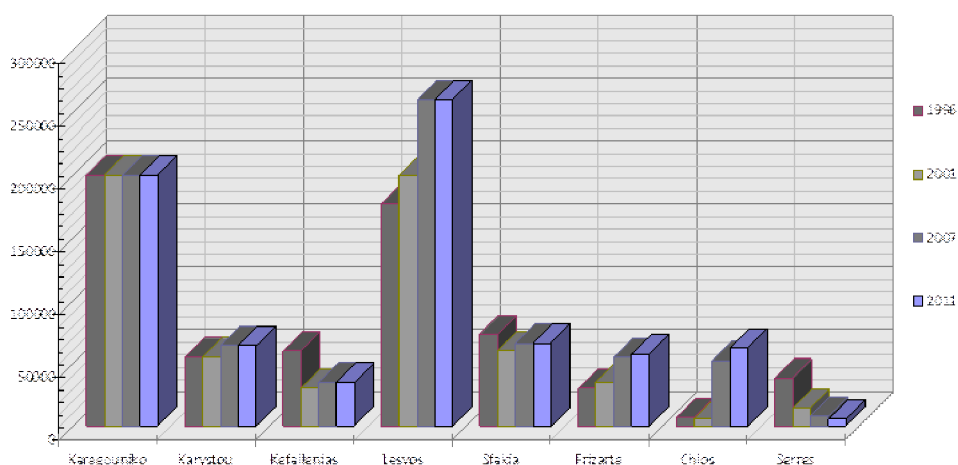
In the last two figures it is shown that some of the breeds present increasing trends, as Kalarritiki breed, which



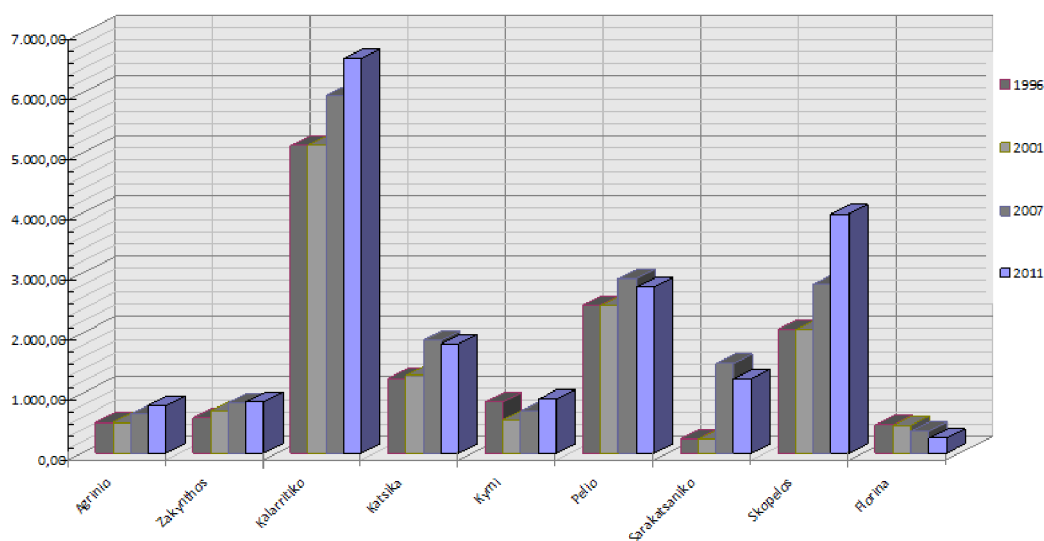
Таблица 1. Състояние на породите овце в Гърция
Table 1. The status of sheep breeds in Greece

No of native sheep breeds/ Брой местни породи овце	20
No of endangered breeds/ Брой застрашени породи	13
No of endangered breeds in situ programs Брой застрашени породи в in situ програми	10
No of endangered breeds in cryo-conservation (*)- Брой застрашени породи в крио консервация (*)-	4*

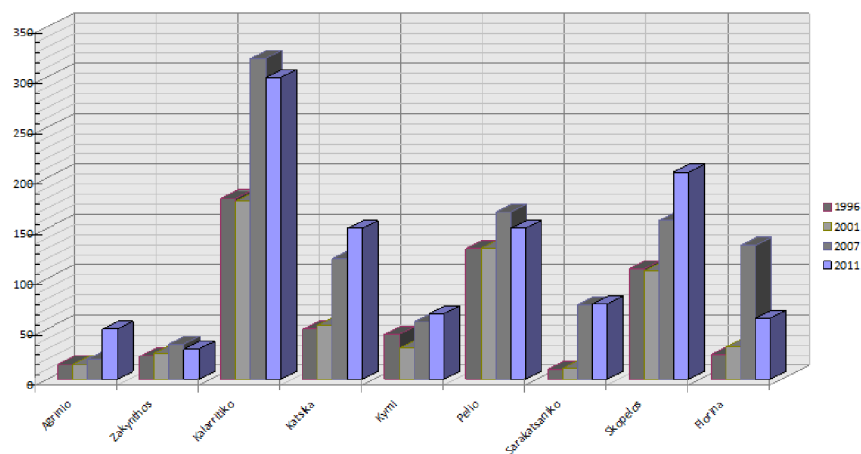
* Not within a National cryo conservation programme/ Невключени в Националната програма за криоконсервация.



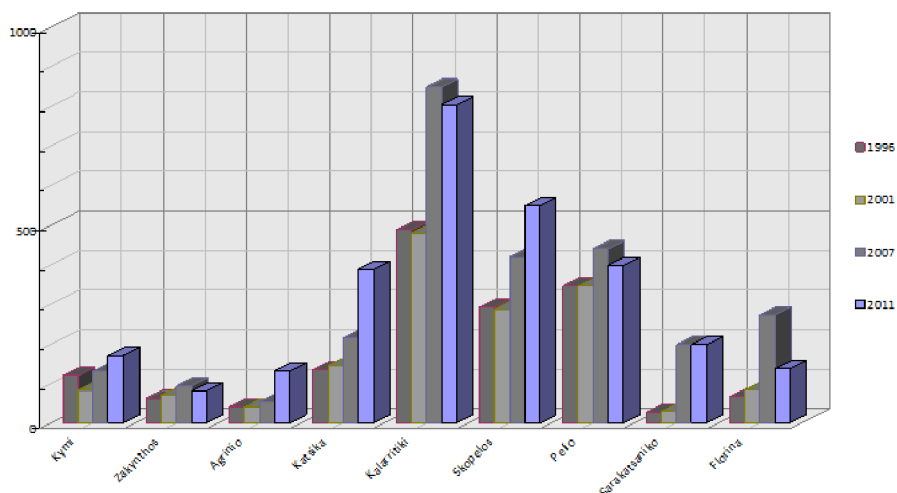
Фиг. 1. Размер на популацията на преобладаващите породи, 1996-2011 г.
Fig. 1. Population size of mainstream breeds, years 1996-2011



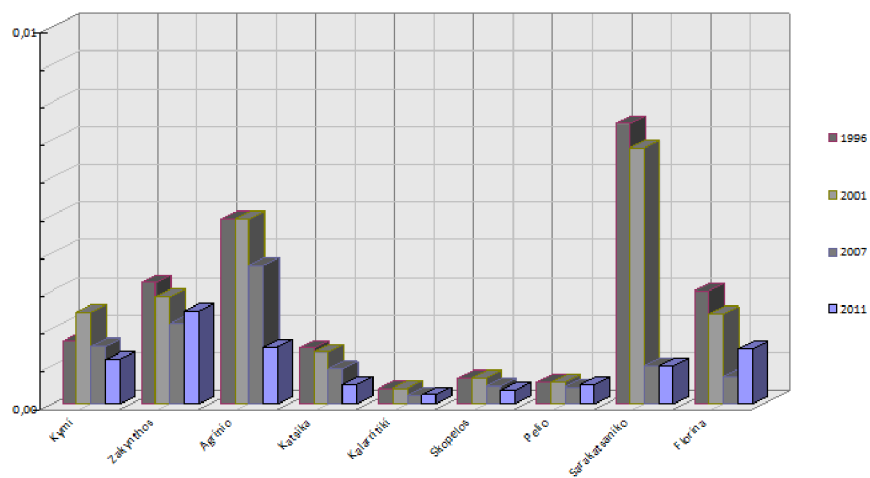
Фиг. 2. Тенденции в популацията на застрашените породи овце (женски разплодни животни)
Fig. 2. Population trends of endangered sheep breeds (breeding females)



Фиг. 3. Тенденции в популациите на застрашените породи овце (мъжки разплодни животни)
Fig. 3. Population trends of endangered sheep breeds (breeding males)



Фиг. 4. Оценка на ефективния популационен размер при застрашени породи овце
Fig. 4. Estimation of Ne endangered sheep breeds



Фиг. 5. Оценка на Δf/година (застрашени породи овце)
Fig. 5. Estimation of Δf/year (endangered sheep breeds)



indicates that the measures that were implemented in the in situ conservation schemes of the breeds had positive results. On the other hand, in some breeds like Agriniou, Zakynthou, Kymi, Florina, Argos and Thraki, which are in critical situation, actions must be taken to establish cryo-preservation programs. Furthermore, inbreeding is a major problem for the majority of endangered breeds, and therefore it is important to apply relevant genetic management schemes in order to control inbreeding.

The results of the analysis highlight the importance of indicators for the estimation of biodiversity status. The indicators, when properly selected and interpreted, contribute to the understanding of the current situation of livestock genetic resources and monitoring of trends and risks. Their value is recognized in the Global Plan of Action for Animal Genetic Resources (Strategic Priority Area 1) (FAO, 2007), where it is mentioned that the use of indicators can be a mechanism for risks and trends monitoring, not only at country level but also at regional and international level, which is specifically useful in the case of transboundary breeds, and can help to develop an early warning system and response mechanisms.

Within the first priorities in the frame of the development of the National Plan for the management of AnGR in Greece, is to continue the survey and characterization of the sheep population. Furthermore, urgent actions should be taken to establish in vitro conservation programs, with priorities in the breeds with very low N_e , as: Zakynthou, Agriniou, Kymi, Florina, Sarakatsaniko, Thraki and Argos.

The results of implementing the proposed indicators showed that sufficient diversity exists in sheep breeds in Greece, efforts are on going to monitor the populations and successful measures have been taken for their conservation and utilization through in situ conservation programs, but there is a considerable delay in the development of conservation strategies, combining in situ and ex situ (in vitro) techniques, under a national system for the conservation and management of farm animal genetic resources, based on the country's conservation priorities.

From this analysis, a restricted group of indicators is proposed aiming to the facilitation of data collection: total number of native breeds; number of endangered native breeds; number of native breeds under in situ conservation programs; number of native breeds under ex situ – in vitro conservation programs.

Additionally, the population size of native breeds (versus total population) and the population size of endangered native breeds (versus the population size of native breeds) could be also used.

The use of indicators group to evaluate the biodiversity at breed level would help to the estimation of the degree of endangerment and take early intervention

measures. The following indicators were included: number of breeding females; number of breeding males; number of flocks.

Furthermore, the following indicators could be used: number of native breeds under in situ conservation programs and - number of native breeds under ex situ – in vitro conservation programs.

An additional parameter that should be taken into account for the estimation of the degree of endangerment and be used as an indicator of biodiversity is the geographical concentration of sheep breeds. The local breeds are adapted in specific geographical areas and sometimes are isolated, with consequences on their population size, especially in diseases outbreaks (Alderson, 2009). The geographical concentration can be estimated by collecting of relevant data and checking of appropriate models. Towards this objective, several projects are on going, incorporating also social and economical indicators.

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