

Symposium sponsors:



Ministry of Education, Science and Technological Development of the
Republic of Serbia



Adress: Mojkovačka 58, 11136 Belgrade
Phone: +381 11 63 555 63
Fax: +381 11 63 555 63
Email: office@zlatiborac.rs



PKB Corporation Belgrade
Padinska skela, Industrijsko naselje bb.
Phone: 8871-002 (ext. 103-199)
8871-499 (ext. 500-599)
8871-350 (ext. 301-398)

PROCEEDINGS INTERNATIONAL SYMPOSIUM ON ANIMAL SCIENCE 2018 (ISAS)



ISAS
International
Symposium
on
ANIMAL SCIENCE



2018



PROCEEDINGS
INTERNATIONAL SYMPOSIUM
ON
ANIMAL SCIENCE 2018
(ISAS)



University of Belgrade
Faculty of Agriculture, Institute of Animal Science
22nd - 23rd November 2018
Zemun, Belgrade



Ministry of Education, Science
and Technological Development
of the Republic of Serbia

PROGRAM
of the
INTERNATIONAL SYMPOSIUM ON ANIMAL SCIENCE 2018

**22nd – 23rd November 2018, Faculty of Agriculture,
Belgrade-Zemun, Serbia**



UNIVERSITY OF BELGRADE
FACULTY OF AGRICULTURE
Institute for Animal Science

Organizers



UNIVERSITY OF NOVI SAD
FACULTY OF AGRICULTURE
Department of Animal
Science

Co-organizers

KMETIJSKI INŠTITUT SLOVENIJE, Slovenia
UNIVERSITY OF ZAGREB, Faculty of Agriculture, CROATIA
JOSIP JURAJ STROSSMAYER UNIVERSITY OF OSIJEK,
Faculty of Agriculture, CROATIA

International Scientific committee

Prof. dr **Zoran Popović**, University of Belgrade, Faculty of Agriculture, Serbia, Chairman

Prof. dr **Milica Petrović**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Saša Dragin**, University of Novi Sad, Faculty of Agriculture, Serbia

Prof. dr **Denis Kučević**, University of Novi Sad, Faculty of Agriculture, Serbia

Prof. dr **Ivan Pihler**, University of Novi Sad, Faculty of Agriculture, Serbia

Prof. dr **Zoran Popovski**, Ss. Cyril and Methodius University in Skopje, Faculty of Agricultural and Food Sciences, F.Y. Republic of Macedonia

Prof. dr **Zvonko Antunović**, Josip Juraj Strossmayer University of Osijek, Faculty of Agriculture, Croatia

Prof. dr **Ante Ivanković**, University of Zagreb, Faculty of Agriculture, Croatia

Prof. dr **Boro Mioč**, University of Zagreb, Faculty of Agriculture, Croatia

Prof. dr **Marjeta Čandek-Potokar**, Agricultural Institute of Slovenia, Slovenia

Prof. dr **Muhamed Brka**, University of Sarajevo, Faculty of Agriculture and Food Science, Bosnia and Herzegovina

Prof. dr **Hristo Mihailov**, University of Forestry, Wildlife management Department, Sofia, Bulgaria

Prof. dr **Vladimir Maletić**, Ss. Cyril and Methodius University in Skopje, Faculty of Forestry, F.Y. Republic of Macedonia

Prof. dr **Georgios Michailidis**, Aristotle University of Thessaloniki, School of Agriculture, Greece

Prof. dr **Paride D'Ottavio**, Polytechnic University of Marche, Faculty of Agriculture, Italy

Prof. dr **Vesna Poleksić**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Vladan Bogdanović**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Goran Grubić**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Duško Vitorović**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Živan Jokić**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Zoran Marković**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Mirjana Joksimović Todorović**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Nenad Đorđević**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Radica Đedović**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Slavča Hristov**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Sreten Mitrović**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Cvijan Mekić**, University of Belgrade, Faculty of Agriculture, Serbia

Secretariat

Doc. dr **Dragan Stanojević**, University of Belgrade, Faculty of Agriculture, Serbia

Doc. dr **Mladen Popovac**, University of Belgrade, Faculty of Agriculture, Serbia

Jelena Janković, University of Belgrade, Faculty of Agriculture, Serbia - Technical Assistant

Organizing committee

Prof. dr **Dragan Radojković**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Bojan Stojanović**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Vladan Đermanović**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Renata Relić**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Branislav Stanković**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Predrag Perišić**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Zorka Dulić**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Nebojša Nedić**, University of Belgrade, Faculty of Agriculture, Serbia

Prof. dr **Nedeljko Tica**, University of Novi Sad, Faculty of Agriculture, Serbia

Prof. dr **Snežana Trivunović**, University of Novi Sad, Faculty of Agriculture, Serbia

Prof. dr **Lidija Perić**, University of Novi Sad, Faculty of Agriculture, Serbia

Doc. dr **Vesna Davidović**, University of Belgrade, Faculty of Agriculture, Serbia

Doc. dr **Ivana Božičković**, University of Belgrade, Faculty of Agriculture, Serbia

Doc. dr **Radomir Savić**, University of Belgrade, Faculty of Agriculture, Serbia

Doc. dr **Marko Stanković**, University of Belgrade, Faculty of Agriculture, Serbia

Doc. dr **Božidar Rašković**, University of Belgrade, Faculty of Agriculture, Serbia

Doc. dr **Aleksa Božičković**, University of Belgrade, Faculty of Agriculture, Serbia

MSc. dipl. ing. **Stefan Stepić**, University of Belgrade, Faculty of Agriculture, Serbia

SUMMARY

Gantner V., Bogdanović V., Potočnik K. METHANE EMISSIONS FROM DAIRY CATTLE	9
Csányi S., THE IMPORTANCE OF THE DEVELOPMENT OF LONG-TERM WILDLIFE MANAGEMENT DATABASES	16
Radojković D., Savić R., Radović Č. AUTOCHTHONOUS PIG BREEDS IN SERBIA-REVIEW OF THE RESEARCH RESULTS CONDUCTED IN THE LAST TEN YEARS	17
Bogdanović V., Đedović R., Stanojević D. PATHWAYS FOR OPTIMISATION OF MILK PRODUCTION AT DAIRY FARM LEVEL.....	28
Gantner V., Dokić D., Gregić M., Vučković G., Kuterovac, K. DIFFERENCES IN PERSISTENCY OF HEAT STRESS EFFECT IN DAIRY PRIMIPAROUS COWS DUE TO CATTLE BREED.....	34
Gantner V., Solić D., Gregić M., Mijić P., Antunović B., Kasarda R. THE EFFECT OF DAIRY CATTLE BREED ON SUBCLINICAL KETOSIS PREVALENCE RISK AND SUBSEQUENT MILK PRODUCTION.....	40
Popovski Z., Tome N., Michal W., Karolina K., Konrad D., Macdonald W., PRELIMINARY DATA ON THE INFLUENCE OF TEMPERATURE ON THE MYOGENIC GROWTH FACTORS AND THEIR IDENTIFICATION IN KOI CARP (<i>Cyprinus carpio haematopterus</i>).....	46
Konovalova T., Sebezhko O., Li V., Liu M., Surbayeva R., Korotkevich O., Narozhnykh K., Nazarenko A., Kamaldinov E., Andreeva V., Petukhov V., Popovski Z. CORRELATIONS OF SOME BIOCHEMICAL AND HEMATOLOGICAL, PARAMETERS WITH POLYMORPHISMS IN α S1-CASEIN AND b-LACTOGLOBULIN GENES IN ROMANOV SHEEP BREED	47
Moreno Millán M., Molina Alcalá A. THE HEAT STRESS IN GOAT IN ANDALUSIAN GOATS: ADVANCES IN THE KNOWLEDGE OF THE GENETICS BASIS	48
Mekić C., Perišić P., Vujić P., Zeljić K. INFLUENCE OF MATING SEASON AND NATURAL GONADTROPIC HORMONE APPLICATION IN ANESTRUS SEASON ON SHEEP FERTILITY AND LAMB BODY WEIGHT AT BIRTH.....	53
Andreeva M., Metodiev N., Stefanov R. EFFECT OF CRYOPRESERVATION ON SPERM PARAMETERS OF RAM BREED LACAUNE SHEEP	59
Beuković D., Popović Z., Beuković M. EXPOSURE OF BROWN HARE (<i>Lepus europaeus</i> P.) POPULATION TO HARMFUL EFFECT OF LEAD (Pb) AND CADMIUM (Cd) IN THE FOOD CHAIN DUE TO ANTHROPOGENIC FACTORS,	64

Beuković D., Popović Z., Beuković M., Bursić V., Đorđević N., Krstović S., Jajić I., Lavadinović V. THE PESTICIDE IN BROWN HARE ADIPOSE TISSUE AS CONSEQUENCE OF ANTHROPOGENIC FACTORS.....	69
Marinković D., Popović Z., Aničić M., Beuković M., Beuković D., Relić R. HEALTH STATUS MONITORING OF THE EUROPEAN BROWN HARE (<i>Lepus Europaeus</i>) FOR THE PURPOSE OF ASSESEMENT ITS POPULATION SIZE IN SERBIA	75
Đorđević N., Popović Z., Beuković D., Beuković M., PRODUCTION LOSSES AND MORTALITY OF PHEASANTS DEPENDING ON CULTIVATION TECHNOLOGY IN VOLIERS, NUTRITION AND HUNTING CONDITIONS	83
Đorđević M., Pešić B. THE ROLE AND SIGNIFICANCE OF PHEASANTS AS A POTENTIAL RESERVOIR OF THE WEST NILE VIRUS.....	90
Potočnik H., Pokorny B., Kos I. RECENT AND FUTURE SPATIAL DISTRIBUTIONS IN GOLDEN JACKALS, WOLVES AND FOXES IN SLOVENIA	95
Pokorny B., Flajšman K., Levanič T. TRAFFIC-RELATED MORTALITY OF WILD UNGULATES AND LARGE CARNIVORES IN SLOVENIA: SITUATION AND MITIGATION MEASURES.....	96
Nedić N. Kostić M., Marković T., Marković M. TOLERABILITY OF APIS MELLIFERA CARNICA TO RESIDUAL CONTACT TOXICITY ON BLACK PINE (<i>Pinus Nigra</i>) AND FIR (<i>Abies Alba</i>) ESSENTIAL OILS	97
Stancheva M. A SURVEY OF FISH CONSUMPTION IN BULGARIA	103
Arslan M.N., Akhan S. AQUACULTURE INSURANCE APPLICATIONS IN THE TURKEY ..	109
Dokić D., Gregić M., Gantner V. THE EFFECTS OF TAX BURDEN IN THE CATTLE PRODUCTION.....	115
Bunevski G., Štrbac Lj., Trivunović S., Mergedush A. GENETIC AND PHENOTYPIC TRENDS FOR MILK YIELD HOLSTEIN FRISIAN COW IN THE R. OF MACEDONIA	119
Đedović R., Bogdanović V., Stanojević D., Trivunović S., Janković D., Stojić P. THE IMPACT OF THE RELATIVE LEVEL OF MILK PRODUCTION, THE SHARE OF HOLSTEIN FRIE-SIAN GENES AND LACTATION ON METABOLIC DISEASES AS THE REASONS FOR CULLING OF DAIRY COWS.....	120
Tsvetkov Ts., Daskalova- Yanakieva D. HIGH MOLECULAR WEIGHT PROTEINS IN CANINE SEMINAL PLASMA AND THEIR INFLUENCE ON HYPERACTIVARION AND CAPACITATION OF SPERMATOOZOA	128
Štrbac Lj., Šaran M., Jurakić Ž., Janković D., Radinović M., Trivunović S. HERITABILITY AND REPEATABILITY ESTIMATES FOR MILK PRODUCTION TRAITS IN ORGANIC AND CONVENTIONAL CATTLE PRODUCTION.....	129

Važić B., Rogić B., Popadić S., Đedović R. METABOLIC PROFILE OF THE BLOOD OF SIMMENTAL CATTLE COWS DURING A PRODUCTION CYCLE IN AN EXTENSIVE BREEDING SYSTEM.....	135
Stepić S., Perišić P., Stanojević D. THE EFFECT OF THE RAISING REGION ON PRODUCTION RESULTS IN SIMMENTAL BREED COWS.....	142
Stanojević D., Đedović R., Bogdanović V., Stepić S., Raguž N., Lazarević M. THE IMPACT OF LONGEVITY ON THE AGE STRUCTURE OF THE HERD OF DAIRY COWS.....	149
Perišić P., Bogdanović, V., Mekić, C., Stojanović, S., Maletić M., Stepić, S. THE CURRENT STATE OF BUSHA POPULATION IN THE REPUBLIC OF SERBIA	155
Dokso A., Zecevic E., Rustempasic A., Brka M. EXTERIOR CHARACTERISTICS OF DUBIAN PRAMENKA SHEEP	163
Bojanić Rašović M., Davidović V., Joksimović-Todorović M. MEASURES OF HEALTH PROTECTION OF BEES FROM VAROOSIS IN MONTENEGRO.....	164
Maletić V., Lavadinović V., Beuković D. FAUNAL AND GAME RICHNESS OF THE NATIONAL PARK PELISTER.....	165
Kos I., Potočnik H., Pokorny B., Flajšman K., Majić Skrbinšek A., Konec M. WHY THERE WAS A NEED TO SET THE MANAGEMENT OF GOLDEN JACKAL WITHIN THE RESEARCH PROJECT IN SLOVENIA?.....	166
Davidovic V., Stojanović B., Bozickovic I. EFFECTS OF DIETARY TANNIN SUPPLEMENTS ON RUMEN FERMENTATION CHARACTERISTICS AND LACTATION PERFORMANCE IN DAIRY COWS Invited paper.....	167
Marković J., Blagojević, M., Petrović, M., Milenković, J., Anđelković, S., Kostić, I., Štrbanović, R. EFFECT OF HARVEST TIME ON FORAGE QUALITY OF INTERCROPPED COMMON VETCH (<i>Vicia sativa</i> L.) AND OAT (<i>Avena sativa</i> L.).....	176
Đorđević N., Grubić G., Stojanović B., Božičković A. THE INFLUENCE OF INOCULATION ON CHEMICAL COMPOSITION, QUALITY AND PROTEOLYSIS IN SILAGES MADE FROM ANNUAL LEGUME SILAGES	182
Mijić P., Bobić, T, Baban, M., Gregić, M, Bagarić, A., Gantner, V. ECOLOGICAL LIVESTOCK IN REPUBLIC OF CROATIA.....	188
Tolimir N., Maslovarić M., Škrbić Z., Rajković B., Radišić R., Lukić M. ATTITUDES OF TABLE EGG CONSUMERS/PURCHASERS FROM THE CITY OF BELGRADE TOWARD ORGANIC EGGS	194
Prodanov-Radulović J., Stanković B., Hristov S. D. AFRICAN SWINE FEWER – SPREADING THE DISEASE IN EUROPE AND PREVENTIVE MEASURES TAKEN IN THE REPUBLIC OF SERBIA Invited paper.....	201

Bojkovski J., Prodanov-Radulović J., Živkov-Baloš M., Relić R., Prodanović R., Vujanac I., Nedić S., Becskei Zs., Doborsavljević I., Pavlović I. THIN SOW SYNDROME IN COMMERCIAL FARMS.....	209
Hristov S., Relić R., Stanković B., Andrić-Ostojić D., Maskimović N. RELEVANCE ANALYSIS AND SELECTION OF KEY INDICATORS FOR ASSESSING THE WELFARE OF DAIRY COWS	214
Stanković B., Hristov S., Relić R. DAIRY FARM BIOSECURITY RISK ASSESSMENT METHODOLOGY - A REVIEW	221
Samolovac Lj., Hristov S., Stanković B., Beskorovajni R. FREQUENCY OF BEHAVIOURAL DISORDERS OF CALVES IN THE FIRST MONTH OF LIFE	231
Kralik Z., Kralik G., Grčević M. QUALITY INDICATORS OF EGGS ENRICHED WITH DHA	238
Ross C. Beier DISINFECTANT AND ANTIMICROBIAL SUSCEPTIBILITY PROFILES OF CAMPYLOBACTER COLI FROM SWINE AND PORK CHOPS	244
Antunović Z., Šperanda M., Klir Ž., Šerić V., Mandić S., Horvat V., Novoselec J. EFFECT OF DIETARY SUPPLEMENTATION WITH THERMOLYSED BREWER'S YEAST ON GROWTH AND STRESS REDUCTION OF LAMBS.....	246
Barać S., Biberdžić M., Petrović D., Đikić A., Vuković A., Radojević R., Milenković B. QUALITY OF WORK OF ROTARY CUTTING MOWERS WITH OSCILLATOR-PERMITTED REPAIR APPARATUS IN CUTTING THE LIVESTOCK PEAS.....	252
Davidovic V., Stojanović B., Bozickovic I., Savic Radovanovic R., Bojanic Rasovic M., Jovetic B. THE IMPORTANCE OF ANTIOXIDANTS IN THE HEALTH PROTECTION, PRODUCTIVE AND REPRODUCTIVE TRAITS OF FARM ANIMALS.....	258
Perić L., Duplecz K., Žikić D., Đukić Stojčić M., Koltay I., Such N. EFFECT OF BEDDING MATERIAL ON OCCURRENCE OF FOOTPAD DERMATITIS IN BROILER CHICKENS.....	268
Grčak D., Grčak M., Milošević B., Grčak T. THE MEDICINAL EFFECTS OF PLANTS ON DOMESTIC ANIMALS.....	274
Krstović S., Popović Vranješ A., Jurakić Ž., Šaran M. Jajić I. THE OCCURRENCE OF AFLATOXIN M1 IN MILK SAMPLES ON HOUSEHOLDS AND DAIRY FARMS IN SERBIA.....	281

HEALTH STATUS MONITORING OF THE EUROPEAN BROWN HARE (*LEPUS EUROPAEUS*) FOR THE PURPOSE OF ASSESSEMENT OF ITS POPULATION SIZE IN SERBIA

Marinković D.*^[1], Popović Z.^[2], Aničić M.^[1], Beuković M.^[3], Beuković D.^[3], Relić R.^[2]

Abstract: In the last couple of decades the case of declining of the European brown hare (*Lepus europaeus*) populations was noted in whole Europe including Serbia. Numerous causes for this can be referred to anthropogenic impacts - landscape changes (agricultural intensification, the use of natural hare habitats by livestock for the purpose of pastures), use of pesticides, machinery and traffic, as well as home range size. Other important causes are inadequate reproduction and the level of survival due to predation (incline in golden jackal population), hunting (especially illegal hunting), variations in climate and diseases, as one of the most important cause of European brown hare population declining. As in other animals, they are etiologically divided to: viral, bacterial, fungal, parasitic and other diseases. During hunting season in 2017 (October and November), a study on 46 hares (whole carcasses or eviscerated organs) from the four locations near Belgrade was conveyed. A post-mortem examination and histopathological investigations were performed and, additionally, routine bacteriology and parasitology of the gastrointestinal system were carried out. The results point to the significance of continuous health status monitoring and discovering the causes and frequency of certain conditions in free-ranging European brown hare populations. In this review paper, some health problems in hares are discussed in more details, taking into account the findings obtained in this preliminary study.

Keywords: health status, *Lepus europaeus*, monitoring

Introduction

The European brown hare (*Lepus europaeus*) is considered as one of the most important game animal species in Europe. Unfortunately, in the last couple of decades the case of declining of the European brown hare (*Lepus europaeus*) populations was noted in whole Europe including Serbia, and this problem is affecting all regions of Europe simultaneously (Frölich et al., 2003; Strandgaard and Asferg, 1980; Tapper and Parsons, 1984; Hutchings and Harris, 1996; Marboutin et al., 2003). Although there are numerous hypothesized causal factors for this decline, it can be referred to health status, or the presence of anthropogenic impacts, different diseases, and the predation (Olesen et al., 2006; Marinković et al., 2018).

During hunting season in 2017 (October and November), a study on 46 hares (whole carcasses or eviscerated organs) from the four locations near Belgrade was conveyed. A post-mortem examination and histopathological investigations were performed and, additionally, routine bacteriology

1 Marinković Darko, PhD, Associate Professor; Aničić Milan, DVM, Teaching Assistant; University of Belgrade, Faculty of Veterinary Medicine - Department of Pathology, Belgrade, Serbia;

2 Popović Zoran, PhD, Full Professor; Renata Relić, Associate Professor; University of Belgrade, Faculty of Agriculture - Department of Animal Science, Serbia;

3 Beuković Miloš, PhD, Full Professor; Beuković Dejan, PhD, Assistant Professor; University of Novi Sad, Faculty of Agriculture - Department of Animal Science, Novi Sad, Serbia.

* Corresponding author: Marinković Darko, darko@vet.bg.ac.rs

and parasitology of the gastrointestinal system were carried out. The results of this recently conveyed preliminary study point to the significance of continuous health status monitoring and discovering the causes and frequency of certain conditions in free-ranging European brown hare populations (Marinković et al., 2018). The aim of this paper is to review possible causes of the decline of the European brown hare (*Lepus europaeus*) population, as well to emphasize the importance of the health status monitoring, especially pathomorphological examination of the hunted animals, and animals found dead in nature.

Factors affecting decline of the European brown hare population

Numerous factors can be referred to the anthropogenic impacts - landscape changes, use of pesticides, machinery and traffic, as well as home range size. One of the important anthropogenic factor are the landscape changes which can inflict the population number of hares. This especially refers to agricultural intensification and use of natural hare habitats as pastures for livestock or for crop production. European brown hare, if available, prefers weeds and wild grasses. However, in areas of agricultural intensification these foods are reduced and crop species, especially monocultures, are increasingly used as a food source. Together with intensive crop production goes the intensive use of pesticides, which are very dangerous and can harm the European brown hare population. The effect of pesticides can be dual. On one side incidents of poisoning have occurred (Chlewski, 1976; Rimkus and Wolf, 1987; Edwards et al., 2000), but on the other side, the use of herbicides is reducing the abundance of weed in cereal fields which decrease the quality of summer diet for the hares. Also, after summer harvest and ploughing fields remain without vegetation, and this is potential lack of summer food for the hares at the time of main breeding and lactating season.

Besides mentioned facts, machinery used for crop harvesting operation is a source of mortality in leverets. Also, "road kills" can additionally decrease the number of hares in the areas where the network of traffic roads is present (Olesen et al., 2006; Posautz et al., 2015; Kornaś et al., 2014).

Other important causes are inadequate reproduction and the level of survival due to predation (incline in golden jackal population), hunting (especially poaching), variations in climate and diseases, as one of the most important cause of European brown hare population declining. The red fox (*Vulpes vulpes*) is considered to be the most important predator for the European brown hare. Oral vaccination of foxes against rabies led to rising of its population in Europe which could be one of the important factors for the declining of hare population (Posautz et al., 2015; Olesen et al., 2006; Reynolds and Tapper, 1995; Panek, 2009; Goszczynski and Waseilewski, 1992). Other predators than the red fox, golden jackal (whose population is in constant incline during past decade), crows, ravens, common buzzards, goshawks, owls, domestic dog and cat also prey on hares, especially leverets (Olesen et al., 2006; Penezić and Ćirović, 2015; Markov and Lanszki, 2012).

Heavy hunting pressure and poaching can jeopardize hare population. Besides that climate influence, particularly climate change can have negative impact on the hare population especially on the leverets (Olesen et al., 2006).

Diseases are considered as one of the natural factors of hare mortality and have greatly influenced the decline of this species in past few decades. As in other animals, diseases in European brown hare can be divided etiologically to: viral, bacterial, fungal, parasitic and other diseases (Frölich et al., 2003; Marinković et al., 2018; Wibbelt and Frölich, 2005).

Among the viral diseases, virus which is the causative agent of European brown hare syndrome (EBHS) is one of the most important. It is classified as a *Calicivirus*, a small (30 to 35 nm) icosahedral, non-enveloped virus (EBHSV) (Ohlinger and Thiel; 1991; Gavier-Widen, 2012). This disease is reported in many European countries (Frölich et al., 2001; Frölich and Lavazza, 2008; Wibbelt and Frölich, 2005) and it is characterized by acute hepatitis and hemorrhages of various internal organs (Poli et al., 1991; Fuchs and Weissenböck, 1992). Interesting fact is that high incidence of degenerative and inflammatory hepatic and renal lesions were noted in liver and kidney tissues originating from the hares from Serbia. So, further investigations are necessary to establish the etiology of these changes (Marinković et al., 2018).

Also, a group of *Leporipoxvirus* are considered as important etiological agents for the hare population, and these two related strains myxoma and fibroma virus can cause fibromatosis as a rare incident in hares or myxomatosis. Fibromatosis is a benign, self-limiting disease with localized fibroblastic nodules within the subcutis (Wibbelt and Frölich, 2005; Grilli et al., 2003; Fenner, 1994). Although myxomatosis is a disease commonly observed in European wild rabbits (*Oryctolagus cuniculus*), hares can also be infected and disease is characterized by multiple firm subcutaneous nodular masses at the head, back and limbs. Virus is transmitted via hematophagous insects or by close contact between hares and affected rabbits or their excretions (Wibbelt and Frölich, 2005; Barlow et al., 2014). Hares are anecdotally infected with papilloma virus usually through cutaneous lesions or by hematophagous insects when focal pedunculated nodular masses – warts can develop (Wibbelt and Frölich, 2005).

Among bacterial diseases, several are important for the health status of the European brown hares: pseudotuberculosis, pasteurellosis, brucellosis, tularemia and staphylococcosis (Wibbelt and Frölich, 2005). Pasteurellosis is considered to be the most important hare disease and sometimes up to 80% of a population might be killed by this infection which is the most common during the winter season, and early spring when sudden, widespread epidemics can occur. This disease is caused by small non-spore forming, gram-negative coccobacillus *Pasteurella multocida* subsp. *multocida*, commonly present in the upper respiratory system. Stress, usually, sudden drop of temperature, especially during the night, inadequate immunological status, food shortage, etc. can induce the multiplication of these bacteria, and the development of disease. The disease can occur either in peracute septicemic haemorrhagic form or acute to chronic with fibrino-purulent pleuro-pneumonia and fibrinous pericarditis.

Other important bacterial disease of lagomorphs and rodents is pseudotuberculosis caused by *Yersinia pseudotuberculosis*, a small rod-shaped gram-negative bacterium, and it is considered to be of one of the most important lethal infections in hare with population losses of up to 50%. This disease can also occur in birds and other animals as well as in humans. Rodents and wild birds are considered to act as a natural reservoir for this microorganism. The disease is common during cold and humid part of the year, but beside weather factors, stress, inadequate food, opportunistic infections are also important factors for the onset of this disease. Common clinical manifestations are dyspnoea and diarrhea, and characteristic morphological lesions are multifocal caeseous granulomatous nodules within spleen, liver, intestine and mesenteric lymph nodes (Wibbelt and Frölich, 2005; Fratini et al., 2017; Frölich et al., 2003).

Staphylococcosis in hares is caused by *Staphylococcus aureus* and characterized by multiple abscessation of the skin, subcutis, and sometimes internal organs and joints, in rare cases as an acute septicaemia which can cause the exitus lethalis without specific morphological changes (Wibbelt and Frölich, 2005).

Two important bacteria can cause disease in hares which also have zoonotic potential: *Francisella tularensis* and *Brucella sp.*, although previously mentioned *Yersinia pseudotuberculosis* also have that kind of potential. Brucellosis is caused by *Brucella suis biovar 2*, gram-negative, non-sporing, small rods. It is believed that wild boars and hares are reservoir species for this agent, but this bacteria is also capable of infecting domestic pigs and other wild or domestic animals and as mentioned humans as well. The most likely source of infection are aborted fetuses. Infection can occur orally, via the reproductive system, the conjunctiva and percutaneously, but the venereal transmission seems to be the dominant way of infection in hares. The course of the disease in hares can be acute or chronic, and the infection in hares is either latent or involves the development of granulomatous nodules or abscesses in the reproductive system – uterus and testes, regional lymph nodes, liver, spleen, lung and other tissues (Thorne, 2001; Gyuranecz et al., 2011; Frölich et al., 2003)

Tularaemia is caused by *Francisella tularensis*, a highly infective gram-negative, non-motile, non-sporing, aerobic coccobacillus with zoonotic potential which occurs naturally in lagomorphs and rodents, with ticks and other arthropods the main vectors, but infections of many other mammals and birds. Infection occurs directly through close contact or indirectly via contaminated food or insect vectors. In the European brown hare in most cases, clinical signs appears as short apathy followed by fatal septicemia. Numerous necrosis are found within liver, spleen and lymph nodes (Gyuranecz et al., 2010; Hestvik et al., 2017; Tomaso et al., 2017; Frölich et al., 2003).

Several other microorganisms can also play important role for the health status of European brown hare, and some of them are also zoonosis and also found in Serbia as well: *Bacillus anthracis*, *Borrelia burgdorferi* (Talleklint and Jaenson, 1994; Jaenson and Talleklint, 1996), *Campylobacter sp.*, *Leptospira sp.*, *Listeria monocytogenes* (Mišić and Marinković, 2002) and *Salmonella sp.*

The most diseases, especially parasitic diseases are density dependent. These diseases can play important role in the health status or can cause mortality in the hare population and in that manner have negative influence on the abundance of this species in nature. Generally, parasitic diseases can be caused by protozoa, nematodes, cestodes, trematodes and acarines and insects.

Coccidiosis is one of the most important protozoal infections in hares. It can occur in the intestinal and hepatic form. Intestinal coccidiosis is caused by variety of species of *Eimeria* such as *E. europea*, *E. hungarica*, *E. robertsoni*, *E. semisculpta*, *E. septentrionalis*, *E. stefanskii* and *E. townsendii*. These coccidia invade cells within epithelial lining of the intestines causing severe catarrhal enteritis and gaseous distension of the gut. Sometimes Often small yellowish nodules within the mucous membranes can be noted. Hepatic coccidiosis is caused by *E. stiedai* which invade epithelial cells of the bile ducts causing hyperplastic lesions of the bile ducts. As in rabbits transmission is feco-oral, and up to 60-100% of the animals in population can be infected with coccidia (Kornaš et al., 2014; Chroust, 1984).

Toxoplasma gondii is protozoal organism causing Toxoplasmosis, disease which in most cases is acute fatal disease in hares. Infection occurs by ingestion of food or water contaminated with oocysts from cat feces. Common pathomorphological changes are interstitial pneumonia, multifocal areas of hepatocellular necrosis, encephalitis, and necrosis of lymphoid follicles of the lymph nodes (Jokelainen et al., 2011; Sedlak et al, 2000, Frölich et al., 2003).

Hares can be infected with both trematodes - *Fasciola hepatica* and *Dicrocoelium dendriticum* and these parasites can cause cholangitis with extensive bile duct hyperplasia with proliferation of mucous glands, and sometimes extensive hepatic cirrhosis (Cuervo et al., 2015; Diakou et al., 2014; Chroust et al., 2012; Sergi et al., 2018). These parasites were also noted in the hare population in Serbia (Marinković et al., 2018).

Gastro-intestinal nematodes can be important due to its pathogenic influence on the process of digestion, and also as a cause of serious anaemia in hares. Several nematode species are important for hares - *Graphidium strigosum*, gastric parasite, *Trichostrongylus retortaeformis*, small intestine parasite, causing catarrhal enteritis and *Trichuris leporis* commonly found on the caecal mucosa, causing necrotic lesions within the gut wall due to its toxic metabolites. *Passalurus ambiguus* can be found both in small and large intestine. The juvenile stages are rather found in the mucosa of the small intestine and the cecum, while the adult worms are located in the anterior part of the cecum and the large intestine (Diakou et al., 2014; Chroust et al., 2012; Sergi et al., 2018; Dubinský et al., 2010).

Lungworms *Protostrongylus sp.* can cause severe infection followed by dyspnoea and seromucosal nasal discharge due to catarrhal pneumonia and pleuritis. This parasitic infection has negative influence to the immunity of the animal, and as a consequence of parasitism hares are more prone to secondary bacterial infection in contrast to clinically healthy hares (Diakou et al., 2014; Chroust et al., 2012; Sergi et al., 2018; Dubinský et al., 2010; Frölich et al., 2003).

Hares also can be hosts for numerous Cestodes - *Paranoplocephala wimerosa*, *Andrya cuniculi*, *Andrya rhopalocephala*, *Cittotaenia denticulata*, *Mosgovoyia pectinata*, *Mosgovoyia ctenoides*. Most of them can cause catarrhal enteritis with malabsorption, degenerative changes on the liver (*Taenia pisiformis* larvae), and some of them are important zoonosis - *Ecchinococcus granulosus* and *Ecchinococcus multilocularis* (Diakou et al., 2014; Chroust et al., 2012; Sergi et al., 2018; Dubinský et al., 2010; Chaignat et al., 2015). Besides mentioned parasites hares can be infected with numerous other parasites such as lice (*Haemodipsus setoni*), *Sarcoptes scabiei* (Restani et al. 1985), *Sarcocystis sp.* and many other.

Conclusion

There is a multicausal etiology for the decline of the population of the European brown hares (*Lepus europeus*), and different diseases have a great importance in this declining. Constant health status monitoring is important for the assessment of the population size and it is necessary to intensify and to facilitate its implementation in Serbia. The pathomorphological examination of the hare carcasses, followed with microbiological and parasitological examinations, plays a crucial role in this process.

Acknowledgement

The authors wish to express gratitude to the Ministry of Education, Science and Technological Development of the Republic of Serbia which financed this investigations within the project TR-31009.

References

1. Barlow A., Lawrence K., Everest D., Dastjerdi A., Finnegan C., Steinbach F. 2014. Confirmation of myxomatosis in a European brown hare in Great Britain. *Veterinary Record*. 175: 75-76.
2. Chaignat V., Boujon P., Frey C.F., Hentrich B., Müller N., Gottstein B. 2015. The brown hare (*Lepus europaeus*) as a novel intermediate host for *Echinococcus multilocularis* in Europe. *Parasitol Res.* 114(8):3167-3169.

3. Chlewicki A. 1976. Estimation of the degree of danger to the European hare caused by pesticides. – In: Pielowski, P. (ed.). Ecology and management of European hare populations. - Polish Hunting Association, Warsaw, pp. 231-236.
4. Chroust K. 1984. Dynamics of coccidial infection in free living and cage-reared European hares. Acta Vet. Brno, 53: 175-182.
5. Chroust K., Vodnansky M., Pikula J. 2012. Parasite load of European brown hares in Austria and the Czech Republic. Veterinarni Medicina, 57(10): 551–558.
6. Cuervo P.F., Cataldo S., Fantozzi M.C., Deis E., Diaz Isenrath G., Viberti G., Artigas P., Peixoto R., Valero M.A., Mera y Sierra R., Mas-Coma S. 2015. Liver fluke (*Fasciola hepatica*) naturally infecting introduced European brown hare (*Lepus europaeus*) in northern Patagonia: phenotype, prevalence and potential risk. Acta Parasitologica, 60(3): 536–543.
7. Diakou A., Sokos C., Papadopoulos E. 2014. Endoparasites found in European brown hares (*Lepus europaeus*) hunted in Macedonia, Greece. Helminthologia, 51 (4): 345 – 351.
8. Dubinský P., Vasilková Z., Hurníková Z., Miterpáková M., Slamečka J., Jurčík R. 2010. Parasitic infections of the European brown hare (*Lepus europaeus* Pallas, 1778) in south -western Slovakia. Helminthologia, 47(4): 219 – 225.
9. Edwards P.J., Fletcher M.R., Berny P. 2000. Review of the factors affecting the decline of the European brown hare, *Lepus europaeus* (Pallas, 1778) and the use of wildlife incident data to evaluate the significance of paraquat. - Agriculture Ecosystems & Environment 79: 95-103.
10. Fenner F. 1994. Hare fibroma virus. In Virus infections of rodents and lagomorphs, ed. A.D.M.E. Osterhaus. Amsterdam: Elsevier, pp. 77–79.
11. Frölich K., Wisser J., Schmäser H., Fehlberg U., Neubauer H., Grunow R., Nikolaou K., Priemer J., Thiede S, Streich W.J., Speck S. 2003. Epizootiologic and ecologic investigations of European brown hares (*Lepus europaeus*) in selected populations from Schleswig-Holstein, Germany. Journal of Wildlife Diseases, 39(4):751-761.
12. Frölich K., Haerer G., Bacciarini L., Janovsky M., Rudolph M., Giacometti M. 2001. European brown hare syndrome (EBHS) in free-ranging European brown and mountain hares from Switzerland. Journal of Wildlife Diseases, 37: 803–807.
13. Frölich K., Lavazza A. 2008. European brown hare syndrome. In: Lagomorph Biology. Springer, Berlin/Heidelberg, Germany, pp. 253–261.
14. Fuchs A., Weissenböck H. 1992. Comparative histopathological study of rabbit haemorrhagic disease (RHD) and European brown hare syndrome (EBHS). Journal of Comparative Pathology, 107: 103-113.
15. Gavier-Widen D. 2012. European brown hare syndrome. In: Gavier-Widen D, Duff JP, Meredith A (eds) Infectious diseases of wild mammals and birds in Europe. Wiley-Blackwell, Singapore, pp 80–85.
16. Goszczynski J., Waseilewski M. 1992. Predation of foxes on a hare population in central Poland. Acta Theriol 37:329–338.
17. Grilli G., Piccirillo A., Pisoni A.M., Cerioli M., Gallazzi D., Lavazza A. 2003. Re-emergence of fibromatosis in farmed game hares (*Lepus europaeus*) in Italy. Vet Rec 153: 152-153.
18. Gyuranecz M., Erdélyi K., Makrai L., Fodor L., Szépe B., Mészáros A.R., Dán A., Dencso L., Fassang E., Szeredi L. 2011. Brucellosis of the European brown hare (*Lepus europaeus*). J Comp Pathol. 145(1):1-5.

19. Gyuranecz M., Szeredi L., Makrai L., Fodor L., Mészáros A.R., Szépe B., Füleki M., Erdélyi K. 2010. Tularemia of European Brown Hare (*Lepus europaeus*): a pathological, histopathological, and immunohistochemical study. *Vet Pathol.* 47(5):958-963.
20. Fratini F., Verin R., Ebani V.V., Ambrogi C., Bertelloni F., Turchi B., Poli A., Cerri D. 2017. Experimental infection with *Yersinia pseudotuberculosis* in European brown hare (*Lepus europaeus*, Pallas). *Asian Pac J Trop Med.* 10(3):285-291
21. Hestvik G., Uhlhorn H., Södersten F., Åkerström S., Karlsson E., Westergren E., Gavier-Widén D. 2017. Tularaemia in European Brown Hares (*Lepus europaeus*) and Mountain Hares (*Lepus timidus*) Characterized by Histopathology and Immunohistochemistry: Organ Lesions and Suggestions of Routes of Infection and Shedding. *J Comp Pathol.* 157(2-3):103-114.
22. Hutchings M., Harris S. 1996. The current status of the brown hare (*Lepus europaeus*) in Britain. – Joint Nature Conservation Committee. 78.
23. Jaenson T.G., Talleklint L. 1996. Lyme borreliosis spirochetes in *Ixodes ricinus* (*Acari: Ixodidae*) and the varying hare on isolated islands in the Baltic Sea. *Journal of Medical Entomology* 33:339–343.
24. Jokelainen P., Isomursu M., Näreaho A., Oksanen A. 2011. Natural toxoplasma gondii infections in European brown hares and mountain hares in Finland: proportional mortality rate, antibody prevalence, and genetic characterization. *J Wildl Dis.* 47(1):154-163.
25. Kornaś S., Wierzbowska I.A., Wajdzik M., Kowal J., Basiaga M., Nosal P. 2014. Endoparasites of European brown hare (*Lepus europaeus*) from southern Poland based on necropsy. *Ann. Anim. Sci.*, 14 (2): 297–305.
26. Marboutin E., Bray Y., Peroux R., Mauvy B., Lartiges A. 2003. Population dynamics in European hare: breeding parameters and sustainable harvest rates. - *Journal of Applied Ecology* 40: 580-591.
27. Marinković D., Aničić M., Popović Z., Relić R. 2018. Pathomorphological changes noted during sanitary hunting and health screening of free-ranging European brown hares (*Lepus europaeus*) in Serbia. 20th symposium of epizootiologists and epidemiologists - Book of Abstracts, 18-20th April 2018, Vrnjačka Banja, Serbia, 112-113.
28. Markov G., Lanszki J. 2012. Diet composition of the golden jackal, *Canis aureus* in an agricultural environment. *Folia Zoologica*, 61(1): 44-48.
29. Mišić D., Marinković D. 2002. Naša iskustva u dijagnostici listerioze zečeva, Zbornik radova i kratkih sadržaja – Simpozijum »IV jugoslovenski epizootiološki dani« sa međunarodnim učesćem, Mataruška Banja, 3-6 april 2002., 194-196.
30. Olesen C.R., Asferg T., Topping C. 2006. Assessing potential causes for the population decline of European brown hare in the agricultural landscape of Europe – a review of the current knowledge. NERI Technical Report No. 600.
31. Ohlinger V.F., Thiel H.J. 1991. Identification of the viral hemorrhagic disease virus of rabbits as a calicivirus. *Revue Scientifique et Technique*, 10: 311–323.
32. Panek M. 2009. Factors affecting predation of red foxes *Vulpes vulpes* on brown hares *Lepus europaeus* during the breeding season in Poland. *Wildl Biol* 15: 345-349.
33. Penezić A., Ćirović D. 2015. Seasonal variation in diet of the golden jackal (*Canis aureus*) in Serbia. *Mamm Res* 60(4): 309-317.

34. Poli A., Mancianti F., Marconcini A., Cerri D., Agrimi P. 1987. Diseases of wild-living hares (*Lepus europaeus* P.) in Tuscany. In Diseases of zoo animals, Proceedings of the 29th international symposium of diseases of zoo animals, R. Ippen and H. D. Schroeder (eds.). Akademie-Verlag, Berlin, Germany, 341–346.
35. Posautz A., Loncaric I., Lundin M., Hoffmann D., Lavazza A., Kelemen Z., Beiglbock C., Walzer C., Kubber-Heiss A. 2015. Health screening of free-ranging European brown hares (*Lepus europaeus*) on the German North-Sea island Pellworm. *Acta Vet Scand* 57:43.
36. Restani R., Tampieri M.P., Prati C.G., Vecchi G. 1985. Sarcoptic mange in a hare [In Italian]. *Obietti e Documenti Veterinari* 6: 53–57.
37. Reynolds J.C., Tapper S.C. 1995. Predation by foxes *Vulpes vulpes* on brown hares *Lepus europaeus* in central southern England, and its potential impact on annual population growth. - *Wildlife Biology* 1: 145-158.
38. Rimkus G., Wolf M. 1987. Contamination of game by harmful substances in Schleswig-Holstein. 2. Residues of dieldrin, heptachlor epoxide and other cyclodiene insecticides in liver fat of hares (*Lepus europaeus* L). - *Zeitschrift für Lebensmittel Untersuchung und Forschung* 184: 308-312.
39. Sedlak K., Literak I., Faldyna M., Toman M., Benak J. 2000. Fatal toxoplasmosis in brown hares (*Lepus europaeus*): possible reasons of their high susceptibility to the infection. *Vet. Parasitol.* 93: 13-28.
40. Sergi V., Romeo G., Serafini M., Torretta E., Macchioni F. 2018. Endoparasites of the European hare (*Lepus europaeus*) (Pallas, 1778) in central Italy. *Helminthologia*, 55, 2: 127 – 133.
41. Strandgaard H., Asferg T. 1980. The Danish bag record II. Fluctuations and trends in game bag record in years 1941-1976 and geographical distribution of the bag in 1976. - *Danish Review of Game Biology* 11 (5): 32-33.
42. Tapper S.C., Parsons N. 1984. The changing status of the brown hare (*Lepus capensis* L.) in Britain. - *Mammal Review* 14: 57-70.
43. Talleklint L., Jaenson T.G. 1994. Transmission of *Borrelia burgdorferi* s. l. from mammal reservoirs to the primary vector of Lyme borreliosis, *Ixodes ricinus* (Acari: Ixodidae) in Sweden. *Journal of Medical Entomology* 31:880–886.
44. Thorne E.M. 2001. Brucellosis. In: Williams, E.S. & Barker I.K. (eds) *Infectious diseases of wild mammals*. Iowa State University Press, Ames, Iowa, pp. 372-395.
45. Tomaso H., Otto P., Peters M., Süß J., Karger A., Schamoni H., Zuchantke E., Hotzel H. 2017. *Francisella tularensis* and other bacteria in hares and ticks in North Rhine-Westphalia (Germany). *Ticks Tick Borne Dis.* 9(2):325-329.
46. Wibbelt G., Frölich K. 2005. Infectious Diseases in European Brown Hare (*Lepus europaeus*). *Wildl Biol Pract*, 1 (1): 86-93.

Proceedings of the International Symposium on Animal Science
2018, 22-23rd November 2018, Belgrade, Serbia

The publishing of this book was made possible by the support of Ministry of Education,
Science and Technological Development and Ministry of Agriculture and Environmental
protection of Republic of Serbia.

All papers of the International Symposium on Animal Science 2018 have been reviewed
by the members of the International Scientific Committee and competent reviewers
proposed by the International Scientific Committee.

Publisher:
University of Belgrade, Faculty of
Agriculture, Nemanjina 6, 11080 Belgrade-Zemun, Belgrade

On behalf of Publisher: Prof. Dr Dušan Živković

Editor in Chief: Prof. Dr Zoran Popović

Language Editor: Mirjana Miljuš

Address of the Editors Office
Faculty of Agriculture, Nemanjina 6,
11080 Zemun, Belgrade

Layout by: Epoha, graphic designer Nikola Ćosić
Printed by: Epoha

Copies: 100

CIP - Каталогизacija у публикацији
Народна библиотека Србије, Београд

636/639(082)

INTERNATIONAL Symposium on Animal Science (2018 ; Beograd)
[Proceedings of the] International Symposium on Animal Science 2018,
22-23rd November 2018, Belgrade, Serbia / organizers University of
Belgrade, Faculty of Agriculture [and] University of Novi Sad, Faculty of
Agriculture ; co-organizers Kmetijski inštitut Slovenije, Slovenija [and]
University of Zagreb, Faculty of Agriculture, Croatia [and] Josip Juraj
Strossmayer University of Osijek, Faculty of Agriculture, Croatia ; [editor
in chief Zoran Popovic]. - Belgrade : University, Faculty of Agriculture,
2018 (Požega : Epoha). - II, 295 str. : ilustr. ; 25 cm

Na nasl. str. pored mesta izdavanja i: Zemun. - Tiraž 100. - Bibliografija
uz većinu radova.

ISBN 978-86-7834-316-2
а) Пољопривреда - Зборници
COBISS.SR-ID 270329868