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Editorial - The first GLOBALDIV Workshop, Bydgoszcz (Poland) 18-19 March 2009

The first GLOBALDIV Workshop took place in Poland on 18th-19th March 2009 and was hosted by the University of Technology and Life Sciences of Bydgoszcz. Of the total of 70 people who attended the workshop, 26 were partners and experts of GLOBALDIV project and 44 were from the local organizing institution and participants from other countries. They represented four continents (Europe, Asia, South America, North America) and 22 Countries, together with the coordinators/representatives of other three GenRes projects (EFABISNet, HERITAGESHEEP and EUREKA) and the representatives of seven International Institutions, the Food and Agriculture Organization of the United Nations (FAO), the International Livestock Research Institute (ILRI), the International Atomic Energy Agency (IAEA), the European Association for Animal Production (EAAP), the World Association of Animal Production (WAAP), the International Committee for Animal Recording (ICAR), the United States Department of Agriculture (USDA).

All attendants received a GLOBALDIV certificate of participation and the instructions on how to retrieve the freely downloadable workshop material from GLOBALDIV website (www.globaldiv.eu).

After the welcome by the Rector of the hosting Institution, Prof. Antoni Bukaluk, the first session of the Workshop was chaired by Prof. Maria Siwek from the University of Technology and Life Sciences of Bydgoszcz, Poland, and focused on the EU initiatives on Farm Animals Genetic Resources (FAnGR) conservation.

EDITORIAL - THE FIRST GLOBALDIV WORKSHOP, BYDGOSZCZ (POLAND) 18-19 MARCH 2009 1

ARTICLE OF THE MONTH - DATABASES & BIODIVERSITY: FROM SINGLE DATABASES TO A GLOBAL NETWORK 8

THE BREED OF THE MONTH: GREEN-LEGGED PARTRIDGELIKE. AN OLD NATIVE POLISH HEN 12

EVENTS CALENDAR 15

BIBLIOGRAPHY 16



Globaldiv



The first contribution was from Dr. Jean-Charles Cavitte, European Community Project Officer, who presented the most recent EU initiatives and funding opportunities within the 7th Framework Programme for the characterization and conservation of FAnGR. After stressing the importance of a harmonized zootechnical legislation to help addressing the actions of breeding organizations and the use of herdbooks within EU countries, Dr. Cavitte's talk focused on the key objectives and outcomes of the past actions supported by the European Community and on funding opportunities for the next years until 2013.

In the following presentation Prof. Paolo Ajmone Marsan from the Università Cattolica del Sacro Cuore of Piacenza, Italy, explained the main objectives of GLOBALDIV project and the specific tasks of the single Working Groups involved in the project. The events organized as side activities for the dissemination of knowledge and project results were also described, with particular attention being paid to the satisfactory experience of the 2008 edition of the GLOBALDIV Summer School.

The major goals and results of other past and ongoing GenRes projects were described by their coordinators or representatives: Dr. Eildert Groeneveld from the FLI Institute of Farm Animal Genetics in Mariensee, Germany, introduced EFABISnet - European Farm Animal Biodiversity Information System (website: <http://efabis.tzv.fal.de>) - project whose main aim was the development of a new free and open source software to create a supra-national network for 1) the storage of information on breeds of 35 different livestock species and 2) the management of information regarding the geographic origin, the type of tissue, the source individual and the movements of samples stored in cryo-banks.



The EURECA - Towards (self)sustainability of EUropean REgional CATTLE breeds (website: www.regionalcattlebreeds.eu) - project was illustrated by the coordinator Dr. Sipke J. Hiemstra from Wageningen University and Research Centre, Netherlands. This GenRes activity, based on an integrative and interdisciplinary approach, aimed at

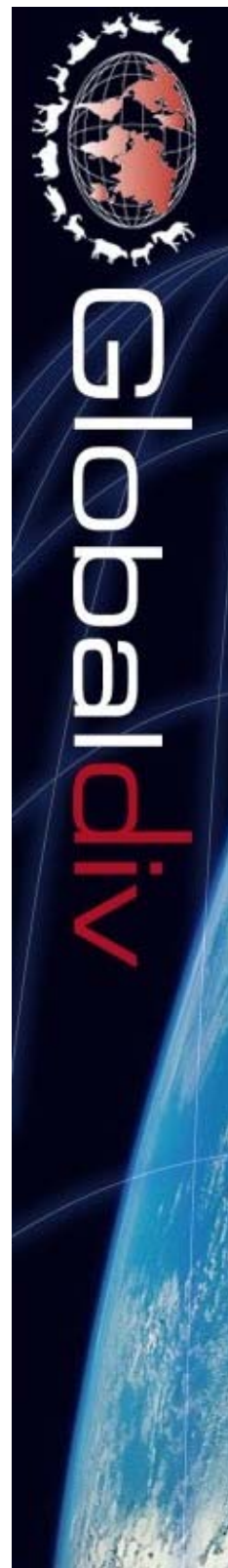
1. Better understanding the dynamics and the current status of local cattle breeds in Europe;
2. Assessing the status and the organization of cryopreservation programs and
3. Reviewing the available methodologies and software used as a support in genetic management, to develop guidelines and policy advice to diffuse good practices among the regional cattle breeders.

The third project, HERITAGE SHEEP (website: <http://heritagesheep.eu>), was described by Dr. Amanda Carson, from the Sheep Trust, University of York, UK. The main purpose of this action was to promote and coordinate at the European level the conservation of the genetic resources of Heritage Sheep Breeds, that is to say those breeds that are genetically distinct, geographically concentrated and adapted to their environment. They are traditionally farmed for commercial use and play an important role in the culture and rural economy of the regions in which they are managed, mostly for the long-term sustainability of medium to low input farming systems. The project included different aspects, from a starting survey and information gathering about the breeds' history and origins, to the current in situ and ex situ conservation actions, and to a forecast on the future trends of the promotional activities and programmes to increase the productivity.

The topic of following morning session, chaired by Dr. Jianlin Han from the International Livestock Research Institute, China, were the new challenges for FAnGR conservation. The first talk was given by Prof. Elzbieta Smalec from the University of Podlasie, Poland, on the rare breeds and varieties of poultry in Eastern European countries. A comprehensive survey of the native chicken, duck, Muscovy duck, geese and turkey breeds was given country by country for Estonia, Latvia, Bulgaria, Lithuania, Czech Republic, Slovakia, Romania, Hungary, Slovenia, Serbia, Ukraine, Belarus, Russian Federation and Poland. Also the principal sources of genetic variation were listed, together with the most important phenotypic differences displayed by the animals.

The advances in avian germplasm preservation were explained by three speakers from the University of Technology and Life Sciences of Bydgoszcz, Poland: Prof. Marek Bednarczyk described the techniques for in situ and ex situ preservation and the reconstitution of poultry genetic stocks through the production of chicken chimeras; Dr. Katarzyna Kasperczyk detailed how to choose, isolate and cryo-preserve embryonic cells and Prof. Maria Siwek concluded the talk by illustrating the tools for the identification of the donor germ line thanks to the analysis of feather pigmentation markers and DNA screening by RFLP and microsatellite markers.

The third and conclusive talk of the session was given by Dr. Irene Hoffmann from the FAO on the new challenges at the global level and the new threats for farm animal biodiversity. Particular attention was paid to the present day drivers and production trends of the livestock sector as well as to the future trends and evolution of the farming systems. The major threats to



AnGR diversity were also described, taking into account their dependence on differences in agro-ecological zones and production systems and the risk status of transboundary and local breeds.

Prof. Elzbieta Smalec from the University of Podlasie, chairman of the first afternoon session on the state of the art in FAnGR characterization and conservation, introduced the contribution of Dr. Linn F. Groeneveld from the FLI Institute of Farm Animal Genetics in Mariensee, Germany. The topic of the presentation was the current status of the evaluation of phenotypic and genetic diversity in livestock breeds. Dr. Groeneveld first summarized the characteristics of the existing national, international and worldwide breed databases and described the state of the art of the genetic characterization of cattle, yaks, water buffaloes, sheep, goats, camelids, pigs, horses and chickens. Also the main molecular databases were listed and the gaps of molecular knowledge still to be filled were reported.

Prof. Johannes A. Lenstra from Utrecht University in the Netherlands reviewed the molecular tools used for conservation purposes through a comprehensive description of a specific case study on cattle breeds. The usefulness of nuclear and mitochondrial markers to assess the levels of genetic variability, to infer the contributions from ancestral populations and to identify relationships among breeds was explained, but also the importance of the uniqueness of specific breeds due to their history and to the importance they have in local tradition and cultural heritage was considered.

The following talk was given by Dr. Milan Zjalic from the European Association for Animal Production (EAAP) on the reform of the Common Agricultural Policy (CAP) and conservation of biodiversity of farm animals in the European Union. After illustrating the starting point of the CAP dating back to 1960s and the evolution of EU agricultural policy during the last decades, the presentation focused on the instruments for AnGR conservation adopted so far and those that will be introduced in the next years to support breed societies, to orient the developments towards market demands and to include the non-productive components of breed utilization (e.g.: environmental services and cultural heritage).

Afterwards, Prof. Stephane Joost from the Ecole Polytechnique Federale de Lausanne, Switzerland, explained how to integrate geo-referenced multiscale and multidisciplinary data for the management of biodiversity in livestock genetic resources. Both the reasons for integrating data in livestock conservation and the outcomes expected from this procedure were detailed, with an extensive explanation of the characteristics of the different data types (molecular data, administrative and political boundaries, socio-economic and socio-demographic, environmental data etc.), the technical requirements, the issues related to the scale heterogeneity and the use of Geographic Information System (GIS) tools. Prof. Joost also provided a comprehensive list of available GIS software and of the most frequently used geodata formats.

The session was concluded by the contribution of Dr. Paul Boettcher from FAO, who described the objectives, criteria and methods for priority setting in conservation of AnGR. During the presentation the factors influencing conservation priority were detailed, taking into account the weight of genetics, phenotypic performances, breed demography and extinction probability; the main methods used so far for prioritization purposes were

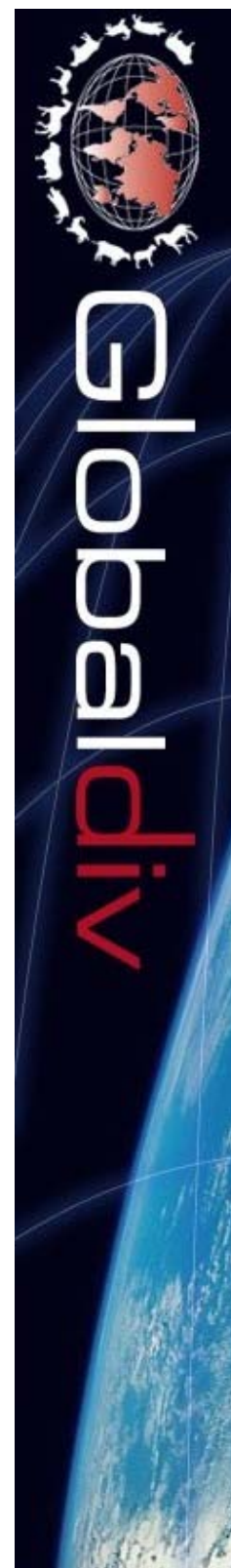


also explained, including Weitzman's conservation potential and diversity indices, the kinship and "core set" approaches and the estimation of extinction risk. As a closing remark, the Dr. Boettcher stressed the gaps still existing and which can prevent successful prioritization actions: lack of consensus on which is the optimal approach, lack of practical tools as e.g. a "one step" software, lack of necessary information.

The second part of the afternoon was devoted to the group discussion. According to the preferences expressed before the beginning of the workshop, the participant split into four groups corresponding to the different working groups of GLOBALDIV project. During four parallel sessions, the discussion was facilitated by the intervention of expert chairmen and moderators who helped focusing the debate on topics specific to the WGs, in particular: WG2 Characterization of FAnGR diversity - Chairman: Prof. Johannes A. Lenstra. Moderators: Prof. Olivier Hanotte from the University of Nottingham, United Kingdom, and Dr. John L. Williams from the Parco Tecnologico Padano di Lodi, Italy; WG3 Meta analysis of diversity - Chairman: Prof. Michael W. Bruford from the University of Cardiff, UK. Moderators: Dr. Linn F. Groeneveld and Prof. Juha T. Kantanen from MTT Agrifood Research, Finland; WG4 Socio economic aspects of conservation - Chairman: Dr. Andrea Rosati from the EAAP. Moderators: Dr. Irene Hoffmann and Prof. Gustavo Gandini from the University of Milan, Italy; WG5 Integrating data and setting priorities for conservation - Chairman: Prof. Stephane Joost. Moderators: Dr. Paul Boettcher and prof. Paolo Ajmone Marsan.

In addition to the debate on topics specific to the different WGs, the overall structure of FAO guidelines was discussed to propose a new organization of the document.

On the second day of the workshop Prof. Josè Fernando Garcia from the São Paulo State University, Brazil, chaired the first part of the morning session focusing on the novel and forthcoming opportunities for FAnGR characterization and conservation. Prof. Garcia introduced the talk of Dr. Massoud Malek from the International Atomic Energy Agency (IAEA) on the web-based Research and Management Platform (RaMP) for animal genetic resources at FAO/IAEA joint division. During the course of the



presentation the activities supported by IAEA in the field of farm animal health and genetics were explained, focusing in particular on the research carried out to identify SNPs polymorphisms associated with nematode resistance in sheep, and to develop a genetic repository bank for small ruminants samples; the conclusive part described the development and use of the RT-db Real Time data base for sheep genomics (www.sheepgenome.com) to provide publicly available information on QTLs, genes and DNA sequences.

Dr. Tad S. Sonstegard illustrated the research projects on whole genome approaches and livestock biodiversity carried out by the United States Department of Agriculture, USA. Starting from the traditional selection programs carried out during the 20th century, the development of US dairy industry was described up to the present day application of genetic improvement methodologies. The core of the presentation focused on the characteristics and performances of the SNPs panels used in cattle for whole genome assays, genetic merit predictions and association with phenotypic traits. The potential of SNPs panel genotyping was also evaluated from the point of view of biodiversity conservation purposes and phylogenomic studies.

The last contribution, given by Prof. Pierre Taberlet from the Université Joseph Fourier of Grenoble, France, depicted the opportunities offered to livestock genetics by new sequencing technologies. The potentials of the main systems for high-throughput sequencing were compared, together with the merits and flaws of each different technology. Some of the possible fields of application in livestock sciences were also explored, taking into account the advantages and disadvantages of SNPs panels compared to whole or partial genome sequencing, the growing importance of good reference genomes and bioinformatics skills, and the possibilities of using information on adaptive genetic variation in conservation projects.

Prof. Paolo Ajmone Marsan chaired the final part of the session during which the WGs moderators reported on the results of the parallel discussions of the previous afternoon: in WG2, the discussion focused on the characterization of biodiversity and on suggestions for the improvement of FAO guidelines. In particular, it was suggested to focus on conservation, utilization and management in addition to characterization, since this is functional to utilization and management. Also, conservation can be made more sustainable by improving breed-specific products. In WG3, the debate concerned some practical issues, such as the nature of the diversity considered in conservation plans. So far the main focus has been on genetic diversity but phenotype/quantitative genetic diversity must be also considered. The pros and cons of the most frequently used molecular markers (STRs, SNPs, mtDNA sequences, AFLPs, Y chromosome) were also revised, and the importance of the standard samples approach and of the ISAG/FAO microsatellite panels was stressed, since they still represent an effective (also cost-effective) tool, mostly in those countries where no access to next-generation sequencing will be available in the near future. The summary of WG4 discussion stressed the importance of finding and highlighting the socio-economic importance of keeping rare breeds to justify the support given with public funds, but also the need to improve dissemination efforts and to link dissemination topics to people's present day feelings about the issue of FAnGR conservation, because the possibility



to have future funding depends on how this topic is perceived by the European people at present. WG5 discussion converged on the revision of FAO guidelines by adding some suggestions on sampling strategies to facilitate data integration. Recommendations were also given about the necessity to define prioritization strategies and methods able to take into account genetics and other criteria (socio-economics, environment, adaptation, etc.). Regarding data integration and prioritization, it is necessary to facilitate the access to the sources of information in the different thematic fields that FAnGR management and conservation actions must take into account; dedicated and easy to use software tools and web-based technological platforms have to be developed in order to facilitate data access and integration, geo-visualization and analysis by multivariate and multi-criteria techniques.

A general discussion followed, whose main conclusions have been summarized by Dr. Paul Boettcher in the "take-home message from the workshop" to transmit to all the relevant parties and to the European Union in particular.

GLOBALDIV is already organizing the forthcoming events, in particular the second edition of the Summer School which will be held once more in Piacenza, Italy, on 7th-11th September 2009, and the final workshop that will take place in Rome in February 2010.

In comparison to the first edition, the syllabus of the second Summer School will include an increased software session and a part on molecular data analysis, and will add some lectures on topics not touched yet, in particular the socio-economic aspects of conservation and the management of genetic diversity. Target audience will be PhD students and young post-doc researchers, possibly including those who attended last year and want to have an upgrade.

We would like to thank the University of Technology and Life Sciences of Bydgoszcz, Poland, for lending itself as the hosting Institution for the first GLOBALDIV Workshop; the members of the Organizing Committee (Prof. Paolo Ajmone Marsan, Prof. Marek Bednarczyk, Prof. Maria Siwek, Dr. Licia Colli, Dr. Katarzyna Kasperczyk, Dr. Elena Murelli, Dr. Riccardo Negrini and Dr. Anna Slawinska), all the speakers who gave invaluable contributions to the initiative and were willing to stimulate and take part to the debate during the workshop sessions and beyond; all the attendants who actively participated and gave their input to the discussion, and all the people who helped organizing the event: Prof. José Fernando Garcia, Dr. Lorenzo Bomba, Dr. Rosanna Marino, Dr. Raffaele Mazza, Marcin Rzepus and Francesca Sibella.

Thank you!

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Article of the month - Databases & biodiversity: from single databases to a global network

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1. Introduction

With continuing urbanization, contacts of a large part of the society with the basis of food production continue to get less and less. Not surprisingly, also knowledge about the breeds becomes increasingly a thing of the past. While this applies to the breed diversity within countries knowledge about the agricultural animal biodiversity beyond national boundaries is even less. This becomes an issue where wide spread support is required for the conservation of such biodiversity: only if people know about biodiversity they can stand up, voice and organize support for endangered breeds.

In this context of local data (i.e. breeds) and global concern the Internet is an ideal vehicle for information transfer. Therefore, it is not surprising that the internet is the most dynamic source of information transfer, also in agricultural breed biodiversity.

2. Types of Databases

An interested user is confronted with a plethora of website on biodiversity in animal agriculture. Broadly speaking, these can be broken down into four categories: project specific websites, those of breeding organizations, national websites, and supra national websites.

As the name suggest, project specific websites inform about a specific project, its objectives, the object of interest and the procedure to achieve the project goals. The Heritage Sheep Breeds (HSB) Project website (<http://heritagesheep.eu>) is one such example. Its objective is 'to establish a European-wide conservation programme of HSB genetic resources for the diversification of production in livestock agriculture and for their central importance in the long-term sustainability of medium to low input farming systems'. Their static Website has descriptive and visual information on a number of European sheep breeds along with contact data of the corresponding breed societies.

In contrast, websites of breeding organizations publish information connected to their own breeds. Factual information may also be available along with organization data around that breed, but its character is one of promotion and advertizing. Nonetheless, they may provide valuable information as can be seen at www.shorthorn.co.uk.



The thrust of national websites is broader as they try to give an exhaustive overview of the national heritage of breeds. They can be a one stop source of information for a whole country with possibly a lot of factual, textual and visual information on the breeds. Examples are www.genres.de/tgrdeu and www.brg.prd.fr. A drawback of many national websites is the presentation language: while some have English versions available, many only use the national language, which may be a barrier to international users.

Finally, there are a few websites which try to cover a whole region of the world [4] <http://efabis.tzv.fal.de> [1] or indeed the globe www.ansi.okstate.edu/breeds and <http://dad.fao.org> [2]. One of the earliest databases was that of the EAAP which collected systematically textual and numerical data on breeds in Europe [5] starting with a breed survey in Europe as early as 1987. Content and structure became a model for the first global world wide domestic animal diversity information system (DAD-IS) which started its operation in 1996 at the FAO in Rome. The EAAP and FAO databases were different as they tried to collect data on the morphology, production and population sizes with well above 100 data fields which opened the possibility for interactive database querying and reporting. Furthermore, DAD-IS has global i.e. worldwide coverage.

3. FABISnet - a European network

In the EFABIS project of the European Union under the 5th framework a new system was developed which used data and data structure from both the EAAP and the DAD-IS databases replacing both and expanding into a network of nationalizable multilingual systems termed FABISnet.

In the follow-up EFABISnet project (a three year EU project under regulation 870/2004) the network was expanded to a network covering Europe from Georgia to Iceland with 13 country databases, one European EAAP website and finally the global DAD-IS node at the FAO in Rome. Their content is synchronized automatically as indicated by the connecting lines in figure 1.

The FABISnet [3] network has by far the most comprehensive websites on the biodiversity in animal agriculture. The content is global worldwide and reflects the FAO infrastructure on documentation of animal genetic resources with 192 FAO member countries comprising more than 12000 breed population from 38 species. The EFABIS node as the regional European database collects all breed information from Europe through automatic synchronization from 14 national European FABISnet web sites and direct manual entry from the others (except for Spain which enters data directly at FAO's DAD-IS). The FABISnet software has been released under the open source license with the intention to have it also installed in other regions of the world free of licensing charges.

One objective of the remaining EFABISnet project time is the setup of 10 national genebank CryoWEB databases and their integration into the FABISnet. CryoWEB is a WEB application that serves as a register and management system for national genebanks of animal genetic cryogenic material.



All samples of genetic material together with their location in the country, in the container down to the cell are recorded in CryoWEB. Together with the type of material (e.g. embryos, semen) also some information on the donor animal is recorded which includes the animal ID and the breed name. CryoWEB does the book keeping of the national genebank. For instance, whenever a bunch of straws of deep frozen semen has been collected and put into a tank, this transaction is recorded, entering data of the donor animal, the material type, amount and location in store. Conversely, if semen is taken out of store or moved with, this transaction is also recorded. If the CryoWEB administrator adheres to these rules, the content of the database will always reflect the content of genetic material in the cryo store. CryoWEB is a generic system, that should work out of the box and satisfy the basic need for documentation of any genebank of animal genetic resources, while allowing for adaptation to the national languages and is also available under the GNU public license.

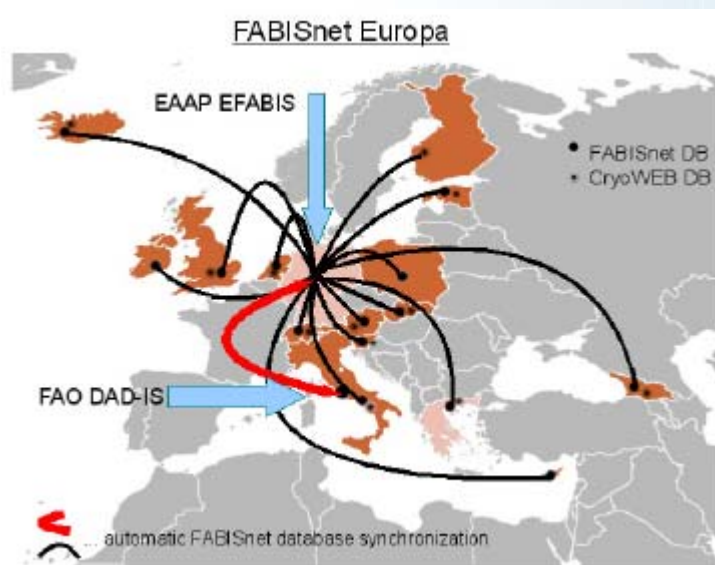


Figure 1. Network of FABISnet and CryoWEB databases.

By choosing the same breed names in CryoWEB and in FABISnet the way for an electronic update of breeds records in an FABISnet database on the basis of exact individual animal records in the CryoWEB system is open. The CryoWEB databases are indicated by a fuzzy dot in figure 1. Transfer of information from CryoWEB to the countries' FABISnet database will be within the countries.

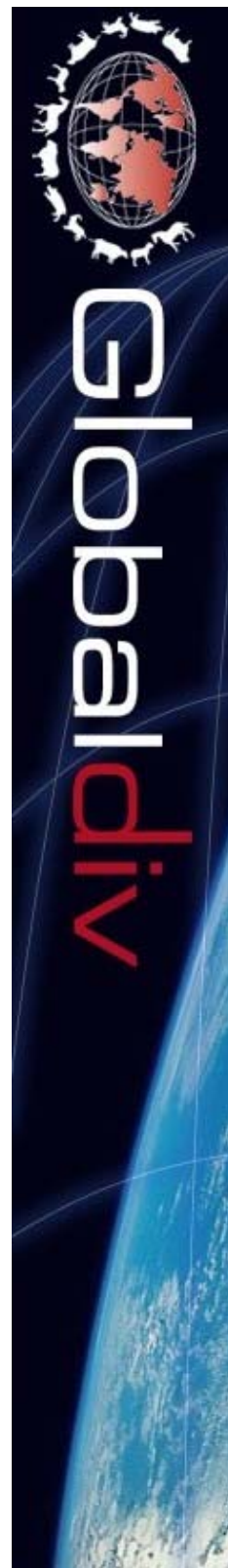
Finally, the lines in figure 1 depict the exchange of breeds data within FABISnet. While synchronisation among FABISnet databases is totally automatic without human intervention, the data transfer from CryoWEB to a FABISnet database is initiated manually. The reason for this is the responsibility of the National Coordinator for data inputs: by having a data file as a go between the two systems, breeds that are not part of the national gene bank but which the national Coordinator wants to include can be added prior to upload.



The object of most biodiversity web sites in animal agriculture is the 'breed' or population, and not the individual animal within (an exception are some breed societies which present individual animal data on some of their most important breeding animals). With the linkage of CryoWEB and FABISnet, for the first time, production type databases with individual animal records are directly linked to the global breeds database network, thereby creating breeds statistics in FABISnet which are directly derived from production data. Perhaps this procedure can also be a model for other data in the biodiversity databases.

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The breed of the month: Green-legged Partridgelike. An old native polish hen



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Introduction & historical facts

The *Zielononózka Kuropatwiana* (Green-legged Partridgelike GP), an old native Polish hen, became recognized as breed at the end of XIX century. The birds have been maintained and bred in south-eastern region of Poland and were very popular by dint of their resistance to severe climatic conditions, excellent hatching and rearing abilities as well as of their disposition for good utilization of pasture. From amongst several color varieties the most popular, with partridge like feathers and reseda-greenish legs and beak, has been chosen for further breeding and consolidation. The breed was described for the first time in 1879. Then, in 1894, it was presented as Green-legged hen at Country Exhibition in Lvov. In 1988 it appeared in the International Registry of Poultry Genetic Stocks by R.G. Somes. For many years the breed remained wide-spread in Poland and was kept even in 70% of Poland's area. It was popular especially in south-eastern parts but in sixties and seventies of the last century, GP's population decreased to about 11% in 1961 and to only 2% in 1973, being at the risk of extinction.

With its medium productivity and body weight the breed could not compete with the modern, intensive breeds introduced at that time in Poland. It became necessary to act towards saving the breed.

The GP's genetic tesources conservation

For this purpose two separate conservation flocks of the breed have been established and included into the program of the laying hen resources conservation. One of these flocks was organized as early as in 1945, right after the end of the II World War. Since 1960 both flocks have been closed to any external genetic influences and reproduced only within them. Currently, the population of Green-legged Partridgelike hen consists of two separate flocks approximating 600 females and 70 males each. Thanks to the interest of the small stock breeders, also for fancy purposes, there also exists a small unregistered population of these birds.

The genetic resources conservation program enables to save the population from extinction and to preserve its phenotypic traits according to the breed standard set. Simultaneously all efforts are made **to maintain an existing genetic balance** and to avoid mating of relatives effecting in possible increase



of inbreeding level. Two different mating systems are applied in the conservative flocks to avoid inbreeding effects. In one flock the birds are mated each year in the small closed groups (pedigree flocks) consisting of one cock and 12 to 20 hens. Besides the phenotypic criteria in selection of the birds, the attention is paid not to mate the birds having even one common grandfather or grandmother ("two generations free"). Thanks to an individual control of laying and pedigreed hatches performed, it is possible to know the origin of each chick after both parents. In the other flock a rotation mating method based on sire group rotation in consecutive years is used. For this purpose the flock has been divided into four separate groups (a, b, c and d) reproduced within each of them. The males from consecutive group are mated each year to the females from different, unrelated group. This enables obtaining pedigree information from the father side.

GP's features and utilisation

Green-legged Partridge-like is regarded as a dual purpose breed, but because of low body weight and a light silhouette it is rather similar to the layer type breeds. When selected for performance traits, GP may reach mean body weight of 1700 - 2200g for cocks and 1500 -1800g for hens and laying production per 450 days amounting from 180 to 190 eggs weighing 55-58g. It is also thought, that the breed is not suitable for an intensive maintaining in the numerous, overpopulated flocks or in cages, although some recent cage studies show its potential ability to lay even over 200 eggs in such conditions. The eggs are smaller than those of other breeds but contain more yolk (even over 32%) and some studies indicate a comparably smaller amount of cholesterol. The white to light-cream eggshell is firm, of good quality with low occurrence of defects.

Another trait typical for GP is partridge pattern of plumage, resembling that of the red jungle fowl (*Gallus gallus*), much richer in form and color in male than in female, especially on the hackle, tail and saddle regions. The chick's down color of GP is wild, with typical stripe on the back. Comb is single, of medium size, straight and upright, ear-lobes red. Shank and beak are reseda-greenish.

Apart from phenotypic traits, the birds selected for reproduction should come from the families showing at least a satisfactory level of **utility traits**. Therefore, though not taken into consideration in the breeding goal, the following traits are individually and/or group controlled:

- Survivability during rearing and production.
- Body weight at 20 weeks of age.
- Sexual maturity as the age at 30% and 50% of egg production.
- Number of eggs and/or laying performance percentage rate in the period from 21 to 56 weeks of age.
- Egg weight and egg and shell quality at the age of 33 and 53 weeks.
- Hatchability from set and fertile eggs.



Extensively maintained, the breed could be competitive to the others because of its peculiar traits such as hardiness, low susceptibility to unfavorable conditions and well developed maternal traits. Additionally, great activity and ability to utilize green area make the GP an ideal breed for a free range keeping. Both the meat and eggs are characterized by an exceptional taste, though a darker color of meat may be discouraging for some consumers.

GP in biological studies

1) GP in genetic diversity studies:

GP breed was included in the studies of genetic diversity and relationships between various, 52 chicken populations (AVIANDIV project on the chickens biodiversity funded by the EC). In the light of those studies, GP appeared to be a high polymorphic population with the gene diversity values accounted for $H = 0.53$, while an average H within the 52 populations across all 22 loci was 0.47. Moreover, Green-legged Partridge-like hen was characterized by specific (private) allele which was absent in the remaining populations.

2) GP in immunological studies:

GP is thought to be a remarkable avian model for investigating the genetic background of immune responses, especially taking under consideration potentially elevated level of immunity in GP breed. In studies conducted, F1 cross of GP with commercial White Leghorn was created and consecutive F2 generation was produced. Immune responses were measured as specific immune response for a Keyhole Lymphet Hemocyanin antigen (KLH) and non specific, innate immune responses for Lipopolysaccharide (LPS) and Lipoteichoic acid (LTA) binding. Estimated heritability was 0.10 for KLH and LPS, and 0.20 for LTA. There was a significant gender effect for a non specific immune response binding LPS. High genetic correlation (0.71) was estimated for LPS and LTA, what could suggest a similar path of innate immune responses for these two homotypes. Studies results confirm a genetic background of specific and innate immune responses in Green - Legged Partridge-like hens, White Leghorn chickens and their cross. The reference cross was genotyped with microsatellite markers in a QTL validation study. Quantitative trait loci linked to anti-LPS and anti-LTA natural antibodies (NAb) level on GGA5, GGA9, GGA14, GGA18 and GGAZ were confirmed. A novel QTL for anti-KLH NAb titer was identified on GGA6. The candidate genes, responsible for NAb level in chicken were proposed.

3) GP in genetic bioengineering

Recent investigations suggest several novel approaches that may be used in the Green-legged Partridge-like chicken. The GP embryo has been a good source of embryonic cells, used in biotechnological manipulations. Blastodermal cells (BCs) isolated from stage X of GP



embryos can be frozen/thawed with high efficiency (90% of cells' survivability) and produce both somatic and germline chimeras when injected into the subgerminal cavity of recipient embryos.

The avian chimeras offer not only an excellent model for studying cells and embryonic development: the chimera's production technology can be useful as an intermediate for development of transgenic birds and can be used for reconstituting poultry foundation stocks. The hatchability of chimeras is usually very low, but depends on an adequate assortment of BCs from the donor and recipient. In the case of BCs from the GP breed, good hatchability (56%) of treated embryos was accompanied by very high percentage (86.9) of chimeras. The resulting male and female chimeras were mated in our recent study and produced donor-derived offspring, suggesting that it is possible to reconstitute a breed of chicken (in this case Green-legged Partridge-like chicken), using blastodermal cells.

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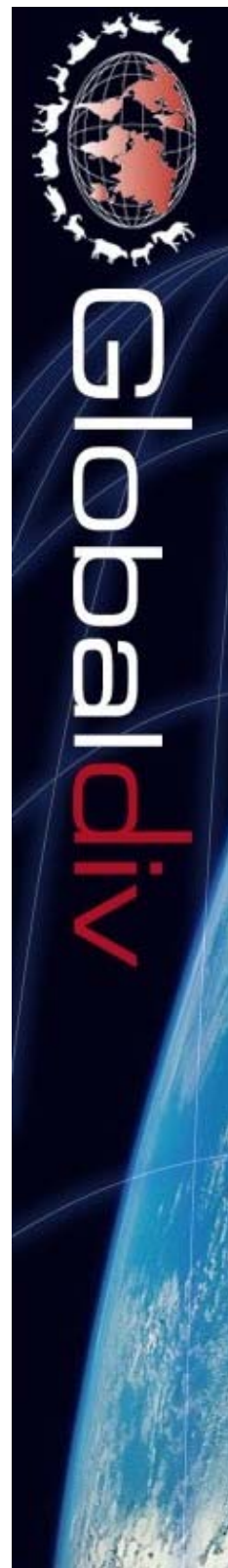
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Events calendar

- XXXIII CIOSTA-CIGR Section V International Conference "Technology and Management to Ensure Sustainable Agriculture, Agrosystems, Forestry and Safety". DISTAFA, Università Mediterranea di Reggio Calabria, Reggio Calabria, Italy. 17-19 June 2009, www.ciosta.unirc.it
- Darwinian selection, selective breeding and the welfare of animals - UFAW International Symposium 22-23RD June, 2009, University of Bristol, UK
<http://www.ufaw.org.uk>



- Joint International Agricultural Conference 2009. Wageningen, NL. 6-8 July 2009
www.jiac2009.nl
- 60th Annual Meeting of EAAP (European Federation of Animal Science), Barcelona, Spain, from 24 to 27 of August 2009
www.eaap2009.com
- 2nd edition of the GLOBALDIV Summer School, 7-10th September 2009 at Piacenza, Italy – www.globaldiv.eu – APPLICATION OPEN TILL 25TH JULY 2009

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