

Questionnaire

Summary of the main activities of a research institute of the Slovak Academy of Sciences

Period: January 1, 2016 - December 31, 2021

1. Basic information on the institute:

1.1. Legal name and address

Institute of Zoology v. v. i., Slovak Academy of Sciences
Dúbravská cesta 9, 845 06 Bratislava, Slovak Republic

1.2. URL of the institute web site

<http://www.zoo.sav.sk>

1.3. Executive body of the institute and its composition

Directoriat	Name	Year of birth	Years in the position, from - to
Director	RNDr. Dušan Žitňan, DrSc.	1958	2015 -
Deputy director	Ing. Ladislav Roller, PhD.	1969	2015 -
Scientific secretary	doc. RNDr. Ľubomír Vidlička, CSc.	1962	2015 -

Add more rows for any changes during the evaluation period

1.4. Head of the Scientific Board

Ing. Ladislav Roller, PhD. (2014 –)

1.4.1 Composition of the International Advisory Board

Dr. Annapaola Rizzoli, Fondazione Edmund Mach, S. Michele all'Adige, Italy

Dr. Francisco Valera Hernández, Spanish Council for Scientific Research, Almería, Spain

Dr. Herbert Hoi, Konrad-Lorenz-Institut für Vergleichende Verhaltensforschung, Veterinär
medizinische Universität Wien, Austria

Prof. Dr. Ivo Šauman, Institute of Entomology, Biology Centre, Acad. Sci. Czech Rep.,
České Budějovice, Czech Republic

Dr. Neil Audsley, Fera Science Ltd., Sand Hutton York/ Institute for Agri-Food Research and
Innovation, Newcastle University, UK

Prof. Dr. Young-Joon Kim, Gwangju Institute of Science and Technology, South Korea

1.5. Basic information on the research personnel

1.5.1. Fulltime equivalent work capacity of all employees (FTE all), FTE of employees with university degrees engaged in research projects (FTE researchers)

2016		2017		2018		2019		2020		2021		2016-2021	
FTE all	FTE researchers	average FTE all per year	average FTE researchers per year										
35,00	18,20	37,58	19,47	40,40	18,90	40,20	19,91	37,46	18,52	51,78	20,46	40,40	19,24

1.5.2. If applicable, add also a short information on the merger of the institute in the evaluation period. You can also add rows in the above table corresponding to the founding institutes

1.6. Basic information on the funding of the institute

1.6.1. Institutional salary budget, other salary budget¹, non-salary budget²

Salary budget	2016	2017	2018	2019	2020	2021	average
Institutional salary budget <i>[millions of EUR]</i>	0,604	0,677	0,737	0,884	0,981	0,964	0,808
Other salary budget <i>[millions of EUR]</i>	0,099	0,078	0,102	0,077	0,074	0,072	0,084
Total salary budget <i>[millions of EUR]</i>	0,703	0,755	0,839	0,961	1,055	1,036	0,892
Non-salary budget <i>[millions of EUR]</i>	0,254	0,231	0,312	0,298	0,336	0,350	0,297

1.7. Mission Statement of the Institute as presented in the Foundation Charter indicating the years when it was adopted and revised

Research activities of the Institute of Zoology SAS (IZ SAS) include basic and applied research in zoology, hydrobiology, ecology, physiology, molecular biology, genetics and related biological disciplines. The main areas of interest are as follows:

1. i) Taxonomy, phylogeny and ecology of invertebrate and vertebrate animals. These studies are conducted in the context of terrestrial and aquatic ecosystem functions, natural history of animals, ecological disturbances by humans and nature conservation.
- ii) Physiology, molecular biology, genetics, biochemistry and animal behaviour. This research focuses on the identification, expression and function of bioactive molecules and their receptors in insects and ticks.
- iii) Animal parasitology and medical relevance. The goal is to investigate complex interactions between vertebrate hosts, invertebrate parasites and various pathogens that cause health problems in animals and humans.
- iv) Applied research in nature conservation and water management. Tasks include development and application of approaches to restoration of freshwater biotopes, improvements to preserve habitats of endangered animals and control of arthropod vectors of pathogens.

¹ Salary budget originating outside the regular budgetary resources of the organization, e.g. from the project funding.

² Includes Goods and Services and PhD fellowships

2. Results of these research activities are published in high quality scientific journals and books.
3. Our institute has established collaborations with institutions and universities conducting similar research activities at the national and international level.
4. The Institute promotes the doctoral programme in accordance with the current legislation.
5. The Institute provides consultancy and expert services related to its research activities.

(The Foundation Charter was updated on 11 February 2022, but the Mission Statement has remained essentially the same throughout the assessment period)

1.8. Summary of R&D activity pursued by the institute during the evaluation period in both national and international contexts. Describe the scientific importance and societal impact of each important result/discovery. Explain on general level – the information should be understandable for a non-specialist (recommended 5 pages, max. 10 pages for larger institutes with more than 50 average FTE researchers per year as per Table 1.5.1.)

a) Hormonal regulation of insect and tick physiology and development

Our research group has been working on identification and function of neuropeptides and their receptors using insect model species, the silk moth *Bombyx mori* and the fruit fly *Drosophila melanogaster*. We described mechanisms of expression, release and action of multiple neuropeptides and receptors that control various behaviours and physiological functions important for normal development, metamorphosis and reproduction.

Updated results of neuroendocrine regulation of insect ecdysis have been reviewed in seven chapters in Handbook of Hormones (Žitňan, Daubnerová, 2016; Daubnerová, Žitňan, 2021). These chapters summarized all the available data and results generated in collaboration with the University of California, Riverside that included identification and functional characterization of several neuropeptides and their receptors in different insect model species. In the related paper we provided detailed description of expression of these bioactive molecules during development and analysed mode of their action using electrophysiology and receptor binding bioassays in vitro (Daubnerová et al., 2021).

We examined function of several neuropeptides (allatotropins, RYamides, trissin) in regulation of feeding in *B. mori*. Expression of these neuropeptides and their receptors was detected in the central nervous system, gut innervation and midgut enteroendocrine cells. Suitable bioassays confirmed roles of these neuropeptides in the feeding behaviour, but indicated other central functions (Roller et al 2016a; 2016b; Bednár et al 2017; Matsumoto et al. 2019). We also described the effects of gama-radiation on enteroendocrine cells producing allatostatins and tachykinins in the bark beetles (Čičková et al., 2018).

Our fruitful collaboration with the Korean group (Gwanju Institute of Science and Technology) resulted in publication of PNAS paper, which is a follow-up of previously published papers in PNAS, PLOS Genetics and Current Biology. This collaborative effort using advanced genetic approaches, molecular biology, Ca imaging and sophisticated bioassays led to identification of specific neuronal circuits that generate circadian rhythm for reproduction in fruit flies (Zhang, Daubnerová et al. 2021). Interestingly, we identified a functional and structural conservation of insect and vertebrate neuropeptide signalling systems (allatostatin and somatostatin) suggesting an ancient origin for the neural substrates that generate reproductive rhythms. Allatostatin is primarily involved in regulation of juvenile hormone (JH) production that controls metamorphosis and reproduction in insects. Our collaboration with Florida International University led to the publication of another article in PNAS describing functional signalling pathways that are essential for JH synthesis and its role in reproduction in mosquitoes (Nouzová et al. 2021). We also identified and described a cluster of large male-specific neurons that produce multiple neuropeptides and innervate the accessory glands and gonoducts in *B. mori*. We detected strong expression of receptors for these neuropeptides in the male reproductive system and our in vitro bioassays clearly showed that this cluster controls contractions of the gonoducts and transfer of sperms into a female during copulation (Čižmár et al. 2019). This is the first report describing mechanisms of fertilization in moths.

Ticks are medically very important haematophagous ectoparasites transmitting numerous dangerous pathogens that seriously affect health of various animals and humans. It is generally known that the salivary glands and gut are important reservoirs of these pathogens, but regulation of their activity during tick feeding has not been elucidated. Also mechanisms required for successful transmission of pathogens from ticks into the host bloodstream are poorly understood. We reviewed possible roles of selected neuropeptides in regulation of salivary glands and gut. These neuropeptides and their receptors may serve as potential targets for control of ticks (Hromníková et al. 2021).

b) Genetics and Physiology of Invertebrates

In line with current trends in animal physiology, IZ SAS has recently established a new branch of research dealing with metabolic studies. In recent years, ageing and metabolism have become one of the fastest growing areas in biology. The prevalence of metabolic disorders is increasing and the socio-economic impact of these diseases is leading to increased efforts to study their molecular basis. The basic metabolic pathways and their regulation are evolutionarily highly conserved, so metabolism is often studied in invertebrate models. In recent decades, the fruit fly *Drosophila melanogaster* has become a versatile system for such studies. Despite the considerable evolutionary distance, flies and humans share similarities in energy storage organs, metabolic pathways and endocrine regulation.

In the newly established department we use fruit flies as models for obesity and dysregulations caused by short- or long-term dietary imbalance. For example, we study metabolic programming triggered by dietary treatments during early life. We also study the development of obesity in adulthood. We are particularly interested in the endocrine regulators that maintain energy balance in health and disease. We also use flies to study metabolism from an ecophysiological perspective.

For example, one of the most important discoveries made by Dr Klepsatel and his colleagues was the discovery of the long-term effects of diet experienced in early life (Klepsatel et al., 2018; 2020). These studies showed that lifespan and metabolism in adulthood are largely dependent on nutrition in early life. We also described how metabolism, reproduction and spontaneous locomotion depend on ambient temperature and thermal conditions in early life (Klepsatel et al. 2019, 2020, 2022).

The group is dedicated to the education of students. Since 2017, we have supervised six undergraduate and three graduate students. We have also participated in numerous outreach activities and given several invited lectures domestically and at research institutes abroad. We currently hold several competitive grants and our work has been recognised by several national and international awards. For more information about our work, publications, awards and activities, please visit www.galikovalab.com and <http://zoo.sav.sk/Drosophila>.

Another group analysed genetics and physiology of haematophagous dipterans. In collaboration with colleagues from the Yale School of Public Health, we analysed genomes of several species of tse tse flies. These findings were published in the prestigious journal *Genomic Biology* (Attardo et al. 2019) and form the basis for further research and protection against the transmission of trypanosomiasis by tse tse flies. To reduce the fecundity of these serious pests, we conducted an initial screening of gene expression in the reproductive organs of tse tse females (Prochazka et al. 2018). We also analysed de novo triglyceride dynamics during the ovarian previtelogenic (PVG) stage (2-7 days after eclosion) of the female mosquito *Aedes aegypti*. Our results provided further evidence for the complexity of the molecular mechanism of follicular lipid dynamics during oogenesis in the mosquito (Valaderes et al. 2021).

c) Bioactive substances in the salivary glands and gut of ticks

IZ SAS has a long tradition in identification of bioactive molecules from haematophagous arthropods that could be used for therapeutic purposes and pest control. We utilized different species of native and tropical ticks (Ixodidae) that we successfully breed in our rearing facility. Ticks are blood-feeding ectoparasites that can transmit a variety of pathogenic microorganisms. Salivary glands (SG) are important organs that produce a wide array of bioactive molecules that have haemostatic, anti-inflammatory, immunosuppressive and cytolytic effects and also influence wound healing. These bioactive compound could be potentially used as drugs to treat vertebrate haemostasis disorders, immune responses and cancer. Bioactive molecules from ticks may also

serve as candidates for the development of vaccines against ticks and for blocking transmission of pathogens.

In several reviews and book chapters, we have expanded our knowledge on the role of tick salivary molecules in various important functions: 1) modulation of the host defence and pathogen transmission (Šimo et al. 2017), 2) interactions between ticks, arboviruses and vertebrate hosts with a focus on immune responses in the host skin (Kazimírová et al. 2017), 3) potential of these molecules in human and veterinary medicine, 4) new trends and utilisation of tick transcriptomes and proteomes (Bonnet et al, 2018), 5) novel strategies to control ticks and tick-borne diseases (Kazimírová et al. 2018).

By analysing SG of adult *Hyalomma excavatum*, over 5,000 gene sequences were submitted to GenBank and novel proteins were identified that can be used to identify antigens for the development of anti-tick vaccines and new drugs (Ribeiro et al. 2017). We also revealed important processes at the tick-host-virus interface during the early phases of tick-borne encephalitis virus transmission (Thangamani et al. 2017, Hart et al. 2020). Another study confirmed the link between tick feeding and alpha-gal syndrome, an allergic reaction typically triggered by the consumption of animal products (Apostolovic et al. 2020). Our efforts to find new bioactive compounds for medical treatment led to the discovery of novel thrombin inhibitors from SG in the tropical tick *Amblyomma variegatum* (Iyer et al. 2017, Patent No. WO2016204696A1).

In another area of our research, we focused on molecules from the tick gut that can serve as vaccines against ticks and tick-borne diseases. Currently, the glycoprotein Bm86 is the only tick antigen that has been commercially developed as a tick vaccine. We found that immunisation with specific epidermal growth factor (EGF)-like domains in Bm86 orthologues of the tick *Ixodes scapularis* partially impairs tick feeding and moulting, as well as the survival of *B. burgdorferi* in the tick (Koči et al. 2021). We identified another vaccine candidate in the PM-associated chitin-binding protein (PM_CBP) of the tick *I. scapularis*. We found that suppression of PM_CBP expression reduced tick feeding and negatively affected *Borrelia* pathogen persistence, but also overall microbial diversity in the tick gut (Yang et al. 2021). Our results suggest that these molecules have the potential to be a component of future vaccines against a variety of ticks, including the most dangerous tick species in Europe, *Ixodes ricinus*.

d) Ecology and diversity of tick-borne pathogens

We investigated the distribution and seasonal dynamics of the epidemiologically most important tick in Central Europe, *Ixodes ricinus*, and its infection with tick-borne pathogens of medical and veterinary importance. Host-seeking and host-attached *I. ricinus* in different habitat types of southwestern (SW) and central Slovakia, including sites in the Bratislava metropolitan area, and their natural hosts (small rodents, birds, free-living ungulates) were screened for *Borrelia burgdorferi* s.l., *Borrelia miyamotoi*, *Anaplasma phagocytophilum*, *Neorhlichia mikurensis* and *Babesia* spp. and, in collaboration with the Institute of Virology, Biomedical Research Centre, SAS, for the presence of *Rickettsia* spp. and *Bartonella* spp.

We detected presence of tick-borne bacterial and protozoan pathogens in large *I. ricinus* populations from urban parks and recreational areas in Bratislava, indicating a high risk of exposure of humans and domestic and companion animals to various infections (Kazimírová et al. 2016, Vaculová et al. 2019). At a specific urban site we found that the overall prevalence of *B. burgdorferi* s.l. was two times lower than the average prevalence for Europe, while the prevalence of *A. phagocytophilum* was significantly higher compared to other habitats in Slovakia. Our results suggest that the spread of ticks and the dynamics of their infection with pathogens are primarily determined by abundance and temporal fluctuations of populations of reservoir hosts (Chvostáč et al. 2018).

Lyme borreliosis (LB), caused by spirochetes of the *B. burgdorferi* s.l. complex, is the most common tick-borne disease in Europe and is transmitted by ticks of the genus *Ixodes*. *Borrelia afzelii*, *B. garinii* and *B. valaisiana* are the most common genospecies in Central Europe, which our investigations confirmed for Slovakia. In contrast, *Borrelia lusitaniae* predominates in Mediterranean countries and is usually associated with lizards and xerothermic habitats. Its prevalence in Slovakia is low and restricted to a few sites. However, we confirmed spread of *I. ricinus* to higher altitudes in central Slovakia (up to 1070 m a.s.l.) and unexpectedly discovered a natural focus of *B. lusitaniae* (Rusňáková-Taragel'ová et al. 2016).

Borrelia garinii associated with avian reservoirs is one of the most genetically diverse and widespread human pathogenic genospecies of the *B. burgdorferi* s.l. complex. The clinical

manifestations of LB vary from region to region and depend on the genetic strain even within *Borrelia* genospecies. We employed multilocus sequence typing (MLST) to investigate the local population structure of *B. garinii* in *I. ricinus* ticks in a natural wetland in Slovakia, temporally encompassing spring and autumn seasons of bird migration and the breeding season of resident birds. *B. burgdorferi* s.l. was detected in 43.4% of the ticks recovered from birds and in 26.3% of questing ticks. Among ticks feeding on birds, the highest prevalence was found in single infections with *B. garinii* (22.5%). We found low geographical structuring of *B. garinii* genotypes and noted consistency in the occurrence of local sequence types and a geographical signal for one of the clonal complexes (Mtierová et al. 2020).

In addition to the *B. burgdorferi* s.l. complex, we investigated spirochetes from the relapsing fever (RF) group. We developed a duplex real-time PCR method for simultaneous detection and differentiation of the emerging pathogen *B. miyamotoi* (RF spirochete) and *B. burgdorferi* s.l. in environmental and potentially clinical samples (Venczel et al. 2016). This allowed us to confirm infections and co-infections with *B. miyamotoi* and *B. burgdorferi* s.l. in *I. ricinus* and small rodents, with *B. afzelii* being the predominant genospecies (Hamšíková et al. 2017). The identified genotype of *B. miyamotoi* had a high degree of identity with the genotype found in ticks and in human patients in Europe, suggesting that the human population in Slovakia is at risk of becoming infected with tick-borne RF, sometimes together with LB.

We confirmed the presence of the emerging pathogen *N. mikurensis* in questing and rodent-attached *I. ricinus* ticks and small rodents in suburban and natural habitats in SW Slovakia (Hamšíková et al. 2016a). The genotype found was identical to the human pathogenic genotype from Europe. We also detected *Babesia microti* and *B. venatorum* in questing *I. ricinus* and *B. microti* in small rodents at the same sites (Hamšíková et al. 2016b). The genotypes of these babesia were identical to the zoonotic strains found in Europe. We also detected DNA from *B. capreolii*, *B. divergens*, *B. odocoilei*, *B. canis* and *Hepatozoon canis* in *I. ricinus* (Hamšíková et al. 2016b, c), as well as two new babesia, *Babesia* sp. 1 and 2 (Eurasia), and *Theileria capreoli* in *Haemaphysalis concinna* ticks (Hamšíková et al. 2016b). For some of these pathogens, whose zoonotic potential is unknown, these were the first records for Slovakia. Presence of the canine parasite *H. canis* in *I. ricinus* may indicate the geographical spread of the parasite and a possible role of other ticks as its vectors in areas where its natural tick vector, *Rhipicephalus sanguineus*, is not endemic.

Human granulocytic anaplasmosis is a zoonotic bacterial disease of increasing public health importance in Europe. Understanding its sylvatic cycle and identification of competent reservoir hosts for different strains and ecotypes of the bacterium are essential for improving risk models and planning preventive measures. In collaboration with a team of researchers from Italy, we detected for the first time the circulation of five tick-borne pathogens, including *A. phagocytophilum*, in ticks of the genus *Ixodes* spp. in this region (Baráková et al. 2018). We also confirmed the circulation of a specific strain of *A. phagocytophilum* in rodents in the Italian Alps and provided further evidence for the marginal role of the yellow-necked mouse *Apodemus flavicollis* compared to the bank vole *Myodes glareolus* as a reservoir host for this pathogen (Rosso et al. 2017).

By examining tissue samples and attached ticks from deer, mouflon and wild boar hunted in the deciduous forests of SW Slovakia for tick-borne pathogens, we found a predominant infection with *A. phagocytophilum* and *Theileria* sp. in cervids. *A. phagocytophilum* was also detected in mouflon and wild boar. Eight and three tick-borne pathogen species were detected in engorged *I. ricinus* and *H. concinna*, respectively (Kazimírová et al. 2018). Roe deer are known reservoirs of non-zoonotic *A. phagocytophilum* strains (ecotype II), but it was unclear whether their presence at a site can reduce the prevalence of pathogenic strains in questing *I. ricinus*. Our screening for the presence of different *A. phagocytophilum* ecotypes in questing ticks collected in different habitats in the Czech Republic, Germany and Slovakia showed that the presence of certain *A. phagocytophilum* ecotypes is related to the presence of roe deer in certain locations and to the developmental stage of the tick (Hamšíková et al. 2019).

We also investigated the mechanisms of pathogen transmission between ticks and hosts under laboratory conditions and tested two mouse models – the C3H/N and Balb/c strains – for their susceptibility to infection and their ability to transmit pathogens by ticks. Our results showed that the C3H/N and Balb/c mice are well-accepted models for infection with *B. afzelii*, but they are not suitable for interaction studies with *R. helvetica* because the animals do not acquire rickettsaemia and do not transmit *R. helvetica* to feeding ticks (Sallay et al. 2017).

e) Taxonomy, phylogeny and phylogeography of invertebrates

1) Mites. We have analysed taxonomy, zoogeography and bionomy of mesostigmatic mite species belonging to different ecological groups, such as edaphic detritophiles, saproxylic mycophages, associates of wood-destroying fungi and necrophilous substrates, etc. Within the assessment period, further considerable progress was made in the systematics of Mesostigmata, in particular Ameroseiidae (Mašán, 2017a), Laelapidae (Babaeian et al., 2019; Mašán & Babaeian, 2019), Pachylaelapidae (Babaeian et al., 2016a, 2016b, Mašán, 2017b, 2018; Mašán & Özbek, 2016; Mašán et al., 2016b, 2018; Özbek & Mašán, 2018) and Melicharidae (Mašán et al., 2021), but some interesting discoveries were also made in Blattisociidae (Mašán & Halliday, 2016), Rhodacaridae (Mašán, 2020), Eviphididae (Mašán et al., 2016a), Pseudolaelapidae (Mašán, 2017c) and Parasitidae (Hrúzová et al., 2017). A number of other studies addressed the systematics, ecology and distribution of parasitic mites, chiggers and soil pincers from different areas of the world (e.g. Kalúz 2019, Kalúz & Ermilov 2018, 2019, Ermilov & Kalúz 2019, Kalúz & Literák 2019, Kalúz et al. 2016, 2021). In the articles cited above, a total of 4 new genera or subgenera and 47 new species are described and illustrated, based on specimens from Europe, Asia and North America. Two of the newly described species were discovered and described based on specimens from Slovakia, namely *Hoploseius oblongus* Mašán & Halliday, 2016 and *Mycomelichares polypori* Mašán & Joharchi, 2021. Both species belong to the mycetobionts inhabiting bracket fungi (Polyporales) and show peculiar morphological adaptations (Mašán & Halliday, 2016; Mašán et al., 2021).

The biology of macrochelid mites may offer new starting points for interpreting the environmental conditions surrounding human death and decomposition. Three human cadavers, one from Sweden and two from Spain, were examined for the presence of Macrochelidae species (Che Kamaruzaman et al., 2018).

2) Insects and other invertebrates. We analysed and identified various species of selected insect groups belonging to fauna in Europe and other zoogeographical regions. We described five species and two genera of cockroaches from Equador (Vidlička 2016, 2019, Hinkelman et al. 2020), one species of Lauxanidae flies from Slovakia (Semelbauer 2016) and, as a by-product of our entomological research, one species of entomopathogenic fungi (Crous et al. 2017). All these taxons are new to science and their findings highlight our poor knowledge of invertebrate fauna worldwide. In addition, several fossil species have been described, e.g. a new genus and species of cockroach *Mulleriblattina bowangi* (Sendi et al. 2020, see also chapter Evolution of insects).

In order to increase our knowledge of the Slovak fauna, we conducted faunistic surveys in various terrestrial biotopes. Twenty-nine species of sawflies (Symphyta), four species of lauxaniid flies (Diptera) and one species of scoliid wasps were recorded for the first time in Slovakia (Roller & Macek 2017, Macek et al. 2020, Kozánek et al. 2018, Semelbauer, Bogusch 2020, Semelbauer, Grechová 2020). In addition, a new invasive cockroach species – *Ectobius vittiventris* – was discovered in Slovakia for the first time. Its expansion in Bratislava and western Slovakia, its bionomy and developmental stages have been described in detail (Vidlička & Pecina 2020).

We have made an important contribution to the first comprehensive survey of sawflies (Hymenoptera, Symphyta) occurring in Central Europe. The book, published by Academia (Prague) as part of the internationally recognised series of atlas books, contains information on 795 sawfly species. In addition to the scientific contribution (identification keys, new data on the occurrence and biology of the species, and unique descriptions and illustrations of larvae), the book contains original colour illustrations of most described species (Macek et al. 2020).

Within aquatic fauna, the worm *Paranais litoralis* was recorded as a new inhabitant of the Danube basin except for its delta (Kokavec & Šporka 2019), while another oligochaete worm *Tasserkidrilus cf. americanus*, a species not native to Europe and originally from North America, was recorded for the first time in Central Europe (Kokavec 2021). We have also rediscovered several rare caddisfly species for the Slovak fauna (Chvojka et al. 2020, Navara et al. 2020, 2021).

f) Ecology

- 1) Soil arthropod assemblages. We obtained a unique 14-year data set on mountain Carabid beetle succession in intact spruce forests and managed stands in the Tatra National Park, which were destroyed by the storm in November 2004. Our long dataset made it possible to detect periodic changes in the quantitative parameters of the assemblages, which occur about one year after the climate fluctuations, especially incidence of extreme drought, with a periodicity of about 3-4 years. The extreme drought reduces the species diversity and cumulative abundance of all assemblages, regardless of the degree of damage and restoration. The standardised precipitation and evaporation index (SPEI) has been found to be most suitable for description and prediction of these changes. The continuous warming of the climate in the Tatras led to a spatial spread of carabid species, which have an optimal vertical distribution at lower altitudes and gradually assume a dominant position in the assemblages of damaged stands. Keeping the fallen wood in situ in the damaged stands has been shown to be most beneficial for the soil surface fauna. Under these circumstances, damage to the stands resulted only in quantitative changes in the structure of the assemblages. In contrast, wood removal and subsequent fire led to a strong reduction of the original fauna and the invasion of xenocoenous species. The differences between burned and unburned areas with removed wood disappeared after ~5 years (Šustek 2021, Vido & Šustek 2021). We also studied plots in two low-elevation habitats, in an area dried out by undermining in the brown coal and an area affected by heavy metal pollution. In both cases, artificial desiccation significantly amplified the effects of natural drought (Šustek et al. 2021).
- 2) Ecology of running waters. We have also conducted several studies on aquatic invertebrate fauna in running waters of Slovakia. First, we used an improved tool for assessing aquatic insect assemblages, the Floodplain Index, in the Danube floodplain (Šporka et al. 2016). The comprehensive study on aquatic insects based on 25 years of monitoring showed decreasing trends in the fauna of mayflies, stoneflies and caddisflies in the area affected by the Gabčíkovo waterworks (Krno et al. 2018). Our studies also contributed to the knowledge on the ecology of specific insect groups in different types of streams (Lehotský et al. 2016, Kalaninová et al. 2017, Larsen et al. 2019, Bulánková et al. 2019, Cívik et al. 2021, Krno et al. 2021).
- 3) Autoecology and population ecology in birds and mammals (intra- and interspecific relationships, maternal investment, species-habitat associations). We investigated the extent of competition between several sympatric breeding and related species where niche breadth and overlap between species is unclear. The blackcap (*Sylvia atricapilla*) was used as a model species (response species) and the response of unmated territorial males to intruders simulated by playback singing of conspecifics and five other *Sylvia* species was studied. Contrary to the assumption that song rate increases with territorial intruders, the number of song strophes by the territorial owner was generally reduced. We have shown differences in the response of the territory holder to sympatric and allopatric species and the importance of some vegetation parameters for the response of the territory holder to the simulated intruder (Darolová et al. 2020).

Next, we tested whether there is a link between one part of the immune system - the diversity of the major histocompatibility complex (MHC) – and the number of culturable eggshell bacteria, some of which originate from the urogenital tract of female house sparrows (*Passer domesticus*). Our study found that female body condition had no effect on the number of bacteria, but there was a significant seasonal effect. In contrast, a significant negative effect was found when MHC diversity was examined in terms of the number of class I functional alleles in relation to eggshell bacteria originating from the urinary tract and growing on a selective medium. This is the first study to find a correlation between MHC diversity of females and eggshell bacteria (Darolová et al. 2021).

In the study conducted on blackbirds, we investigated the relationship between eggshell colouration, the presence of eggshell bacteria and egg compounds characteristics. Our results suggest that eggshell colour and eggshell spot size are related to different egg parameters, and we found that certain eggshell colour parameters were related to egg yolk mass. In addition, the amount of eggshell bacteria originating from the urogenital tract of the female was negatively related to eggshell colour. The results of the study shed light on the association between eggshell colouration in blackbirds, culturable bacteria horizontally transferred from mother to eggs, and various maternally transmitted substances (Hoi et al. 2019).

Habitat associations were investigated for several owl and passerine species, focusing on identifying the most important habitat attributes for nest site selection in different regions with contrasting breeding habitats (Šálek et al. 2016, Šálek et al. 2019), but also within a region with different nest site types (Valera et al. 2019). Species-habitat associations were investigated for several bird species to uncover the causes of differences in mortality and survival rates (Šálek et al. 2019, Valera & Václav 2021). The importance of artificial habitat structures in the agricultural landscape was also investigated for the small mammal community. It was found that such structures (power line infrastructure) play an important role as refugia for overwintering and spring dispersal of small mammals (Šálek et al. 2020).

- 4) Host-parasite interactions and local population structure of pathogens. The local population structure of haemosporidia was studied at the level of avian host communities, taking into account seasonal dynamics in avian host community structure, host abundance and host age structure. The aim of this research is to understand the environmental and biotic drivers of local emergence of vector-borne pathogens. In a longitudinal study, we investigated the local population structure of avian haemosporidia for a host community of birds in a natural forest area. We found marked diversity and seasonal dynamics in haemosporidian genera/lineages (Šujanová et al. 2021). We have also identified important avian hosts responsible for spreading the pathogens (Václav et al. 2016, Šujanová et al. 2021), as well as two species of biting midges (Diptera), one of which was introduced to Europe from America and plays a crucial role in the local transmission of several haemoproteid lineages (Veiga et al. 2018). To highlight the epidemiological role of nest reuse by avian species, the microbiome of soft *Argas* ticks collected from the nests of avian hosts was studied and several new parasite taxa/genotypes were discovered (Palomar et al. 2021). To understand patterns of local parasite distribution within breeding habitat patches and nest sites, breeding habitat and host conditions were experimentally manipulated in a coraciid bird species (Václav and Valera 2018, Veiga et al. 2020). We also investigated the effects of haematophagous and saprophagous insects on nestling development in the European bee-eaters (*Merops apiaster*) (Křištofík et al. 2017, Hoi et al. 2018).

g) Evolution of arthropods and their life traits

- 1) Evolution of insects. We studied the evolution of insects with special attention to fossil cockroaches. Within the framework of two national projects VEGA and UNESCO project AMBA, we discovered and described very important cockroach fossils, mainly thanks to the extensive exploitation of Myanmar amber. Obtained results can be summarised as follows. (1) for the first time, we detected significant differences in variations in wing venation in the fossil record and their relationship to important phylogenetic advances were demonstrated (Vršanský et al. 2017); (2) a theory of phylogenetic patterns postulated that classical dichotomizations do not occur in the real world or are extremely rare (Vršanský et al. 2019a); (3) we described the only known eusocial cockroaches, i.e. those living in highly organised states (Hinkelman et al. 2020); (4) the discovery of the earliest cave organisms with subsequent analysis of the entire cave biota revealed that the entire cave fauna is basically modern – Tertiary (Cenozoic) (Sendi et al. 2020b; in Gondwana Research IF = 6.4); (5) discovery of possibly the earliest pollinators belonging to cockroaches (Sendi et al. 2020a); (6) discovery of a viral infection damaging insect wings in amber from the age of dinosaurs (Vršanský et al. 2019b); (7) the early parasites of eusocial ants and termites confirmed complexity of their nests (Vršanský et al. 2019c); (8) the oldest true (insect-insect) mimicry (Vršanský et al. 2018); (9) the earliest viviparous insect (Vršanský et al. 2016); (10) complex evaluation of major Jurassic site Bakhar in Mongolia with the presence of strategic coal and uranium (Vršanský 2020, monograph at Springer NATURE). Subsequently, postulates of important evolutionary principles were published in the prestigious journal Earth Science Reviews (IF = 12.4, Chen et al. 2021-2022). Some of these results were obtained with two PhD students (one of them from Croatia) and disseminated among primary school students (Superschool, over 30,000 registered participants) and high school students (BARS 1 and BARS 2, over 1,000 participants).
- 2) Evolution of nuptial feeding. Nuptial feeding is the provision of food by the male to his mate before, during or after mating. It occurs in many arthropods and the evolution of this behaviour is of interest to evolutionary biologists. We investigated 1) sexual cannibalism as a form of nuptial feeding in the praying mantis *Mantis religiosa* and 2) gift carrying in the web spider

Pisaura mirabilis under both field and laboratory conditions. We found that females of the sexually cannibalistic praying mantis are able to discriminate between their own mates and potential prey; in particular, attacks on prey were more frequent and faster than attacks on conspecifics. This research refutes one of the original hypotheses that females are cannibalistic due to their inability to discriminate between males and prey (Prokop and Maxwell, 2016). Our field research on the web spiders has shown that males are more likely to invest their endogenous component of the nuptial gift (i.e. silk) in lower quality gifts. This suggests that silk investment is a form of cheating used by the male to entice the female to copulate, even though the gift is of low quality (Prokop and Semelbauer, 2017). However, we showed that investment in silk is costly for the male (Prokop and Okrouhlík, 2021). Finally, our results indicate that nuptial feeding in *P. mirabilis* is more a product of sexual conflict, because males benefit more than females, rather than congruence between the sexes (Maxwell and Prokop, 2018).

h) Applied zoology

- 1) Impacts of hydropower plants on aquatic invertebrates in streams. Our young research team has studied the impact of hydropower plants on the stream environment and on aquatic invertebrates by assessing their responses at the species or community level. In cooperation with the Department of Ecology of the Faculty of Natural Sciences of Comenius University in Slovakia, we showed in several studies on different types of streams in Slovakia that fragmentation and associated hydromorphological changes threaten many ecological functions and macroinvertebrate structure of streams more than pollution (Kokavec et al 2017, Kokavec & Beracko 2018, Kokavec et al 2018).
- 2) Monitoring the effects of river restoration on macroinvertebrate community structure. IZ SAS participated in the project LIFE led by the Water Research Institute and the non-profit organisation BROZ. Our aim was to study effects of revitalisation of the Danube floodplain sidearms and improvement of the hydrological regime on structure of the macroinvertebrate fauna. Changes in the assemblages of bioindicative animal groups were monitored throughout the assessment period.
- 3) Several fauna inventory studies have been carried out. The results of these studies can be used directly by nature conservation authorities and investors.
- 4) During the Covid 19 pandemic, we analysed ecology of this newly emerged viral pathogen. The possible role of cats in the spread of the SARS-CoV-2 virus was investigated in Slovakia. Overall, 2.7% of domestic and stray cats carried specific antibodies to the SARS-Cov2 virus, suggesting that cats are susceptible to the infection.
- 5) IZ SAS offers a "tick and pathogen analysis" service to the public. This service includes identification of species and developmental stage of ticks that have fed on humans or animals, and further molecular diagnostics for the presence of various tick-borne pathogens. Data collected in Slovakia in 2008-2018 show an increasing importance of ticks as vectors of serious human pathogens (Špitalska et al. 2021).

2. Partial indicators of main activities:

2.1. Research output

2.1.1. Principal types of research output of the institute: basic research/applied research, international/regional (in percentage)

basic research / applied research: 80 % / 20 %

international research / regional research: 95 % / 5 %

2.1.2 List of selected publications documenting the most important results of basic research. The total number of publications should not exceed the number of average FTE researchers per year. The principal research outputs (max. 10% of the total number of selected publications, including Digital

Object Identifier – DOI if available) should be underlined. Authors from the evaluated organizations should be underlined.

- [1] ROLLER, Ladislav - ČIŽMÁR, Daniel - GÁLIKOVÁ, Zuzana - BEDNÁR, Branislav - DAUBNEROVÁ, Ivana - ŽITŇAN, Dušan. Molecular cloning, expression and identification of the promoter regulatory region for the neuropeptide trissin in the nervous system of the silkworm *Bombyx mori*. In *Cell and Tissue Research*, 2016, vol. 364, iss. 3, p. 499-512. (2015: 2.948 - IF, Q3 - JCR, 1.536 - SJR, Q1 - SJR, Current Contents - CCC). (2016 - Current Contents). ISSN 0302-766X. <https://doi.org/10.1007/s00441-015-2352-z>
- [2] HAMŠÍKOVÁ SVITÁLKOVÁ, Zuzana - HARUŠŤIAKOVÁ, Daniela - MAHRÍKOVÁ, Lenka - MOJŠOVÁ, Michala - BERTHOVÁ, Lenka - SLOVÁK, Mirko - KOCIANOVÁ, Elena - VAYSSIER-TAUSSAT, Muriel - KAZIMÍROVÁ, Mária. Candidatus *Neoehrlichia mikurensis* in ticks and rodents from urban and natural habitats of South-Western Slovakia. In *Parasites & vectors*, 2016, vol. 9, iss. 1, art. no. 2, 11 pp. (2015: 3.234 - IF, Q1 - JCR, 1.720 - SJR, Q1 - SJR). ISSN 1756-3305. <https://doi.org/10.1186/s13071-015-1287-2>
- [3] TYBUR, Joshua M. - INBAR, Yoel - AARØE, Lene - BARCLAY, Pat - BARLOWE, Fiona Kate - DE BARRA, Mícheál - BECKERH, Vaughn D. - BOROVOI, Leah - CHOI, Incheol - CHOI, Jong An - CONSEDINE, Nathan S. - CONWAY, Alan - CONWAY, Jane Rebecca - CONWAY, Paul - ADORIC, Vera Cubela - DEMIRCI, Dilara Ekin - FERNÁNDEZS, Ana María - FERREIRA, Diogo Conque Seco - ISHII, Keiko - JAKŠIĆ, Ivana - VAN LEEUWEN, Florian - LEWIS, David M. G. - LI, Norman P. - MCINTYRE, Jason C. - MUKHERJEE, Sumitava - PARK, Justin H. - PAWLOWSKI, Boguslaw - PETERSEN, Michael Bang - PIZARRO, David - PRODROMITIS, Gerasimos - PROKOP, Pavo - RANTALA, Markus J. et al. Parasite stress and pathogen avoidance relate to distinct dimensions of political ideology across 30 nations. In *Proceedings of the National Academy of Sciences of the United States of America*, 2016, vol. 113, no. 44, p. 12408-12413. (2015: 9.423 - IF, Q1 - JCR, 6.814 - SJR, Q1 - SJR, Current Contents - CCC). (2016 - Current Contents). ISSN 0027-8424. <https://doi.org/10.1073/pnas.1607398113>
- [4] KRIŠTOFÍK, Ján - DAROLOVÁ, Alžbeta - HOI, Christine - HOI, Herbert. Housekeeping by lodgers: the importance of bird nest fauna on offspring condition. In *Journal of Ornithology*, 2016, vol. 158, iss. 1, p. 245–252, 8 pp. (2015: 1.419 - IF, Q2 - JCR, 0.990 - SJR, Q1 - SJR, Current Contents - CCC). (2016 - Current Contents). ISSN 0021-8375. <https://doi.org/10.1007/s10336-016-1384-9>
- [5] IYER, Janaki Krishnamoorthy - KOH, C.Y. - KAZIMÍROVÁ, Mária - ROLLER, Ladislav - JOBICHEN, Chacko - SWAMINATHAN, Kunchithapadam - MIZUGUCHI, Jun - IWANAGA, Sadaaki - NUTTALL, Patricia A. - CHAN, Mark Y. - KINI, R.M. Avathrin: a novel thrombin inhibitor derived from a multi-copy precursor in the salivary glands of the ixodid tick, *Amblyomma variegatum*. In *Faseb Journal : official publication of the Federation of American Societies for Experimental Biology*, 2017, vol. 31, no. 7, p. 2981-2995. (2016: 5.498 - IF, Q1 - JCR, 2.694 - SJR, Q1 - SJR, Current Contents - CCC). (2017 - Current Contents). ISSN 0892-6638. <https://doi.org/10.1096/fj.201601216R>
- [6] KAZIMÍROVÁ, Mária - THANGAMANI, Saravanan - BARTÍKOVÁ, Pavlína - HERMANCE, Meghan - HOLÍKOVÁ, Viera - ŠTIBRÁNIOVÁ, Iveta - NUTTALL, Patricia A. Tick-Borne Viruses and Biological Processes at the Tick-Host-Virus Interface. In *Frontiers in Cellular and Infection Microbiology : Specialty Journal of Frontiers in Microbiology.*, 2017, vol. 7, art. no. 339, 21 pp. (2016: 4.300 - IF, Q1 - JCR, 2.311 - SJR, Q1 - SJR). ISSN 2235-2988. <https://doi.org/10.3389/fcimb.2017.00339>
- [7] HAMŠÍKOVÁ, Zuzana - COIPAN, C. - MAHRÍKOVÁ, Lenka - MINICHOVÁ, Lenka - SPRONG, H. - KAZIMÍROVÁ, Mária. *Borrelia miyamotoi* and Co-Infection with *Borrelia afzelii* in *Ixodes ricinus* Ticks and Rodents from Slovakia. In *Microbial Ecology*, 2017, vol. 73, no. 4, p. 1000-1008. (2016: 3.630 - IF, Q1 - JCR, 1.325 - SJR, Q1 - SJR, Current Contents - CCC). (2017 - Current Contents). ISSN 0095-3628. <https://doi.org/10.1007/s00248-016-0918-2>
- [8] ČIŽMÁR, Daniel - ROLLER, Ladislav - PILLEROVÁ, Miriam - SLÁMA, Karel - ŽITŇAN, Dušan** . Multiple neuropeptides produced by sex-specific neurons control activity of the male accessory glands and gonoducts in the silkworm *Bombyx mori*. In *Scientific Reports*, 2019, vol. 9, art. no. 2253, 13 pp. (2018: 4.011 - IF, Q1 - JCR, 1.414 - SJR, Q1 - SJR,

- Current Contents - CCC). (2019 - Current Contents, WOS, SCOPUS). ISSN 2045-2322. <https://doi.org/10.1038/s41598-019-38761-x>
- [9] KLEPSATEL, Peter** - WILDRIDGE, D. - GÁLIKOVÁ, Martina**. Temperature induces changes in *Drosophila* energy stores. In *Scientific Reports*, 2019, vol. 9, iss. 1, art. no. 5239. (2018: 4.011 - IF, Q1 - JCR, 1.414 - SJR, Q1 - SJR, Current Contents - CCC). (2019 - Current Contents, WOS, SCOPUS). ISSN 2045-2322. <https://doi.org/10.1038/s41598-019-41754-5>
- [10] VALERA, Francisco** - VÁCLAV, Radovan - CALERO-TORRALBO, Miguel A. - MARTINEZ, Teresa - VEIGA, Jesús. Natural cavity restoration as an alternative to nest box supplementation. In *Restoration Ecology*, 2019, vol. 27, no. 1, p. 220–227. (2018: 2.826 - IF, Q2 - JCR, 1.183 - SJR, Q1 - SJR, Current Contents - CCC). (2019 - Current Contents). ISSN 1061-2971. <https://doi.org/10.1111/rec.12841>
- [11] ATTARDO, Geoffrey M.** - ABD-ALLA, Adly M. M. - ACOSTA-SERRANO, Alvaro - + 24 AUTHORS - MICHALKOVÁ, Veronika - + 13 AUTHORS - TAKÁČ, Peter - + 11 AUTHORS - AKSOY, Serap**. Comparative genomic analysis of six *Glossina* genomes, vectors of African trypanosomes. In *Genome Biology*, 2019, vol. 20, art. no. 187, 31 p. (2018: 14.028 - IF, Q1 - JCR, 9.867 - SJR, Q1 - SJR, Current Contents - CCC). (2019 - Current Contents). ISSN 1474-7596. <https://doi.org/10.1186/s13059-019-1768-2>
- [12] VRŠANSKÝ, Peter* - SENDI, Hemen** - ARISTOV, Danil* - BECHLY, Günter - MÜLLER, Patrick - ELLENBERGER, Sieghard - AZAR, Dany - UEDA, K. - BARNA, Peter - GARCIA, Thierry. Ancient roaches further exemplify 'no land return' in aquatic insects. In *Gondwana Research*, 2019, vol. 68, p. 22-33. (2018: 6.478 - IF, Q1 - JCR, 3.612 - SJR, Q1 - SJR, Current Contents - CCC). (2019 - Current Contents). ISSN 1342-937X. <https://doi.org/10.1016/j.gr.2018.10.020>
- [13] SENDI, Hemen* - VRŠANSKÝ, Peter** - PODSTRELENÁ, Lenka - HINKELMAN, Jan - KÚDELOVÁ, Tatiana - KÚDELA, Matúš - VIDLIČKA, Ľubomír - REN, Xiaoyin - QUICKE, D.L.J. Nocticolid cockroaches are the only known dinosaur age cave survivors. In *Gondwana Research*, 2020, vol. 82, p. 288-298. (2019: 6.174 - IF, Q1 - JCR, 3.033 - SJR, Q1 - SJR, Current Contents - CCC). (2020 - Current Contents). ISSN 1342-937X. <https://doi.org/10.1016/j.gr.2020.01.002>
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- [15] ŠÁLEK, Martin** - VÁCLAV, Radovan - SEDLÁČEK, František. Uncropped habitats under power pylons are overlooked refuges for small mammals in agricultural landscapes. In *Agriculture, Ecosystems & Environment*, 2020, vol. 290, art. no. 106777. (2019: 4.241 - IF, Q1 - JCR, 1.719 - SJR, Q1 - SJR, Current Contents - CCC). (2020 - Current Contents). ISSN 0167-8809. <https://doi.org/10.1016/j.agee.2019.106777>
- [16] HART, Charles Edward - RIBEIRO, J. M. C - KAZIMÍROVÁ, Mária - THANGAMANI, Saravanan**. Tick-borne encephalitis virus infection alters the sialome of *Ixodes ricinus* ticks during the earliest stages of feeding. In *Frontiers in Cellular and Infection Microbiology : Specialty Journal of Frontiers in Microbiology*, 2020, vol. 10, art. no. 41. (2019: 4.123 - IF, Q2 - JCR, 1.626 - SJR, Q1 - SJR, Current Contents - CCC). (2020 - Current Contents). ISSN 2235-2988. <https://doi.org/10.3389/fcimb.2020.00041>
- [17] APOSTOLOVIC, Danijela - MIHAILOVIC, Jelena - COMMINS, Scott P. - WIJNVELD, M. - KAZIMÍROVÁ, Mária - STARKHAMMAR, Maria - STOCKINGER, Hannes - PLATTS-MILLS, Thomas A.E. - CIRKOVIC VELICKOVIC, Tanja - HAMSTEN, Carl - VAN HAGE, Marianne**. Allergenomics of the tick *Ixodes ricinus* reveals important α -Gal-carrying IgE-binding proteins in red meat allergy. In *Allergy : European journal of allergy and clinical immunology*, 2020, vol. 75, no. 1, p. 217-220. (2019: 8.706 - IF, Q1 - JCR, 3.061 - SJR, Q1 - SJR, Current Contents - CCC). (2020 - Current Contents). ISSN 0105-4538. <https://doi.org/10.1111/all.13978>
- [18] DAUBNEROVÁ, Ivana - ROLLER, Ladislav - SATAKE, Honoo - ZHANG, Chen - KIM, Young-Joon - ŽITŇAN, Dušan**. Identification and function of ETH receptor networks in the silkworm *Bombyx mori*. In *Scientific Reports*, 2021, vol. 11, no. 1, art. no.11693, _ pp. (2020: 4.380 - IF, Q1 - JCR, 1.240 - SJR, Q1 - SJR, Current Contents - CCC). (2021 -

- Current Contents, WOS, SCOPUS). ISSN 2045-2322. <https://doi.org/10.1038/s41598-021-91022-8>
- [19] ZHANG, Chen - DAUBNEROVÁ, Ivana* - JANG, Yong-Hoon - KONDO, Shu - ŽITŇAN, Dušan - KIM, Young-Joon**. The neuropeptide allatostatin C from clock-associated DN1p neurons generates the circadian rhythm for oogenesis. In *Proceedings of the National Academy of Sciences of the United States of America*, 2021, vol. 118, iss. 4, article number: [e2016878118](https://doi.org/10.1073/pnas.2016878118). (2020: 11.205 - IF, Q1 - JCR, 5.011 - SJR, Q1 - SJR, Current Contents - CCC). (2021 - Current Contents). ISSN 0027-8424. <https://doi.org/10.1073/pnas.2016878118>
- [20] KOČI, Juraj** - BISTA, Sandhya - CHIRANIA, Payal - YANG, Xiuli - KITSOU, Chrysoula - RANA, Vipin S. - YAS, Ozlem B. - SONENSHINE, Daniel E. - PAL, Utpal**. Antibodies against EGF-like domains in Ixodes scapularis BM86 orthologs impact tick feeding and survival of *Borrelia burgdorferi*. In *Scientific Reports*, 2021, vol. 11, no. 1, art. no. 6095. (2020: 4.380 - IF, Q1 - JCR, 1.240 - SJR, Q1 - SJR, Current Contents - CCC). (2021 - Current Contents, WOS, SCOPUS). ISSN 2045-2322. <https://doi.org/10.1038/s41598-021-85624-5>
- [21] NOUZOVÁ, Marcela - EDWARDS, M.J. - MICHALKOVÁ, Veronika - RAMIREZ, Cesar E. - RUIZ, Marnie - AREIZA, Maria - DEGENNARO, Matthew - FERNANDEZ-LIMA, Francisco - FEYEREISEN, Rene - JINDRA, Marek** - NORIEGA, Fernando G.*. Epoxidation of juvenile hormone was a key innovation improving insect reproductive fitness. In *Proceedings of the National Academy of Sciences of the United States of America*, 2021, vol. 118, no. 45, e2109381118, 9 pp. (2020: 11.205 - IF, Q1 - JCR, 5.011 - SJR, Q1 - SJR, Current Contents - CCC). (2021 - Current Contents). ISSN 0027-8424. <https://doi.org/10.1073/pnas.2109381118>

2.1.3 List of monographs/books published abroad

- [1] HAMERLÍK, Ladislav - DA SILVA, Fabio Laurindo. *Chironomidae of Central America : An Illustrated Introduction To Larval Subfossils*. CRC Press, Taylor & Francis Group, 2021. 198 pp, 284 Color & 5 B/W Illustrations. ISBN 978-0-367-55821-5
- [2] MACEK, J. - ROLLER, Ladislav - BENEŠ, Karel - HOLÝ, Kamil - HOLUŠA, J. *Blanokřídli České a Slovenské republiky II: Širopasí*. 1. vydanie. Praha : Academia, 2020. 672 s. ATLAS, 12505. ISBN 978-80-200-2999-7
- [3] VRŠANSKÝ, Peter. *Cockroaches from Jurassic sediments of the Bakhar Formation in Mongolia*. 1. Edition. Cham : Springer, 2020. 98 p. <<https://link.springer.com/book/10.1007/978-3-030-59407-7>>. ISBN 978-3-030-59406-0

2.1.4 List of monographs/books published in Slovakia

- [1] ČERNECKÝ, Ján - LEŠO, P. - RIDZOŇ, Jozef - KRIŠTÍN, Anton - KARASKA, Dušan - DAROLOVÁ, Alžbeta - FULÍN, Miroslav - CHAVKO, Jozef - BOHUŠ, Mirko - KRAJNIAK, Dušan - ĎURICOVÁ, Viktória - LEŠOVÁ, Andrea - ČULÁKOVÁ, Jana - SAXA, A. - DURKOŠOVÁ, Jana - ANDRAŠ, Peter. *Stav ochrany vtáctva na Slovensku v rokoch 2013 –2018* = Conservation status of birds in 2013 –2018 in Slovakia. Recenzenti Peter Urban, Peter Puchala. Banská Bystrica : Štátna ochrana prírody SR, 2020. 105 s. <http://www.sopsr.sk/news/file/Monografia_vtaky_reporting_18_12_2020.pdf>. ISBN 978–80–8184–084–5
- [2] STANKO, Michal - SLOVÁK, Mirko. *História výskumov ekológie kliešťov : na území Česka a Slovenska (do roku 2000)*. Vydanie prvé. Košice : Parazitologický ústav SAV ; Bratislava : Ústav zoológie SAV : VEDA, vydavateľstvo Slovenskej akadémie vied, 2019. 544 s. ISBN 978-80-224-1752-5

2.1.5. List of other scientific outputs specifically important for the institute, max. 10 items for institute with less than 50 average FTE researchers per year, 20 for institutes with 50 – 100 average FTE researchers per year and so on

Monographic studies in journals published abroad

- [1] ANETTOVÁ, Lucia - KAZIMÍROVÁ, Mária**. Human Babesiosis: Ecoepidemiology, Diagnosis and Treatment : Chapter 4. In *Vector-Borne Diseases & treatment*. Volumen 3. - Las Vegas, USA : Open Access eBooks, 2019, p. 44-72. ISBN 978-93-87500-52-5.
- [2] BONNET, Sarah - KAZIMÍROVÁ, Mária - RICHARDSON, Jennifer - ŠIMO, Ladislav. Tick Saliva and Its Role in Pathogen Transmission. In *Skin and Arthropod Vectors*. - GB : Elsevier, 2018, p. 121-192. ISBN 978-0-12-811436-0. <https://doi.org/10.1016/B978-0-12-811436-0.00005-8>
- [3] KAZIMÍROVÁ, Mária - BARTÍKOVÁ, Pavlína - ŠTIBRÁNIOVÁ, Iveta. Tick-Borne Viruses and Host Skin Interface. In *Skin and Arthropod Vectors*. - GB : Elsevier, 2018, p. 325-384. ISBN 978-0-12-811436-0. <https://doi.org/10.1016/B978-0-12-811436-0.00010-1>
- [4] MAŠÁN, Peter. A revision of the family Ameroseiidae (Acari, Mesostigmata), with some data on Slovak fauna. In *Zookeys : Monograph*, 2017, vol. 704, p. 1-228. (2016: 1.031 - IF, Q3 - JCR, 0.540 - SJR, Q2 - SJR, Current Contents - CCC). (2017 - Current Contents). ISSN 1313-2989. <https://doi.org/10.3897/zookeys.704.13304>
- [5] OŠLEJŠKOVÁ, Lucie - KRIŠTOFÍK, Ján - TRNKA, Alfréd - SYCHRA, O. An annotated checklist of chewing lice (Phthiraptera: Amblycera, Ischnocera) from Slovakia. In *Zootaxa : Monograph*, 2021, vol. 5069, no. 1, 80 pp. (2020: 1.091 - IF, Q3 - JCR, 0.621 - SJR, Q2 - SJR, Current Contents - CCC). (2021 - Current Contents). ISSN 1175-5334. <https://doi.org/10.11646/zootaxa.5069.1.1>
- [6] THIEBAUT, Gaëtan - PROKOP, Pavol* - MÉOT, Alain - WITT, Arnaud - BONIN, Patrick**. The Behavioral Immune System: How does it contribute to our understanding of human behavior? In *Advances in Psychology Research..* Vol. 144. 1. - Nova Science Publishers, 2021, 2021, chapter 1, pp.1-59. ISBN 978-1-53619-542-2.

Chapters in scientific monographs published abroad

- [7] BUČEKOVÁ, Marcela - VALACHOVÁ, Ivana - MAJTÁN, Juraj. Enzým glukózo oxidáza - kľúčový faktor podmieňujúci antibakteriálne vlastnosti včelieho medu a jeho úloha v ochrane včelstva. In *Ekologie chovu včel*. - Nakladatelství Pavel Mervart, 2016, s. 97-115. ISBN 978-80-7465-215-8.

Monographic studies in journals published in Slovak publishing

- [8] SMETANA, Vladimír - ROLLER, Ladislav - BENDA, Daniel - BOGUSCH, Petr - HOLÝ, Kamil - PURKART, Adrián - ŘÍHA, M. - STRAKA, Jakub - ŠIMA, P. - ERHART, Jan - HALADA, Marek - HOLECOVÁ, Milada - HORÁK, Ján - KLESNIAKOVÁ, Mária - MACEK, J. - PAVLÍKOVÁ, A. - PETRÁKOVÁ, Lenka - RINDOŠ, Michal. Blanokrídlovce (Hymenoptera) na vybraných lokalitách Malých Karpát. In *ACTA MUSEI TEKOVENSIS LEVICE : Zborník Tekovského múzea v Leviciach* (231 pp). - Levice : Tekovské múzeum v Leviciach, 2020, 2020, roč. XII, s.75-141. ISBN 978-80-88831-24-2.

2.1.6. List of patents, patent applications, and other intellectual property rights registered abroad

[1] Patent application No.: 62/230,923

Published on: 22/12/2016

Author names: Krishnamoorthy J.I., Koh Ch.Y., Kini R.M., Kazimírová Mária, Roller Ladislav

Patent name: Novel thrombin inhibitors

Co-owners: National University of Singapore / Institute of Zoology SAS

Worldwide applications: 2016 - AU JP CA CN KR RU US SG MX WO EP

2017 - IL PH

2018 - HK

2.1.7. List of patents, patent applications, and other intellectual property rights registered in Slovakia

None

2.1.8. Narrative on the most important research outputs of the institute – especially focused on their importance for society (3-5 pages)

a) Hormonal regulation of insect physiology and development

Neuropeptides are important signalling molecules that regulate physiological processes, development and behaviour in animals. In silkworms (*Bombyx mori*), we identified two neuropeptides (trissin and RYamide) whose expression and function were previously unknown. Using in situ hybridisation, immunohistochemistry and targeted expression of EGFP, we detected neurons that produce these neuropeptides and also target organs for these neuropeptides. Our results suggest that trissin and RYamide regulate gut activity during food intake and digestion (Roller et al 2016a,b). We also described a specific part of the nervous system and identified peptide neurohormones that play a crucial role in the regulation of fertilisation and reproduction in insects. We found that a cluster of about 20 male-specific neurons innervates the internal reproductive organs (accessory glands and gonoducts). These neurons, which we have named MAN9 (male abdominal neurons of 9th neuromere), develop during metamorphosis along with the reproductive organs. We showed for the first time that specific neurons producing a large mixture of neuropeptides regulate male genital activity during copulation and are essential for female fertilisation (Čižmár et al. 2019).

Metazoans optimise the timing of reproduction to maximise their fitness. In the fruit fly *Drosophila melanogaster*, we have identified a conserved neuropeptide pathway that links female reproduction and the biological clock. The neuropeptide allatostatin C, produced by a subset of circadian clock neurons, generates the circadian rhythm of oogenesis via the brain's insulin-producing cells and the insect's gonadotropin – juvenile hormone. Identifying this pathway provides insights into the molecular mechanisms that control the timing of reproduction in most metazoans (Zhang, Daubnerová et al. 2021, PNAS).

The epoxidised form of methyl farnesoate (MF), known as juvenile hormone (JH), controls metamorphosis and stimulates reproduction in insects. To explore the evolutionary significance of MF epoxidation, we created mosquitoes that completely lack one of the two enzymes that catalyse the final steps of MF / JH biosynthesis and epoxidation. Remarkably, the mutants that synthesised MF, but not JH, completed the entire life cycle, but their reproductive output of both sexes was dramatically reduced. These results suggest that while MF can substitute for the absence of JH in mosquitoes, it does so at a significant fitness cost. We hypothesise that the epoxidation of MF to JH was a key innovation that gave insects a reproductive advantage (Nouzová et al. 2021, PNAS). Our results are extremely important for understanding hormonal regulation of insect development and reproduction, and could contribute to the development of effective means of pest control.

b) Effect of environmental factors on physiology and life-history traits in *Drosophila*

Conditions experienced during development have often long-lasting effects persisting into adulthood. In the model organism *Drosophila*, it is well-documented that larval crowding influences fitness-related traits such as body size, starvation resistance and lifespan. However, the underlying mechanism of this phenomenon is not well understood. We have shown that the effects of larval crowding on life-history traits are mainly caused by the reduced availability of dietary yeasts due to increased larval competition (Klepsatel et al. 2018).

Temperature has a profound impact on animal physiology. We conducted the first systematic study of the effects of ambient temperature on energy stores in *Drosophila*. The analysis of energy reserves within the natural thermal range of this species revealed that the reaction norms for the energy stores are best described by a quadratic function with the maximum at intermediate temperatures (Klepsatel et al. 2019a). We also investigated how developmental temperature affects reproductive performance of wild fruit flies. Our results provide solid support for the optimal developmental temperature hypothesis, which states that in different thermal environments, the highest fitness is achieved when an organism is raised at its optimal developmental temperature (Klepsatel et al. 2019b).

The adaptive significance of phenotypic changes elicited by environmental conditions experienced early in life has long attracted attention in evolutionary biology. We have used *Drosophila* to test whether the developmental diet produces phenotypes better adapted to cope with similar nutritional conditions later in life. We found that individuals that had developed on either low-yeast or high-sugar diet showed decreased reproductive performance regardless of their adult nutritional environment. Our findings suggest that differences in the adult physiology induced by early-life diet likely result from inevitable and general effects of nutrition on the development of reproductive and metabolic organs, rather than from adaptive mechanisms (Klepsatel et al. 2020a).

The ability to tolerate non-optimal thermal conditions can be substantially improved by acclimation. Therefore, we examined how an early-life acclimation to different temperatures influences thermal reaction norms for energy stores in *Drosophila* adults. Overall, our results demonstrate that thermal reaction norms for energy reserves are sensitive to acclimation temperature, which can have a direct impact on survival and fitness, especially under nutritionally poor conditions (Klepsatel et al. 2020b). Altogether, our studies contribute to understanding how environmental factors affect animal physiology and fitness.

c) Bioactive compounds and vaccine candidates in ticks

Ticks are blood-feeding ectoparasites and transmit a wide range of pathogenic microorganisms. Tick salivary glands (SG) produce bioactive molecules which secure successful blood feeding and pathogen transmission by modulating defence reactions in the host's skin. We summarised current knowledge on the role of tick salivary molecules in modulation of host defence and pathogen transmission and the perspectives of their use in human and veterinary medicine and tick control (Šimo et al. 2017, Bonnet et al. 2018). We also analysed the interactions between ticks, arboviruses and vertebrates, focusing on processes in the host skin (Kazimírová et al. 2017, 2018). By analysing the transcriptome of *Hyalomma excavatum* SG we identified new proteins that can serve as antigens for anti-tick vaccines (Ribeiro et al. 2017). Of high priority are results on transcriptional immunoprofiling in the host skin and analyses of the tick sialome during the early stages of tick-borne encephalitis virus (TBEV) transmission by *Ixodes ricinus*. We confirmed the presence of TBEV antigen in mouse skin mononuclear phagocytes and fibroblasts 3 hours after tick attachment and the important role of proinflammatory chemokines and cytokines during virus transmission (Thangamani et al. 2017). Differences in the expression of a number of genes were found in SG of TBEV-infected and uninfected ticks (Hart et al. 2020), indicating importance of processes at the tick-host virus interface during early phases of virus transmission.

Feeding of *I. ricinus* on humans is often associated with allergic reactions to red meat (Alpha-Gal syndrome). We demonstrated that IgE antibodies in the blood of allergic patients cross-react with proteins from ticks, which confirms association between tick feeding and Alpha-Gal syndrome (Apostolovic et al. 2020).

Currently, Bm86 glycoprotein is the only tick antigen commercially developed as a vaccine that protects immunised cattle from tick infestation and partially blocks transmission of *Babesia*

parasites. We found that immunisation with specific epidermal growth factor (EGF)-like domains in Bm86 orthologues of the tick *Ixodes scapularis* partially affects tick feeding and moulting, as well as the survival of *B. burgdorferi* in the tick. As the Bm86 orthologues show significant sequence homology to closely related ticks such as the European tick *Ixodes ricinus*, they suggest strong potential for EGF domains as global vaccines (Koči et al. 2020).

In arthropods, the peritrophic membrane (PM) is an acellular structure that lines the intestinal epithelium and forms during the blood meal. Our study characterises the PM-associated chitin-binding protein of the tick *I. scapularis*, called PM_CBP. We found that suppression of PM_CBP expression reduces PM thickness and affects its integrity, leading to reduced feeding by the tick. Furthermore, PM_CBP antibodies affect the overall microbial diversity in the tick intestine that also includes persistence of *Borrelia burgdorferi*. Our results point to the potential of PM_CBP antigen to be a component of future vaccines against ticks and tick-borne diseases, as well as an active substance in agrochemicals for pest control (Yang et al. 2020).

In SG of the tropical bont tick *Amblyomma variegatum*, we identified thrombin inhibitors belonging to a new class of so-called "variegin-like" peptides. We determined specific cells in SG that produce these peptides, as well as their structure and binding domains. One of these peptides called avathrin showed stronger antithrombin activity than hirulog-1 (bivalirudin), which is used in medical practice. Avathrin and other variegin-like peptides provide a broad basis for the development of more effective drugs to treat haemostasis disorders (Iyer et al. 2017, Patent No. WO2016204696A1).

d) Ecology and epidemiology of ticks and tick-borne pathogens

During the 7FP EDENext project collaboration led by Dr Rizzoli from Fondazione Edmund Mach, Italy, we studied ecology of emerging tick-borne pathogens and their horizontal and vertical spread into new foci within Europe. We demonstrated for the first time presence of some species of tick-borne pathogens in the mountainous regions of northern Italy and in different habitats in Slovakia, and identified various species of rodents as their reservoir hosts (Baráková et al. 2017, Rosso et al. 2017, Hamšíková et al. 2016a, b, 2017). Our results are extremely important for determining the risk of infection with tick-borne pathogens in different regions of Europe.

As part of the international collaboration, we monitored the density of ticks and their infection prevalence with selected tick-borne pathogens in various habitat types across different European countries. We showed that tick activity was significantly associated with climatic conditions and not land use categories. Different pathogens showed various density in infected nymphs and depended on the degree of anthropization. These results contribute to a better understanding of acarological hazard for *I. ricinus*-transmitted pathogens in Central Europe (Rosá et al. 2018).

e) Ecology of host-parasite and host-commensal interactions

In collaboration with scientists from the Spanish Experimental Institute for Desert Zones (CSIC), we studied ecology of blood parasitic haemosporidia (Protozoa: Apicomplexa) in a long-distance bird migrant, the European roller (*Coracias garrulus*). Molecular screening of blood-sucking parasites was used as a unique approach to determine their abundance. Our work confirmed the presence of several blood parasites, including *Plasmodium* sp. which was detected for the first time in the roller (Václav et al. 2016).

The role of parasites on development of bird nestlings have been well documented. However, influence of insect nesting fauna on bird fitness has not been experimentally investigated. Our experiments confirmed that increased number of saprophagous larvae of *Fannia* spp. had a positive effect on body conditions of the European bee-eater (*Merops apiaster*) nestlings due to decomposition of biological material in the nests. In this way, the larvae compensated for the bee-eaters' lack of nest hygiene behaviour (Krištofík et al. 2016).

f) Parasites shape human behaviour

Emotions protect people against pathogen contamination. Our recent research suggests that antipathogen strategies relate to political attitudes, with more ideologically conservative individuals reporting more disgust toward pathogen cues and with higher parasite stress nations being, on average, more conservative. We found that national parasite stress and individual disgust sensitivity relate more strongly to adherence to traditional norms than they relate to

support for barriers between social groups. These results suggest that the relationship between pathogens and politics reflects intragroup motivations more than intergroup motivations (Tybur et al. 2016, in PNAS).

g) Evolution of insects

We have conducted two studies whose results have contributed significantly to our knowledge of insect evolution and have been published in the prestigious journal *Gondwana Research*. Global analysis of all aquatic organisms (300-98 million years; and living equivalents) with 6,000 aquatic records of insects showed inability of aquatic insects to invade the land. The ratio of aquatic to terrestrial insects stabilised during the Triassic and has remained constant since - the majority of aquatic lineages still survive. Insects invaded the water 236 times but never returned. This is important because it contrasts sharply with vertebrates and challenges the hypothesis that terrestrial insects evolved from aquatic ones (Vršanský et al. 2019).

We found that evolution in caves is initially dynamic and produce bizarre forms. However, this specialized evolution is followed by extinction that encompasses all cave systems. All living cave biotas are modern, from the Cenozoic (usually under 30 Ma) and vast majority are only up to 3 million years old. The only exception is the cave cockroach from the Myanmar amber. In all caves (even the perfectly protected ones), a mass extinction took place. Our discovery is important because it shows that evolution in caves was subject to different evolutionary principles caused by specialisation of small populations (Sendi et al. 2020).

h) Biodiversity

Our taxonomic and phylogenetic studies help to understand the boundaries between related and sibling taxa and provides a tool for correct identification of species, including those important to humans. Data obtained on distribution and ecology of taxa studied also provide a solid basis for conservation institutions. Among numerous publications dealing with diversity of invertebrates, the monograph on all species of the family Ameroseiidae (Acari: Mesostigmata) stands out for its scope. This family of mites comprises a total of 12 valid genera and 206 named species distributed worldwide. The monograph contains specific descriptions and diagnoses of the analysed taxa (including one new genus, 3 new species, 23 new combinations and 27 new junior synonymies), revisions of taxonomically doubtful species and identification keys illustrated with original photographs, as well as comments on the morphology, taxonomy, chorology and ecology of individual species (Mašán 2017).

i) Pest management

Tsetse flies are found in most parts of sub-Saharan Africa, where they transmit pathogens that cause African trypanosomiasis in humans and animals. In collaboration with the International Atomic Energy Agency in Austria we developed the sterile insect technique (SIT) to eliminate tsetse flies. A campaign is currently underway in Senegal for the integrated pest management of *Glossina palpalis gambiensis* using SIT. Our protocol allows close monitoring of the quality of sterile male tsetse flies used in programmes under the Pan-African Tsetse and Trypanosomiasis Eradication Campaign (Pagabeleguem et al. 2016). In addition, we analysed genes related to host-seeking, reproduction and lactation in the genomes of several tsetse fly species. Lactation-associated genes are conserved in all species of the *Glossina* genus, while male testis proteins evolved rapidly. Olfactory and odour genes were reduced throughout the genus compared to other insects. Rhodopsin genes associated with vision show that motion recognition functions are conserved and colour recognition varies in the blue wavelength range. These results provide a basis for further investigation and protection against the transmission of trypanosomiasis in animals and humans (Attardo et al. 2019, in *Genome Biology*).

j) Nature conservation

We conducted several studies to improve habitat conditions for threatened birds and mammals in the cultivated landscapes. The effects of habitat degradation and simplification have important consequences for population dynamics and species diversity, but these effects are relatively less studied than those of habitat loss. We studied species-habitat associations in bird species with

declining populations in soil-disturbed habitats of a post-mining landscape. As a result, specific management measures were proposed to improve the suitability of breeding habitats in degraded landscapes (Šálek et al. 2019). In another study, we showed the importance of natural nesting sites for a cavity-nesting bird species to maintain suitable breeding habitats. Therefore, we propose specific management measures to increase the suitability of natural nesting sites (Valera et al. 2019).

Habitat complexity and biodiversity have also declined sharply in agricultural landscapes over the last century. One radical change is the loss of linear vertical vegetation structures, such as hedge rows or tree lines, and the concomitant loss of unmanaged habitats on agricultural land. We found that isolated habitats under electricity pylons serve as hotspots for biodiversity and provide permanent habitats for small mammals to overwinter and disperse in spring (Šálek et al. 2020).

Our research team also participated in restoring the original character of meandering rivers to achieve a dynamic equilibrium of the ecosystem and improve the diversity of natural floodplain habitats. We applied and calibrated the Floodplain Index in the Danube floodplain, a tool for assessing lateral waters based on macroinvertebrates and their habitat preferences (Šporka et al. 2016). The index is frequently used in the context of revitalisation measures in floodplain rivers throughout Europe. Its application provides important data for the currently implemented revitalisation of the Danube river in Slovakia.

We also contributed to the database of Austria's benthic invertebrates (*Fauna Aquatica Austriaca*). The database is used for assessment of the ecological status of flowing waters in European countries and their research institutions. The database was also used in assessment of the Čierny Váh hydropower plant (Kokavec et al. 2017). Our results are important for further consideration of environmental changes related to planned construction of hydropower plants.

2.1.9. Table of research outputs

Papers from international collaborations in large-scale scientific projects (Dwarf team, ALICE Collaboration, ATLAS collaboration, CD Collaboration, H1 Collaboration, HADES Collaboration, and STAR Collaboration) have to be listed separately

Scientific publications	2016			2017			2018			2019			2020			2021			total			
	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	No. / FTE researches	No. / one million total salary budget	number	averaged number per year	av. No. / FTE researches	av. No. / one million total salary budget
Scientific monographs and monographic studies in journals and proceedings published abroad (AAA, ABA)	0	0,000	0,000	1	0,051	1,325	2	0,106	2,384	1	0,050	1,041	2	0,108	1,896	3	0,147	2,896	9	1,500	0,078	1,683
Scientific monographs and monographic studies in journals and proceedings published in Slovakia (AAB, ABB)	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	1	0,050	1,041	2	0,108	1,896	0	0,000	0,000	3	0,500	0,026	0,561
Chapters in scientific monographs published abroad (ABC)	1	0,055	1,422	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	1	0,167	0,009	0,187
Chapters in scientific monographs published in Slovakia (ABD)	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0,000
Scientific papers published in journals registered in Current Contents Connect (ADCA, ADCB, ADDA, AADB)	44	2,418	62,589	32	1,644	42,384	46	2,434	54,827	32	1,607	33,299	39	2,106	36,967	43	2,102	41,506	236	39,333	2,044	44,120
Scientific papers published in journals registered in Web of Science Core Collection and SCOPUS not listed above (ADMA, ADMB, ADNA, ADN B)	12	0,659	17,070	10	0,514	13,245	13	0,688	15,495	11	0,552	11,446	5	0,270	4,739	5	0,244	4,826	56	9,333	0,485	10,469
Scientific papers published in other foreign journals (not listed above) (ADEA, ADEB)	4	0,220	5,690	3	0,154	3,974	2	0,106	2,384	2	0,100	2,081	3	0,162	2,844	0	0,000	0,000	14	2,333	0,121	2,617
Scientific papers published in other domestic journals (not listed above) (ADFA, ADFB)	5	0,275	7,112	12	0,616	15,894	3	0,159	3,576	6	0,301	6,243	9	0,486	8,531	4	0,196	3,861	39	6,500	0,338	7,291
Scientific papers published in foreign peer-reviewed proceedings (AECA)	4	0,220	5,690	0	0,000	0,000	1	0,053	1,192	0	0,000	0,000	1	0,054	0,948	0	0,000	0,000	6	1,000	0,052	1,122
Scientific papers published in domestic peer-reviewed proceedings (AEDA)	2	0,110	2,845	0	0,000	0,000	1	0,053	1,192	3	0,151	3,122	0	0,000	0,000	0	0,000	0,000	6	1,000	0,052	1,122
Published papers (full text) from foreign scientific conferences (AFA, AFC)	0	0,000	0,000	1	0,051	1,325	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	0	0,000	0,000	1	0,167	0,009	0,187
Published papers (full text) from domestic scientific conferences (AFB, AFD)	17	0,934	24,182	5	0,257	6,623	3	0,159	3,576	1	0,050	1,041	3	0,162	2,844	3	0	3	32	5	0	6

2.2. Measures of research outputs (citations, etc.)

2.2.1. Table with citations per annum (without self-citations)

Citations of papers from international collaborations in large-scale scientific projects (Dwarf team, ALICE Collaboration, ATLAS collaboration, CD Collaboration, H1 Collaboration, HADES Collaboration, and STAR Collaboration) are listed separately

Citations, reviews	2015		2016		2017		2018		2019		2020		total		
	number	No. / FTE researchers	number	averaged number per year	av. No. / FTE researchers										
Citations in Web of Science Core Collection (1.1, 2.1)	1 018	55,93	1 078	55,37	1 296	68,57	1 330	66,80	1 526	82,40	1 462	71,46	7 710	1 285,00	66,78
Citations in SCOPUS (1.2, 2.2) if not listed above	179	9,84	262	13,46	273	14,44	271	13,61	278	15,01	409	19,99	1 672	278,67	14,48
Citations in other citation indexes and databases (not listed above) (3.2,4.2)	1	0,05	5	0,26	6	0,32	11	0,55	12	0,65	1	0,05	36	6,00	0,31
Other citations (not listed above) (3.1, 4.1)	193	10,60	131	6,73	98	5,19	119	5,98	142	7,67	161	7,87	844	140,67	7,31
Reviews (5,6)	0	0,00	2	0,10	0	0,00	0	0,00	0	0,00	0	0,00	2	0,33	0,02

2.2.2. List of 10 most-cited publications published any time with the address of the institute, with number of citations in the assessment period (2015 – 2020)

- [1] ADMA01 000001
MEDLOCK, Jolyon** - HANSFORD, Kayleigh M - BORMANE, A. - DERDÁKOVÁ, Markéta - ESTRADA-PEÑA, Agustín - GEORGE, Jean-Claude - GOLOVLJOVA, I. - JAENSON, Thomas G.T. - JENSEN, Jens-Kjeld - JENSEN, Per M. - KAZIMÍROVÁ, Mária - OTEO, José A. - PAPA, A. - PFISTER, Kurt - PLANTARD, Olivier - RANDOLPH, S.E. - RIZZOLI, Annapaola - SANTOS-SILVA, Maria Margarida - SPRONG, H. - VIAL, Laurence - HENDRICKX, Guy - ZELLER, H. - VAN BORTEL, Wim. Driving forces for changes in geographical distribution of Ixodes ricinus ticks in Europe. In *Parasites & vectors*, 2013, vol. 6, iss. 1, art. no. 1, 11 pp. (2012: 3.246 - IF, Q1 - JCR, 1.224 - SJR, Q1 - SJR). ISSN 1756-3305.
Number of citation (2015-2020): 212
- [2] ADMB01 000002
RIZZOLI, Annapaola - SILAGHI, Cornelia - OBIEGALA, Anna - RUDOLF, I. - HUBÁLEK, Zdeněk - FÖLDVÁRI, Gabor - PLANTARD, Olivier - VAYSSIER-TAUSSAT, Muriel - BONNET, Sarah - ŠPITÁLSKA, Eva - KAZIMÍROVÁ, Mária. Ixodes ricinus and its transmitted pathogens in urban and peri-urban areas in Europe: new hazards and relevance for public health. In *Frontiers in Public Health*, 2014, vol. 2, p. 251. ISSN 2296-2565.
Number of citation (2015-2020): 190
- [3] ADCA01 000003
XIA, Qingyou - WANG, Jun - ZHOU, Zeyang - LI, Ruiqiang - FAN, Wei - CHENG, Daojun - CHENG, Tingcai - QIN, Junjie - DUAN, Jun - XU, Hanfu - LI, Qibin - LI, Ning - WANG, Mingwei - DAI, Fangyin - LIU, Chun - LIN, Ying - ZHAO, Ping - ZHANG, Huijie - LIU, Shiping - ZHA, Xingfu - LI, Chunfeng - ZHAO, Aichun - PAN, Minhui - PAN, Guoqing - SHEN, Yihong - GAO, Zhihong - WANG, Zilong - WANG, Genhong - WU, Zhengli - HOU, Yong - CHAI, Chunli - YU, Quanyou - HE, Ningjia - ZHANG, Z. - LI, Songgang - YANG, Huanming - LU, Cheng - WANG, Jian - XIANG, Zhonghuai - MITA, Kazuei - KASAHARA, Masahiro - NAKATANI, Yoichiro - YAMAMOTO, Kimiko - ABE, Hiroaki - AHSAN, Brudrul - DAIMON, Takaaki - DOI, Koichiro - FUJII, Tsuguru - FUJIWARA, Haruhiko - FUJIYAMA, Asao - FUTANASHI, R. - HASHIMOTO, Shin-ichi - ISHIBASHI, Jun - IWAMI, Masafumi - KADONO-OKUDAF, Keiko - KANAMORI, Hiroyuki - KATAOKA, Hiroshi - KATSUMA, Susumu - KAWAOKA, Shinpei - KAWASAKI, Hideki - KOHARA, Yuji - KOZAKI, T. - KUROSHU, Reginaldo M. - KUWAZAKI, Seigo - MATSUSHIMA, Kouji - MINAMI, Hiroshi - NAGAYASU, Yukinobu - NAKAGAWA, Tatsuro - NARUKAWA, Junko - NOHATA, Junko - OHISHI, Kazuko - ONO, Yukiteru - OSANAI-FUTAHASHI, Mizuko - OZAKI, Katsuhisa - QU, Wei - ROLLER, Ladislav - SASAKI, Shin - SASAKI, Takuji - SEINO, Atsushi - SHINOMURA, M. - TADASU, Shin-i - SHINODA, Tetsuro - SHIOTSUKI, Takahiro - SUETSUGU, Yoshitaka - SUGANO, Sumio - SUWA, Makiko - SUZUKI, Yutaka - TAKIYA, Shigeharu - TAMURA, Toshiki - TANAKA, Hiromitsu - TANAKA, Yoshiaki - TOUHARA, Kazushige - YAMADA, Tomoyuki - YAMAKAWA, Minoru - YAMANAKA, Naoki - YOSHIKAWA, Hiroshi - ZHONG, Yang-Sheng - SHIMADA, Toru - MORISHITA, Shinichi. The genome of a lepidopteran model insect, the silkworm Bombyx mori. International Silkworm Genome Consortium. In *Insect Biochemistry and Molecular Biology*, 2008, vol. 38, p. 1036-1145. ISSN 0965-1748.
Number of citation (2015-2020): 173
- [4] ADMB01 000004
KAZIMÍROVÁ, Mária - ŠTIBRÁNIOVÁ, Iveta. Tick salivary compounds: their role in modulation of host defences and pathogen transmission. In *Frontiers in Cellular and Infection Microbiology / Front. Cell. Infect. Microbiol. : Specialty Journal of Frontiers in Microbiology*, 2013, vol. 3, article 43, 19 p. ISSN 2235-2988.
Number of citation (2015-2020): 159

- [5] ADCA01 000005
ČIČKOVÁ, Helena - NEWTON, Larry G. - LACY, Curt R. - KOZÁNEK, Milan. The use of fly larvae for organic waste treatment. : review. In *Waste Management*, 2015, vol. 35, no. __, p. 68–80. (2014: 3.220 - IF, Q1 - JCR, 1.763 - SJR, Q1 - SJR, karentované - CCC). (2015 - Current Contents). ISSN 0956-053X.
Number of citation (2015-2020): 159
- [6] ADCA02 000006
MICHALKOVÁ, Veronika - MEMBERS OF THE INTERNATIONAL GLOSSINA GENOME INITIATIVE. Genome sequence of the tsetse fly (*Glossina morsitans*): vector of African trypanosomiasis. Michalková V. (spoluautor). In *Science*, 2014, vol. 344, no. 6182, p. 380-386. (2013: 31.477 - IF, Q1 - JCR, 12.305 - SJR, Q1 - SJR, karentované - CCC). (2014 - Current Contents). ISSN 0036-8075.
Number of citation (2015-2020): 96
- [7] ADCA03 000007
ROLLER, Ladislav - YAMANAKA, Naoki - WATANABE, Ken - DAUBNEROVÁ, Ivana - ŽITŇAN, Dušan - KATAOKA, Hiroshi - TANAKA, Yoshiaki. The unique evolution of neuropeptide genes in the silkworm *Bombyx mori*. In *Insect Biochemistry and Molecular Biology*, 2008, vol. 38, no. 12, p. 1147-1157. (2007: 2.827 - IF, Q1 - JCR, 1.608 - SJR, Q1 - SJR). ISSN 0965-1748.
Number of citation (2015-2020): 85
- [8] ADCA04 000008
HANINCOVÁ, Klára - SCHÄFFER, S.M. - ETTI, S. - SEWELL, H.S. - TARAGELOVÁ, Veronika - ŽIAK, Dalimír - LABUDA, Milan - KURTENBACH, K. Association of *Borrelia afzelii* with rodents in Europe. In *Parasitology*, 2003, vol. 126, p. 11-20 Part 1. (2002: 1.828 - IF, karentované - CCC). (2003 - Current Contents). ISSN 0031-1820.
Number of citation (2015-2020): 79
- [9] ADCA05 000009
 CHARREL, R.N. - ATTOUI, H. - BUTENKO, A.M. - CLEGG, J.C. - DEUBEL, V. - FROLOVA, T.V. - GOULD, E.A. - GRITSUN, T.S. - HEINZ, F.X. - LABUDA, Milan - LASHKEVICH, V.A. - LOKTEV, V. - LUNDKVIST, A. - LVOV, D.V. - MANDL, C.W. - NIEDRIG, M. - PAPA, A. - PETROV, V.S. - PLYUSNIN, A. - RANDOLPH, S. - SUSS, J. - ZLOBIN, V.I. - DE LAMBALLERIE, X. Tick borne virus diseases of human interest in Europe. In *Clinical Microbiology and Infection*, 2004, vol. 10, no. 12, p. 1040-1055. (2003: 2.238 - IF). ISSN 1198-743X.
Number of citation (2015-2020): 77
- [10] ADCA06 000010
 RUBEL, Franz - BRUGGER, Katharina - PFEFFER, Martin - CHIŢIMIA-DOBLER, Lidia - DIDYK, Yuliya - LEVERENZ, Sandra - DAUTEL, Hans. Geographical distribution of *Dermacentor marginatus* and *Dermacentor reticulatus* in Europe. In *Ticks and Tick-Borne Diseases*, 2016, vol. 7, p. 224-233. (2015: 2.690 - IF, Q2 - JCR, 1.248 - SJR, Q1 - SJR, karentované - CCC). (2016 - Current Contents). ISSN 1877-959X.
Number of citation (2015-2020): 73

2.2.3. List of 10 most-cited publications published any time with the address of the institute, with number of citations obtained until 2020

- [1] ADCA01 000001
 XIA, Qingyou - WANG, Jun - ZHOU, Zeyang - LI, Ruiqiang - FAN, Wei - CHENG, Daojun - CHENG, Tingcai - QIN, Junjie - DUAN, Jun - XU, Hanfu - LI, Qibin - LI, Ning - WANG, Mingwei - DAI, Fangyin - LIU, Chun - LIN, Ying - ZHAO, Ping - ZHANG, Huijie - LIU, Shiping - ZHA, Xingfu - LI, Chunfeng - ZHAO, Aichun - PAN, Minhui - PAN, Guoqing - SHEN, Yihong - GAO, Zhihong - WANG, Zilong - WANG,

Genhong - WU, Zhengli - HOU, Yong - CHAI, Chunli - YU, Quanyou - HE, Ningjia - ZHANG, Z. - LI, Songgang - YANG, Huanming - LU, Cheng - WANG, Jian - XIANG, Zhonghuai - MITA, Kazuei - KASAHARA, Masahiro - NAKATANI, Yoichiro - YAMAMOTO, Kimiko - ABE, Hiroaki - AHSAN, Brudrul - DAIMON, Takaaki - DOI, Koichiro - FUJII, Tsuguru - FUJIWARA, Haruhiko - FUJIYAMA, Asao - FUTANASHI, R. - HASHIMOTO, Shin-ichi - ISHIBASHI, Jun - IWAMI, Masafumi - KADONO-OKUDAF, Keiko - KANAMORI, Hiroyuki - KATAOKA, Hiroshi - KATSUMA, Susumu - KAWAOKA, Shinpei - KAWASAKI, Hideki - KOHARA, Yuji - KOZAKI, T. - KUROSHU, Reginaldo M. - KUWAZAKI, Seigo - MATSUSHIMA, Kouji - MINAMI, Hiroshi - NAGAYASU, Yukinobu - NAKAGAWA, Tatsuro - NARUKAWA, Junko - NOHATA, Junko - OHISHI, Kazuko - ONO, Yukiteru - OSANAI-FUTAHASHI, Mizuko - OZAKI, Katsuhisa - QU, Wei - ROLLER, Ladislav - SASAKI, Shin - SASAKI, Takuji - SEINO, Atsushi - SHINOMURA, M. - TADASU, Shin-i - SHINODA, Tetsuro - SHIOTSUKI, Takahiro - SUETSUGU, Yoshitaka - SUGANO, Sumio - SUWA, Makiko - SUZUKI, Yutaka - TAKIYA, Shigeharu - TAMURA, Toshiki - TANAKA, Hiromitsu - TANAKA, Yoshiaki - TOUHARA, Kazushige - YAMADA, Tomoyuki - YAMAKAWA, Minoru - YAMANAKA, Naoki - YOSHIKAWA, Hiroshi - ZHONG, Yang-Sheng - SHIMADA, Toru - MORISHITA, Shinichi. The genome of a lepidopteran model insect, the silkworm *Bombyx mori*. International Silkworm Genome Consortium. In *Insect Biochemistry and Molecular Biology*, 2008, vol. 38, p. 1036-1145. ISSN 0965-1748. **(340 citations)**

- [2] ADMA01 000002
 MEDLOCK, Jolyon** - HANSFORD, Kayleigh M - BORMANE, A. - DERDÁKOVÁ, Markéta - ESTRADA-PEÑA, Agustín - GEORGE, Jean-Claude - GOLOVLJOVA, I. - JAENSON, Thomas G.T. - JENSEN, Jens-Kjeld - JENSEN, Per M. - KAZIMÍROVÁ, Mária - OTEO, José A. - PAPA, A. - PFISTER, Kurt - PLANTARD, Olivier - RANDOLPH, S.E. - RIZZOLI, Annapaola - SANTOS-SILVA, Maria Margarida - SPRONG, H. - VIAL, Laurence - HENDRICKX, Guy - ZELLER, H. - VAN BORTEL, Wim. Driving forces for changes in geographical distribution of *Ixodes ricinus* ticks in Europe. In *Parasites & vectors*, 2013, vol. 6, iss. 1, art. no. 1, 11 pp. (2012: 3.246 - IF, Q1 - JCR, 1.224 - SJR, Q1 - SJR). ISSN 1756-3305. **(253 citations)**
- [3] ADMB01 000003
 RIZZOLI, Annapaola - SILAGHI, Cornelia - OBIEGALA, Anna - RUDOLF, I. - HUBÁLEK, Zdeněk - FÖLDVÁRI, Gabor - PLANTARD, Olivier - VAYSSIER-TAUSSAT, Muriel - BONNET, Sarah - ŠPITÁLSKA, Eva - KAZIMÍROVÁ, Mária. *Ixodes ricinus* and its transmitted pathogens in urban and peri-urban areas in Europe: new hazards and relevance for public health. In *Frontiers in Public health*, 2014, vol. 2, p. 251. ISSN 2296-2565. **(190 citations)**
- [4] ADCA01 000004
ROLLER, Ladislav - YAMANAKA, Naoki - WATANABE, Ken - DAUBNEROVÁ, Ivana - ŽITŇAN, Dušan - KATAOKA, Hiroshi - TANAKA, Yoshiaki. The unique evolution of neuropeptide genes in the silkworm *Bombyx mori*. In *Insect Biochemistry and Molecular Biology*, 2008, vol. 38, no. 12, p. 1147-1157. (2007: 2.827 - IF, Q1 - JCR, 1.608 - SJR, Q1 - SJR). ISSN 0965-1748. **(171 citations)**
- [5] ADMB01 000005
KAZIMÍROVÁ, Mária - ŠTIBRÁNIOVÁ, Iveta. Tick salivary compounds: their role in modulation of host defences and pathogen transmission. In *Frontiers in Cellular and Infection Microbiology / Front. Cell. Infect. Microbiol. : Specialty Journal of Frontiers in Microbiology*, 2013, vol. 3, article 43, 19 p. ISSN 2235-2988. **(171 citations)**
- [6] ADCA01 000006
ŽITŇAN, Dušan - KINGAN, T.G. - HERMESMAN, J.L. - ADAMS, M.E. Identification of ecdysis-triggering hormone from an epitracheal endocrine system. In *Science*, 1996, vol. 271, no. 5245, p. 88-91. ISSN 0036-8075. **(159 citations)**

- [7] ADCA02 000007
ČIČKOVÁ, Helena - NEWTON, Larry G. - LACY, Curt R. - KOZÁNEK, Milan. The use of fly larvae for organic waste treatment. : review. In *Waste Management*, 2015, vol. 35, no. __, p. 68–80. (2014: 3.220 - IF, Q1 - JCR, 1.763 - SJR, Q1 - SJR, karentované - CCC). (2015 - Current Contents). ISSN 0956-053X. **(158 citations)**
- [8] ADCA03 000008
 KIM, Y. J. - ŽITŇAN, Dušan - GALIZIA, C.G. - CHO, K.H. - ADAMS, M.E. A command chemical triggers an innate behavior by sequential activation of multiple peptidergic ensembles. In *Current Biology*, 2006, vol. 16, no. 14, p. 1395-1407. (2005: 11.732 - IF, Q1 - JCR, 5.970 - SJR, Q1 - SJR). ISSN 0960-9822. **(142 citations)**
- [9] ADCA04 000009
HANINCOVÁ, Klára - TARAGEL'OVÁ, Veronika - KOČI, Juraj - SCHÄFFER, S.M. - HAILS, R. - ULLMANN, A.J. - PIESMAN, J. - LABUDA, Milan - KURTENBACH, K. Association of *Borrelia garinii* and *B. valaisiana* with songbirds in Slovakia. In *Applied and Environmental Microbiology*, 2003, vol. 69, no. 5, p. 2825-2830. (2002: 3.691 - IF, karentované - CCC). (2003 - Current Contents). ISSN 0099-2240. **(142 citations)**
- [10] ADCA05 000010
 YAMANAKA, Naoki - YAMAMOTO, Sachie - ŽITŇAN, Dušan - WATANABE, Ken - KAWADA, Tsuyoshi - SATAKE, Honoo - KANEKO, Yu - HIRUMA, Kiyoshi - TANAKA, Yoshiaki - SHINODA, Tetsuro - KATAOKA, Hiroshi. Neuropeptide Receptor Transcriptome Reveals Unidentified Neuroendocrine Pathways. In *PLoS ONE*, 2008, vol. 3, no.8, e3048. 12 pp. (2007: 1.379 - SJR, Q1 - SJR). **(142 citations)**

2.2.4. List of 10 most-cited publications published during the evaluation period (2016-2021) with the address of the Institute, with number of citations obtained until 2021

- [1] ADMA01 000001
 ŠIMO, Ladislav - KAZIMÍROVÁ, Mária - RICHARDSON, Jennifer - BONNET, Sarah I. The Essential Role of Tick Salivary Glands and Saliva in Tick Feeding and Pathogen Transmission. : Review. In *Frontiers in Cellular and Infection Microbiology : Specialty Journal of Frontiers in Microbiology.*, 2017, vol. 7, article no. 281, 23 pp. (2016: 4.300 - IF, Q1 - JCR, 2.311 - SJR, Q1 - SJR). ISSN 2235-2988. **(115 citations)**
- [2] ADCA01 000002
 RUBEL, Franz - BRUGGER, Katharina - PFEFFER, Martin - CHIŤIMIA-DOBLER, Lidia - DIDYK, Yuliya - LEVERENZ, Sandra - DAUTEL, Hans. Geographical distribution of *Dermacentor marginatus* and *Dermacentor reticulatus* in Europe. In *Ticks and Tick-Borne Diseases*, 2016, vol. 7, p. 224-233. (2015: 2.690 - IF, Q2 - JCR, 1.248 - SJR, Q1 - SJR, karentované - CCC). (2016 - Current Contents). ISSN 1877-959X. **(105 citations)**
- [3] ADCA02 000003
 CROUS, P.W. - WINGFIELD, M.J. - BURGESS, T.I. - KAUTMAN, Václav - KAUTMANOVÁ, Ivona - KOZÁNEK, Milan - SEMELBAUER, Marek - WRZOSEK, M. - ZOTHANZAMA, J. - GROENEWALD, J.Z. Fungal Planet description sheets: 558–624. In *Persoonia*, 2017, vol. 38, p. 240–384. (2016: 7.511 - IF, Q1 - JCR, 4.487 - SJR, Q1 - SJR, karentované - CCC). (2017 - Current Contents). ISSN 0031-5850. **(82 citations)**
- [4] ADCA03 000004
 TYBUR, Joshua M. - INBAR, Yoel - AARØE, Lene - BARCLAY, Pat - BARLOWE, Fiona Kate - DE BARRA, Mícheál - BECKERH, Vaughn D. - BOROVOI, Leah - CHOI, Incheol - CHOI, Jong An - CONSEDINE, Nathan S. - CONWAY, Alan - CONWAY, Jane Rebecca - CONWAY, Paul - ADORIC, Vera Cubela - DEMIRCI,

- Dilara Ekin - FERNÁNDEZS, Ana María - FERREIRA, Diogo Conque Seco - ISHII, Keiko - JAKŠIĆ, Ivana - VAN LEEUWEN, Florian - LEWIS, David M. G. - LI, Norman P. - MCINTYRE, Jason C. - MUKHERJEE, Sumitava - PARK, Justin H. - PAWLOWSKI, Boguslaw - PETERSEN, Michael Bang - PIZARRO, David - PRODROMITIS, Gerasimos - PROKOP, Pavol - RANTALA, Markus J. et al. Parasite stress and pathogen avoidance relate to distinct dimensions of political ideology across 30 nations. In *Proceedings of the National Academy of Sciences of the United States of America*, 2016, vol. 113, no. 44, p. 12408-12413. (2015: 9.423 - IF, Q1 - JCR, 6.814 - SJR, Q1 - SJR, karentované - CCC). (2016 - Current Contents). ISSN 0027-8424. **(80 citations)**
- [5] ADMA01 000005
KAZIMÍROVÁ, Mária - THANGAMANI, Saravanan - BARTÍKOVÁ, Pavlína - HERMANČE, Meghan - HOLÍKOVÁ, Viera - ŠTIBRÁNIOVÁ, Iveta - NUTTALL, Patricia A. Tick-Borne Viruses and Biological Processes at the Tick-Host-Virus Interface. In *Frontiers in Cellular and Infection Microbiology : Specialty Journal of Frontiers in Microbiology.*, 2017, vol. 7, art. no. 339, 21 pp. (2016: 4.300 - IF, Q1 - JCR, 2.311 - SJR, Q1 - SJR). ISSN 2235-2988. **(44 citations)**
- [6] ADCA01 000006
WALTER, Kathryn, V. - CONROY-BEAM, Daniel - BUSS, David M. - ASAO, Kelly - SOROKOWSKA, Agnieszka - SOROKOWSKI, Piotr - SARMÁNY-SCHULLER, Ivan - SCHMEHL, Susane - SHARAD, Shivantika - PROKOP, Pavol. Sex Differences in Mate Preferences Across 45 Countries: A Large-Scale Replication. In *Psychological Science*, 2020, vol. 31, no. 4, p. 408-423. (2019: 5.389 - IF, Q1 - JCR, 3.303 - SJR, Q1 - SJR, karentované - CCC). (2020 - Current Contents). ISSN 0956-7976. **(36 citations)**
- [7] ADCA02 000007
DOUDOUMIS, Vangelis - BLOW, Frances - SARIDAKI, Aggeliki - AUGUSTINOS, Antonios A. - DYER, Naomi A. - GOODHEAD, Ian - SOLANO, Philippe - RAYAISSE, Jean Baptiste - TAKÁČ, Peter - MEKONNEN, Solomon - PARKER, Andrew Gordon - ABD-ALLA, Adly M. M. - DARBY, Alistair Charles - BOURTZIS, Kostas - TSIAMIS, George. Challenging the Wigglesworthia, Sodalis, Wolbachia symbiosis dogma in tsetse flies: Spiroplasma is present in both laboratory and natural populations. In *Scientific Reports*, 2017, vol. 7, iss. 1., article no. 4699. 13 pp. (2016: 4.259 - IF, Q1 - JCR, 1.692 - SJR, Q1 - SJR, karentované - CCC). (2017 - Current Contents). ISSN 2045-2322. **(31 citations)**
- [8] ADMA01 000008
HAMŠÍKOVÁ, Zuzana - KAZIMÍROVÁ, Mária - HARUŠTIAKOVÁ, Danka - MAHRÍKOVÁ, Lenka - SLOVÁK, Mirko - BERTHOVÁ, Lenka - KOCIANOVÁ, Elena - SCHNITTGER, Leonhard. Babesia spp. in ticks and wildlife in different habitat types of Slovakia. In *Parasites & vectors*, 2016, vol. 9, iss. 1, art. no. 92, 14 pp. (2015: 3.234 - IF, Q1 - JCR, 1.720 - SJR, Q1 - SJR). ISSN 1756-3305. **(31 citations)**
- [9] ADCA01 000009
ČONDLOVÁ, Šárka - HORČIČKOVÁ, Michaela - SAK, Bohumil - KVĚTONOVÁ, Dana - HLÁSKOVÁ, Lenka - KONEČNÝ, Roman - STANKO, Michal - MCEVOY, John - KVÁČ, M.**. Cryptosporidium apodemi sp. n. and Cryptosporidium ditrichi sp. n. (Apicomplexa: Cryptosporidiidae) in Apodemus spp. In *European journal of Protistology*, 2018, vol. 63, p. 1-12. (2017: 2.430 - IF, Q3 - JCR, 0.897 - SJR, Q2 - SJR, karentované - CCC). (2018 - Current Contents). ISSN 0932-4739. **(30 citations)**
- [10] ADMA01 000010
JAARSMA, Ryanne I. - SPRONG, Hein - TAKUMI, K. - KAZIMÍROVÁ, Mária - SILAGHI, Cornelia - MYSTERUD, Atle - RUDOLF, Ivo - RELJA, Beck - FÖLDVÁRI, Gabor - TOMASSONE, Laura - GROENEVELT, Margit - EVERTS, Reinard - RIJKS, Jolianne M. - ECKE, Frauke - HORNFELDT, Birger - MODRÝ, David - MAJEROVÁ, Karolína - VOTÝPKA, Jan - ESTRADA-PEÑA, Agustín**. Anaplasma

phagocytophilum evolves in geographical and biotic niches of vertebrates and ticks. In *Parasites & vectors*, 2019, vol. 12, iss. 1, art. no. 328, 17 pp. (2018: 3.031 - IF, Q1 - JCR, 1.565 - SJR, Q1 - SJR). ISSN 1756-3305. (30 citations)

2.2.5. List of most-cited authors from the Institute (at most 10 % of average FTE researchers per year) and their number of citations in the assessment period (2015– 2020). The cited papers must bear the address of the institute

Author	Number of citation (2015-2020)
PROKOP, Pavol	1380
KAZIMÍROVÁ, Mária	1281
LABUDA, Milan	1174
ŽITŇAN, Dušan	770

2.2.6. List of most-cited authors from the Institute (at most 10 % of average FTE researchers per year) and their number of citations obtained until 2020. The cited papers must bear the address of the Institute

Author	Number of citation (until 2020)
PROKOP, Pavol	2061
ŽITŇAN, Dušan	1788
KAZIMÍROVÁ, Mária	1609
ROLLER, Ladislav	1199

2.2.7. List of most-cited authors from the Institute (at most 10 % of average FTE researchers per year) and their number of citations obtained until 2021 of their papers published during the evaluation period (2016– 2021). The cited papers must bear the address of the Institute

Author	Number of citation (until 2021; papers published 2016-2021)
KAZIMÍROVÁ, Mária	454
PROKOP, Pavol	334
DERDÁKOVÁ, Markéta	211
DIDYK, Yulia	165

2.3. Research status of the institute in international and national context

• **International/European position of the institute**

2.3.1. List of the most important research activities demonstrating the international relevance of the research performed by the institute, incl. major projects (details of projects should be supplied under Indicator 2.4). Max. 10 items for institute with less than 50 average FTE researchers per year, max. 20 for institutes with 50 – 100 average FTE researchers per year and so on

1) Ticks and Tick-borne diseases research programme

The aim is to study the biology, ecology and epidemiology of tick-borne infections and the role of rodents in their circulation. We established a long-term collaboration with laboratories from different European countries to improve and standardise methods for identifying species and strains of tick-borne microorganisms and to conduct studies on a larger scale (e.g. Dr Margos and Dr Fingerle from the National Reference Centre for Borrelia in Germany). The prevalence and geographical distribution of the Lyme disease group and relapsing fever spirochetes were determined in Slovakia and Germany (Bavaria) (Vencel et al. 2016). State-of-the-art techniques (MLST/MLSA) were used to determine the population structure, gene flow and spread of LB

spirochetes. Our results contributed to studies on the population structure of *B. burgdorferi* s.l. at the European level (Norte et al. 2021). We investigated short- and long-read technologies for their suitability for *Borrelia* genome assembly, with a particular focus on plasmids (Margos et al. 2017). Questing *I. ricinus* nymphs density and their infection rates with *Borrelia burgdorferi* s.l., *Anaplasma phagocytophilum* and *Rickettsia* spp. were investigated in five European countries (Italy, Germany, Czech Republic, Slovakia, Hungary) in relation to climatic and environmental factors (Rosá et al. 2019). These results contribute to a better understanding of the variation in acarological risk for pathogens transmitted by *I. ricinus* in different habitat types in Europe.

Projects: DAAD Project: Molecular Epidemiology of Lyme Borreliose (LB) spirochetes in Europe; Project ESCMID: Exploring the genomics tool box for tick-borne bacterial pathogens of the *Borrelia burgdorferi* sensu lato species complex; 7th FP project EDENext „Biology and control of vector-borne infections in Europe

Partners: e.g. Reference centre (NRZ) for *Borrelia* at the Bavarian Health and Food Safety authority (LGL), Oberschleissheim Germany; Medical University of Vienna, Austria; Research and Innovation Centre, Fondazione Edmund Mach, Italy

2) This programme includes research on fruit flies, mosquitoes and silkworms

We used methods of molecular biology, neurophysiology, confocal microscopy and transgenic insects to explore some basic principles of regulation of physiological and behavioural processes in animals. Our collaboration with laboratories at renowned research institutions have led to publications in high-impact journals. In the fly *D. melanogaster*, we have elucidated the signalling pathway of the neuropeptide allatostatin in the diurnal regulation of oogenesis. Our results suggest that allatostatin is the functional counterpart of vertebrate somatostatin (Zhang et al. 2021, in PNAS). Using transgenic mosquitoes with suppressed expression of specific enzymes in the synthesis of juvenile hormone in corpora allata, we showed that epoxidation of methyl farnesoate is a key innovation that confers a reproductive advantage to the insect (Nouzová et al. 2021, in PNAS). We also pointed to the role of two neuropeptides, allatotropin and RYamide, produced in midgut cells in modulation of feeding and digestion (Matsumoto et al. 2019, in PLOS One).

Partners: Gwangju Institute of Science and Technology, Buk-gu Gwangju, South Korea; Florida International University, USA; Tokyo University, Japan

3) Ecophysiology of fruit flies research programme

We examined effects of conditions during the early development of fruit flies on their later life. Together with our collaborative partners, we conducted four different studies that were published in first quartile journals. The first study showed that crowding alters energy metabolism and lifespan and that yeast supplementation reverses this effect (Klepsatel et al., 2018). The next study pointed to the role of developmental diet in adult fly reproduction and metabolism (Klepsatel et al. 2020a). The third project showed the importance of acclimation temperature, which significantly modulates the amount of stored fat and glycogen and the optimal temperature for their accumulation (Klepsatel et al. 2020b). In the fourth study, we tested competing hypotheses about the character of developmental thermal plasticity. The study showed that in *D. melanogaster*, development at a given temperature does not necessarily lead to a subsequent advantage in that thermal environment in terms of reproductive fitness (Klepsatel et al. 2019).

Partners: Department of Zoology, Stockholm University, Sweden and Department of Biosciences, Sri Sathya Sai Institute of Higher Learning, India

4) Ecology of host-parasite interactions research programme

The long-term collaboration with the lab of Dr. Francisco Valera addresses a wide range of questions on the ecology of avian parasites and pathogens as well as the hematophagous vectors of the pathogens. Currently, we focus on Diptera-borne avian haemosporidian parasites, to unravel and understand the host-parasite and vector-parasite associations at the local host community level. The host model system is dominantly represented by the European roller, a declining avian species of conservation importance. Consequently, the research also tackles selected questions about the ecology of European rollers, focusing on the determinants of variation in crucial life-history traits, such as reproductive performance, survival, sex ratios or hatching asynchrony, and the biotic and abiotic determinants of breeding habitat and nest-site selection.

Projects: CGL2014-55969-P: „Determinantes de la variación en las interacciones parasito-hospedador“; CGL2015-65055-P: „Consecuencias de las preferencias de alimentación de los mosquitos para la transmisión de patógenos de transmisión vectorial; PGC2018-097426-B-C22: "Efecto de las interacciones bióticas en las relaciones parásito-hospedador"

Partners: Estación Experimental de Zonas Áridas, CSIC, Spain; Estación Biológica Doñana, CSIC, Spain

5) Reproductive strategies, maternal investment and habitat selection research programme

The research programme, conducted in collaboration with Dr Hoi's laboratory, focused mainly on two related topics: 1) the importance of song quality in territorial defence at intraspecific and interspecific levels, and 2) eggshell characteristics and their relationship to the maternal immune system in relation to the diversity of major histocompatibility complex and maternal egg components. We have investigated these questions in three bird species native to Slovakia and published our results in several articles (Hoi et al. 2019, Darolová et al. 2020, 2021).

Partner: Konrad Lorenz Institute of Ethology, Department of Integrative Biology and Evolution, University of Veterinary Medicine, Vienna, Austria

6) Evolution of insects research programme

This programme focuses mainly on fossil cockroach research, which requires extensive collaboration with our partners worldwide. This fruitful collaboration has led to significant discoveries and the publication of a number of articles, some of which have appeared in high-impact journals. We found and described the only eusocial cockroaches known to date that live in highly organised states in the rainforest of Ecuador (Hinkelman et al. 2020). We also published the complex evaluation of fossils in the large Jurassic Bakhar deposit in Mongolia with strategic coal and uranium deposits (Vršanský 2020, Springer NATURE monograph). Within the framework of this programme, we have also contributed to the conservation of biotopes in various countries.

Partners: UNESCO ANKA synchrotron facility, Harvard University, Cambridge University, Chinese Academy of Sciences and many others

7) Research programme on haematophagous dipterans

This includes research on tsetse flies and the use of sterile insect technique (SIT) to eradicate sleeping sickness and Nagana in Africa. To expand our knowledge of the genes underlying biology of these flies and provide a rich body of knowledge for basic research and disease control, we have contributed to sequencing and annotation of the genomes of six tsetse species (Attardo et al. 2019, in Genome Biology). At the same time, we conducted research to improve the breeding characteristics of tsetse colonies and optimise the flight ability of sterile males to compete efficiently with wild tsetse males. In collaboration with Dr Noriega's team (Florida International University), we have also contributed to the understanding of molecular and biochemical basis of development and reproduction of mosquitoes, which are also important vectors of human pathogens (Nouzova et al. 2021 in PNAS, Tose et al. 2021).

Partners: Department of Epidemiology of Microbial Diseases, Yale School of Public Health, Yale University, New Haven, Connecticut, USA; Department of Biological Sciences, Biomolecular Science Institute, Florida International University, Miami, Florida, USA

2.3.2. List of international conferences (co)organised by the institute

None

2.3.3. List of edited proceedings from international scientific conferences

None

2.3.4. List of journals edited/published by the institute and information on their indexing in WOS, SCOPUS, other database or no database, incl. impact factor and other metrics of journals in each year of the assessment period

[1] **Biologia** (IF 2016 – 0.759; IF 2017 – 0.696; IF 2018 – 0.728; IF 2019 – 0.811, IF 2020 - 1.350)
5-year IF – 1.140

Indexed in: WOS (Current Contents / Agriculture, Biology & Environmental Sciences, Science Citation Index Expanded (SCIE)), SCOPUS, BIOSIS, Biological Abstracts, Zoological record, SCImago, Google Scholar

- **National position of the institute**

2.3.5. List of selected activities of national importance

[1] IZ SAS co-organised or organised several conferences at national level:

- V. Labudove dni [Labuda's days], Smolenice, Slovakia, 12.9.-14.9.2018, 53 participants from Central European countries, conference on arthropod parasites and pathogens transmitted by them.
- 13th Workshop of Hymenoptera specialists: Blanokrídlovce v českých zemiach a na Slovensku, 31.5. - 4.6. 2017, 24 participants from the Czech and Slovak Republics.
- 2nd Roubalove dni 2017 [Roubal's days], Banská Bystrica, Slovakia, 27.3.2017, conference of entomologists, zoologists and conservation biologists.

[2] Participation in advisory board: State Nature Conservation Agency Committee for monitoring of birds

[3] Expert reports for conservation bodies.

Title: Entomofaunal research in protected areas.

Addressee of the expert opinion: ŠOP SR, KÚ ŽP Nitra, KÚ ŽP Bratislava

Short description: Study of Symphyta fauna in small-scale areas – xerothermic habitats in the Malé Karpaty Protected Area in 2017 and salt marshes, sands and wetlands in the Lower Považie and Pohronie regions in 2018.

2.3.6. List of journals (published only in the Slovak language) edited/published by the institute and information on their indexing in WOS, SCOPUS, other database or no database, incl. impact factor and other metrics of journals in each year of the assessment period

[1] **Entomofauna Carpathica** – indexed by Zoological Record (Biosis), Google Scholar

- **Position of individual researchers in the international context**

2.3.7. List of invited/keynote presentations at international conferences, as documented by programme or invitation letter

[1] Roller, L., Gálíková, Z., Čižmír, D., Bednár, B., Daubnerová, I., Žitňan, D.: Expression and possible functions of neuropeptides trissin and RYamide inn the neuroendocrine system of Bombyx mori. Invertebrate Neuropeptide Conference 2016, Ouro Preto, Brazil.

[2] Žitňan, D., Daubnerová, I., Čižmár, D., Bednár, B., Roller, L.: Neuropeptide regulation of reproductive behaviors in Bombyx mori. ICE 2016 XXV International Congress of Entomology, Orlando, FL, USA.

- [3] Žitňan, D., Roller, L., Sveráková-Škodová, I., Morávková, S., Slovák, M.: Expression and functional analysis of neuropeptides in ticks. CECE 2016, 28th Conference of European Comparative Endocrinologists. Leuven, Belgium.
- [4] Kazimírová, M., Bartíková, P., Štibrániová, I. & Nuttall, P.A.: Tick salivary compounds and their role in pathogen transmission. SOVE 2017 - 7th International congress, Palma, Spain
- [5] Gáliková, M.: In search of a fly glucagon. In: Frontiers in Insect Physiology, České Budejovice, Česká republika, jún 2019.
- [6] Gáliková M. In search of a fly glucagon. In: Talk at Insect Research Colloquium, Biocentrum of the University of Würzburg, Germany. 2019.
- [7] Derdáková, M.: Ecological Aspect of Lyme borreliosis in Central Europe, SNÄFF meeting, Ystadt 3-5.6.2019, Švédsko
- [8] Mtierova, Z, Václav, R, Rusnakova-Taragelova, V., Didyk, Y., Mangová, B., Chvostá,č M., Derdáková, M.: Birds and Borrelia in Central Europe. Lecture series on Ticks and Tick-borne Zoonoses in Eurasia, Vienna, Austria Wednesday, 20th November 2019.
- [9] Didyk, Y.M., Mangova, B., Akimov, I.A., Derdáková. M.: *Ixodes ricinus* and *Dermacentor reticulatus* ticks and tick-borne pathogens. Lecture series on Ticks and Tick-borne Zoonoses in Eurasia, Vienna, Austria Wednesday, 20th November 2019.
- [10] Kazimírová, M.: Ticks are rich sources of anti haemostatics: presentation. In International Symposium on Tick Borne Pathogens and Disease / ITPD 2019, Austria.

2.3.8. List of researchers who served as members of the organising and/or programme committees

Name of researcher	Programme Com.	Organising Com.	Prog. & organ. Com.
Kazimírová Mária	0	1	0

2.3.9. List of researchers who received an international scientific award

- [1] **Gáliková Martina**
Seal of Excellence Certificate (Evaluator: European Commission)
- [2] **Roller Ladislav**
Prize for Encyclopaedic Publications of the year 2020 (Awarded by Academia Praha Publishing House)

• Position of individual researchers in the national context

2.3.10. List of invited/keynote presentations at national conferences, as documented by programme or invitation letter

- [1] Gáliková, M.: Lecture: Vínne mušky a štúdium obezity [Wine flies and the study of obesity]. In: Noc Výskumníkov [Researchers' Night], IX.2019, Bratislava, Slovakia.
- [2] Gáliková M.: Talk title: Vínne musky a štúdium obesity [Fruit flies and the study of obesity]. In: European Researcher's Night, 2019, Bratislava, Slovakia.
- [3] Gáliková M.: Talk title: Vínne mušky a výskum civilizačných chorôb [Fruit flies and research on diseases of civilization]. In: European Researcher's Night, 2020, Bratislava, Slovakia.
- [4] Vidlička, L.: Šváby - naši a tí druhí [Cockroaches – ours and the others]. In: XV. seminár DDD - Štrbské Pleso 2018. Seminár Cechu profesionálov DDD (with international participation). Štrbské Pleso 14.-16.XI.2018, Slovakia.
- [5] Vidlička, L.: *Blattella germanica* vs. *Ectobius vittiventris*. In: XVI. seminár DDD, (with international participation). Tatranská Lomnica, 11.-13.XI.2019, Slovakia.
- [6] Žitňan, D.: Plenary lecture: Význam štúdia hmyzu pre pochopenie biochemických a fyziologických pochodov u človeka [The importance of studying insects for understanding biochemical and physiological processes in humans]. In: Biochemické dni 2019, Horný Smokovec, 21.-24.IX.2019, Slovakia.

- [7] **Derdáková, M.:** Kliešte a nimi prenášané patogény [Ticks and their transmitted pathogens]. In: Letná škola mladých biológov [Summer school for young biologists] „Viva La Science“, SPU, Nitra, 8.VIII.2018, Slovakia.
- [8] **Derdáková, M., Kraljik, J., Chvostáč, M., Selyemová, D., Václav, Ďurovská, Pancák, Rusňáková Tarageľová:** Molekulárna eko-epidemiológia lymfkej borreliózy na Slovensku [Molecular eco-epidemiology of Lyme borreliosis in Slovakia]. In: Konzultačný deň SZÚ Praha [Consultation day SZÚ Prague]. Lymeská borrelióza a ďalšie infekcie prenášané klíšťaty“, 19.III.2018, Státní zdravotní ústav, Praha, Czech Republic.

2.3.11. List of researchers who served as members of organising and programme committees of national conferences

Name of researcher	Programme Com.	Organising Com.	Prog. & organ. Com.
Derdáková Markéta	0	1	0
Kazimírová Mária	0	1	0
Roller Ladislav	1	0	1
Rusňáková	0	1	0
Tarageľová Veronika			
Selyemová Diana	0	1	0
Stanko Michal	1	0	0
Vidlička Ľubomír	1	0	0

2.3.12. List of researchers who received a national scientific award

- [1] **Kraljik Jasna**
Prize of the Competition of the Council of Slovak Scientific Societies (RSVS) for Young Scientists and Doctoral Students (Awarded by RSVS at the Slovak Academy of Sciences in 2017)
- [2] **Kraljik Jasna**
Prize of the Slovak Society for Parasitology at the Slovak Academy of Sciences for the best papers published by young parasitologists in 2016 (Awarded by Slovak Society for Parasitology in 2017)
- [3] **Hamšíková Zuzana**
Prize of the Slovak Society for Parasitology at the Slovak Academy of Sciences for the best papers published by young parasitologists in 2016 (Awarded by Slovak Society for Parasitology in 2017)
- [4] **Gáliková Zuzana**
Diploma of the Dean of the Faculty of Natural Sciences, Comenius University in Bratislava, 2018
- [5] **Gáliková Martina**
Nomination for STS Young Leader at the Science and Technology in Society (STS) Forum in Kyoto (Awarded by Slovak Academy of Sciences in 2019)
- [6] **Gáliková Martina**
Ľudovít Drobnica Award (Awarded by the Slovak Society of Biochemistry and Molecular Biology in cooperation with the Institute of Biochemistry and Microbiology, Slovak Technical University, the Centre for Biosciences of the Slovak Academy of Sciences and the civic association Science and Life in 2019).
- [7] **Gáliková Martina**
L'ORÉAL-UNESCO for Women in Science (Awarded by L'Oréal Slovakia in cooperation with UNESCO, SOVVA and SAS, in 2019)
- [8] **Slovák Mirko**
Prize for Scientific and Technical Literature 2019 in the category Natural Sciences and Mathematics (Awarded by the Literary Fund, Section for Scientific and Technical Literature, in 2020)

[9] **Stanko Michal**

Prize for Scientific and Technical Literature 2019 in the category Natural Sciences and Mathematics (Awarded by the Literary Fund, Section for Scientific and Technical Literature, in 2020)

[10] **Derdáková Markéta**

Slovak Academy of Sciences Prize in the category with the highest number of citations for the year 2020 from the Section for Natural Sciences of the Slovak Academy of Sciences (Awarding body: SAS, in 2021)

[11] **Kazimírová Mária**

Slovak Academy of Sciences Prize in the category with the highest number of citations for the year 2020 from the Section for Natural Sciences of the Slovak Academy of Sciences (Awarding body: SAS, in 2021)

2.4. Research grants and other funding resources

(List type of project, title, grant number, duration, total funding and funding for the institute, responsible person in the institute and his/her status in the project, e.g. coordinator “C”, work package leader “W”, investigator “I”. Add information on the projects which are interdisciplinary, and also on the joint projects with several participating SAS institutes)

- **International projects**

2.4.1. List of major projects of Framework Programmes of the EU (which pillar), NATO, COST, etc.

HORIZON 2020

[1] **Call:** H2020-MSCA-IF-2020 (Marie Skłodowska-Curie Individual Fellowships)

Type of action: MSCA-IF-EF-RI (Reintegration panel)

Project number: 101030179

Project title: Tick-Virus Interactions Shape persistence and Transmission OF Flavivirus pathogen in tick vector

Proposal acronym: TVISTOFF

Duration of the project: 9/2021 – 8/2023

Role of the Institute / Responsible person: W / Juraj Koči

[2] **Call:** H2020-MSCA-IF-2018 (Marie Skłodowska-Curie Individual Fellowships)

Type of action: MSCA-IF-EF-RI (Reintegration panel)

Proposal number: Seal of Excellence

Project title: Fruit fly *Drosophila melanogaster* as a model to study the anti-obesity role of gonad-derived steroid hormones

Funding: 69 600 € (by SAS)

Proposal acronym: SteroidFLY

Duration of the project: 5/2019 – 5/2022

Role of the Institute / Responsible person: I / Martina Gáliková

Programmes of UNESCO

[1] **Project title:** Amba project.

Duration: 1/1998 –

Role of the Institute / Responsible person: W / Peter Vršanský

Other Programmes

- [1] **Project title:** Determinantes de la variación en las interacciones parasito-hospedador.
Project number: CGL2014-55969-P
Duration: 1/2015 – 12/2018
Role of the Institute / Responsible person: W / Radovan Václav
- [2] **Project title:** Consecuencias de las preferencias de alimentación de los mosquitos para la transmisión de patógenos de transmisión vectorial.
Project number: CGL2015-65055-P
Duration: 1/2016 – 12/2019
Role of the Institute / Responsible person: W / Radovan Václav
- [3] **Project title:** Efecto de las interacciones bióticas en las relaciones parásito-hospedador.
Project number: PGC2018-097426-B-C22
Duration: 1/2019 – 12/2021
Role of the Institute / Responsible person: W / Radovan Václav
- [4] **Project title:** Enhancing Vector Refractoriness to Trypanosome Infection.
Project number: IAEA project
Duration: 11/2014 – 11/2016
Role of the Institute / Responsible person: I / Peter Takáč
- [5] **Project title:** Enhancing Vector Refractoriness to Trypanosome Infection.
Project number: IAEA project
Duration: 2/2016 – 2/2017
Role of the Institute / Responsible person: I / Peter Takáč
- [6] **Project title:** Enhancing Vector Refractoriness to Trypanosome Infection.
Project number: IAEA project
Duration: 8/2017 – 2/2018
Role of the Institute / Responsible person: I / Peter Takáč
- [7] **Project title:** Restoration and management of Danube floodplain habitats.
Project number: LIFE14 NAT/SK001306
Funding: 15 000 €
Duration: 1/2017 – 12/2021
Role of the Institute / Responsible person: W / Ferdinand Šporka (2017-2018), Igor Kokavec (2018-2021)
- [8] **Project title:** Optimization of in vitro feeding systems for rearing and infecting ixodid ticks.
Project number: DAAD project
Duration: 1/2020 – 12/2021
Role of the Institute / Responsible person: W / Mária Kazimírová
- [9] **Project title:** Molecular Epidemiology of Lyme Borreliose (LB) spirochetes in Europe.
Project number: DAAD project
Duration: 1/2020 – 12/2021
Role of the Institute / Responsible person: W / Markéta Derdáková

Add information on your activities in international networks

See section 2.3.1.

- **National projects, incl. international projects with only national funding**

2.4.2. List of ERA-NET projects funded from SAS budget

None

2.4.3. List of projects of the Slovak Research and Development Agency, APVV

	Project title	Project number	Duration in months	Funding Total / Institute (€)	Role of the Institute / Responsible person
2016	Biological significance and pharmacological features of proteins in tick saliva.	APVV-0737-12	10/2013 – 9/2017	164 295 / 26 502	W / Mária Kazimírová
	Small mammals as a potential source of zoonotic bacteria and resistance to antibiotics.	APVV-14-0274	6/2015 – 6/2019	168 032 / 38 048	W / Markéta Derdáková
	Pesticide-free control of the house fly and stable fly populations on livestock farms in Slovakia.	APVV-14-0652	7/2015 – 6/2018	233 647 / 90 112	W / Peter Takáč
	The role of neuropeptides and receptors in regulation of pathogen transfer from ticks to their hosts.	APVV-14-0556	7/2015 – 6/2019	211 985 / 195 199	C / Dušan Žitňan
	Reduction of fecundity and trypanosomiasis control of tsetse flies by the application of sterile insect techniques and molecular methods	APVV-15-0604	7/2016 – 6/2019	248 606 / 49 488	W / Peter Takáč
2017	Ecology of host specificity in vector-borne parasites.	APVV-16-0463	7/2017 – 6/2021	193 370	I / Markéta Derdáková
	Of Sheep, Goats and Tick-borne Encephalitis virus.	APVV-16-0518	7/2017 – 6/2021	250 000 / 75 000	W / Markéta Derdáková
	The role of neuropeptides and their receptors in regulation of endocrine and reproductive organs in the silkworm (<i>Bombyx mori</i>).	APVV-16-0395	7/2017 – 6/2021	200 000	I / Ladislav Roller
2019	Functional analysis and production of bioactive substances in insects and ticks	APVV-18-0201	1/2019 – 12/2023	230 000 / 154 350	C / Dušan Žitňan
2020	Neuroendocrine regulation of energy metabolism in the <i>Drosophila melanogaster</i> Model.	APVV-19-0196	7/2020 – 6/2024	205 000 / 145 288	C / Martina Gáliková
2021	Ecology of sexual selection.	APVV-20-0081	1/2021 – 12/2025	170 000 / 53 600	W / Ľubomír Vidlička

2.4.4. List of projects of the Scientific Grant Agency of the Slovak Academy of Sciences and the Ministry of Education, VEGA (for funding specify only total sum obtained from all VEGA grants in particular year)

	Project title	Project number	Duration in months	Funding for the Institute (€)	Role of the Institute / Responsible person
2016	Identification and expression of neuropeptides in the silkworm (<i>Bombyx mori</i>).	2/0121/13	1/2013 – 12/2016	28 925	I / Ladislav Roller
	Interactions between tick-borne microorganisms and mechanisms of their transmission. (2/0108/13	1/2013 - 12/2016	29 995	I / Veronika Rusňáková Tarageľová
	Cockroaches (Blattaria) from the family Nocticolididae – revision, occurrence, distribution and ecological requirements.	2/0186/13	1/2013 - 12/2016	22 821	I / Ľubomír Vidlička

	Influence of experimental manipulations of abundance of the haematophagous ectoparasite <i>Carnus hemapterus</i> and of saprophagous/necrophagous dipteran larvae on immunological and conditional parameters of European bee-eaters chicks (<i>Merops apiaster</i>).	2/0137/13	1/2013 – 12/2016	18 039	I / Ján Krištofik
	Short- and medium-termed fluctuations of climatic factors as regulator of succession of Carabid taxocoenoses (Coleoptera, Carabidae) in differently disturbed mountain forest ecosystems.	2/0101/14	1/2014 – 12/2017	8 373	I / Zbyšek Šustek
	Arboricolous mites (Acari: Mesostigmata) associated with wood-destroying insects and fungi in Slovakia, with consideration on taxonomy, ecology and chorology of individual species.	2/0091/14	1/2014 – 12/2017	16 139	I / Peter Mašán
	Web atlas of neuroendocrine system in insect.	2/0164/15	1/2015 – 12/2017	-	W / Ladislav Roller
	Insects as an alternative source of protein.	2/0171/15	1/2015 – 12/2017	15 553	I / Milan Kozánek
	A 250 year history of human impacts on a landscape of the Banská Štiavnica mining territory: a palaeolimnological reconstruction using biotic and abiotic indicators from lake sediments.	1/0664/15	1/2015 – 12/2017	4 127	W / Ferdinand Šporka
	Influence of nest type, nesting habitat, antimicrobial substances and behavioral mechanisms on bacterial assemblages living on egg surface in selected bird species.	2/0034/15	1/2015 – 12/2018	17 142	I / Alžbeta Darolová
	The influence of landscape and regulations on the freshwater benthic macroinvertebrates communities.	1/0119/16	1/2016 – 12/2019	15 601	W / Ferdinand Šporka (2016-2018), Igor Kokavec (2018-2019)
	Neuropeptides regulating innervation of the genital organs and sexual behavior of tsetse flies.	2/0119/16	1/2016 – 12/2019	38 703	I / Peter Takáč
	Importance of reproductive habitat heterogeneity in reproductive allocation and survival.	2/0008/16	1/2016 – 12/2019	16 477	C / Radovan Václav
2017	Ecological and ethological research of invasive cockroach <i>Ectobius vittiventris</i> (Blattaria)	2/0139/17	1/2017 – 12/2020	24 086	I / Ľubomír Vidlička
	Multilocus sequence typing (MLST) of <i>Borrelia burgdorferi</i> sensu lato and <i>Borrelia miyamotoi</i> .	2/0119/17	1/2017 – 12/2020	34 755	I / Veronika Rusňáková Taragel'ová
2018	Oribatid mite communities of urban ecosystems.	2/0111/18	1/2018 - 12/2021	11 792	I / Barbara Mangová
	Systematics, ecological requirements and chorology of saproxylic mites (Acari: Mesostigmata) phoretically associated with woodboring insects in Europe.	2/0036/18	1/2018 - 12/2021	23 668	I / Peter Mašán
	Vulnerability assessment of selected natural and disturbed ecosystems by hydrometeorological extremes.	1/0370/18	1/2018 - 12/2021	6 542	W / Zbyšek Šustek
	Cockroaches from amber II.	2/0042/18	1/2018 - 12/2021	5 792	W / Peter Vršanský
	Expression and functional characterization of receptors for neuropeptides of insects and ticks.	2/0080/18	1/2018 - 12/2021	72 614	I / Dušan Žitňan
2019	Identification of adaptive mechanisms to blood-feeding of tick <i>Ixodes ricinus</i> at individual tissue level and identification of novel biomarkers with their potential use in vaccine development against vector-borne diseases carried by <i>Ixodes ricinus</i> .	1/0404/19	1/2019 - 12/2022	7 528	W / Markéta Derdáková

	Climate change and reservoirs – the effect of anthropic influences on temperature regime and benthic invertebrate diversity in streams.	2/0063/19	1/2019 - 12/2022	17 203	I / Igor Kokavec
2020	The role of ectoparasite-ectoparasite interactions in the transmission of vector-borne parasites.	2/0023/20	1/2020 - 12/2023	16 960	C / Radovan Václav
	Reproductive strategies and relation to acoustics and migration: case studies on Reed Warbler and Lesser Grey Shrike.	2/0065/20	1/2020 – 12/2023	16 947	C / Alžbeta Darolová
	Metabolic functions of insect gonad-derived hormones.	2/0141/20	1/2020 - 12/2023	23 467	I / Martina Gáliková
	Benthic Life in Karst Springs: Linkage between ecological isolation of spring and functional composition as well as phylogenetic diversity of the benthic invertebrates.	1/0127/20	1/2020 - 12/2023	5 224	W / Igor Kokavec
	Study of mitochondrial genome evolution using yeast <i>Kluyveromyces lactis</i> .	2/0151/20	1/2020 - 12/2023	16 186	I / Emanuel Procházka
2021	The occurrence of common as well as atypical tick species in Slovakia, and their role in the circulation of tick-borne agents.	2/0137/21	1/2021 - 12/2024	13 961	I / Veronika Rusňáková Tarageľová
	Invasive cockroach <i>Planuncus tingitanus</i> (Blattaria) in Slovakia - expansion of species, ecology and ethology.	2/0074/21	1/2021 - 12/2024	15 115	I / Ľubomír Vidlička

2.4.5. List of projects supported by EU Structural Funds

- [1] **Project title:** DNA barcoding of Slovakia (SK-BOL), as a part of international initiative International Barcode of Life (iBOL).
Project number: ITMS2014+: 313021W683
Funding Total / Institute (€): 599 551 / 239 551
Duration: 3/2021 – 6/2023
Role of the Institute / Responsible person: W / Dušan Žitňan

2.4.6. List of other projects funded from national resources

None

2.4.7. List of projects funded from private funds

- [1] **Project title:** Monitoring of birds in the area of the planned wind farm near Popudinské Močidl'any.
Project number: 14/2020
Funding: 1300 € (WSB Invest j. s. a.)
Duration: 9/2020 – 9/2021
Role of the Institute / Responsible person: I / Alžbeta Darolová
- [2] **Project title:** Bird monitoring in the area of the planned wind farm near Rohovo.
Project number: 13/2020
Funding: 1300 € (WSB Invest j. s. a.)
Duration: 9/2020 – 9/2021
Role of the Institute / Responsible person: I / Alžbeta Darolová

2.4.8. List of projects funded from other competitive funds

None

2.5. PhD studies and educational activities

2.5.1. List of accredited programmes of doctoral studies, period of validity, source of funding

- [1] 4.2.3 molekulárna biológia [Molecular Biology] – period of validity: 2009 – until now
 [2] 4.2.4 genetika [Genetics] – period of validity: 2020 – until now
 [3] 4.2.5 zoológia [Zoology] – period of validity: 2010 – until now
 [4] 4.2.10 fyziológia živočíchov [Animal Physiology] – period of validity: 2020 – until now

2.5.2. Summary table on doctoral studies (number of internal/external PhD students at the end of the year; number of foreign PhD students, number of students who successfully completed their theses during the year, number of PhD students who quit the programme during the year)

PhD study	2016			2017			2018			2019			2020			2021		
Number of potential PhD supervisors	21			21			22			22			24			24		
PhD students	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted	number, end of year	defended thesis	students quitted
Internal total	9	2	1	5	2	1	7	3	0	8	0	0	7	0	0	7	1	0
from which foreign citizens	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	1	0	0
External	2	0	0	1	1	0	0	1	0	0	0	0	0	0	0	1	0	0
Other supervised by the research employees of the institute	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	0	1	0

2.5.3. PhD carrier path – Information on the next career steps of the PhD graduates who received their degree from the institute

- [1] Dr **Darina Arendt** (Šípošová): Curator of Molecular Genetics Collections, Slovak National Museum, Bratislava (Aug 2008 - Jun 2020); Laboratory Technician and currently Sequencing Lab Tech Supervisor, Madison, Wisconsin, United States (Nov 2020 -).
- [2] Dr **Daniel Čižmár**: Scientist-Embryologist, Leibniz Institute for Zoo and Wildlife Research (Leibniz-IZW), Berlin, Germany (2019 -).
- [3] Dr **Katatrína Goffová**: Scientist in Entomology and Conservation Biology, Department of Zoology, Comenius University in Bratislava & non-profit organisation BROZ (Aug 2016 -).
- [4] Dr **Juraj Čačaný**: Curator of Invertebrate Collections, Slovak National Museum, Bratislava (2018 -).
- [5] Dr **Ján Kočišek**: researcher in molecular systematics and entomology, IZ SAS, Bratislava (Aug. 2021 -).
- [6] Dr **Michal Chvostáč**: researcher in the field of ecology of tick-borne pathogens, IZ SAS, Bratislava (Nov 2018 -).

2.5.4. Summary table on educational activities

Teaching	2016	2017	2018	2019	2020	2021
Lectures (hours/year)*	36	42	15	39	33	98
Practicum courses (hours/year)*	88	94	114	86	21	38
Supervised diploma and bachelor thesis (in total)	18	15	15	23	22	24
Members in PhD committees (in total)	5	3	3	3	6	6
Members in DrSc. committees (in total)	2	2	1	1	0	0
Members in university/faculty councils (in total)	0	0	2	2	2	2
Members in habilitation/inauguration committees (in total)	2	1	2	1	1	1

2.5.5. List of published university textbooks

- [1] ANTOLOVÁ, Daniela - BADALÍK, Ladislav - BAKOSS, P. - BAŠKA, Tibor - BUCHVALD, J. - ČATÁR, Gustáv - ČISLÁKOVÁ, L. - DUBINSKÝ, Pavol - GURYČOVÁ, Darina - JALILI, N.A. - JAREKOVÁ, J. - HUDEČKOVÁ, Henrieta - KMEŤOVÁ, Marta - KOCIANOVÁ, Elena - KRIŠTÚFKOVÁ, Zuzana - LABUDA, Milan - MAĎAR, Rastislav - MACHÁČOVÁ, E. - MIKAS, J. - MITROVÁ, Eva - SOLOVIČ, I. - STRAKA, Štefan - ŠTEFKOVIČOVÁ, Mária - ŠPALEKOVÁ, M. - VOLLEKOVÁ, Anna - VÝROSTEKOVÁ, V. Špeciálna epidemiológia. Sylvia Bazovská (ed.) Špliňo Miroslav, Schréter Miroslav (rec.). 2. doplnené a aktualizované vydanie. Bratislava : Univerzita Komenského v Bratislave, 2017. 366s. ISBN 978-80-223-4179-0.
- [2] BERACKO, Pavel - BULÁNKOVÁ, Eva - ČEJKA, Tomáš - ČIAMPOR, Fedor, ml. - ČIAMPOROVÁ-ZAŤOVIČOVÁ, Zuzana - DERKA, Tomáš - KOKAVEC, Igor - KRNO, Ilja - REDUCIENDO-KLEMENTOVÁ, Barbora - ROGÁNSKA, Alexandra - RÚFUSOVÁ, Andrea - SVITOK, Marek - ŠPORKA, Ferdinand. Bentické bezstavovce a ich biotopy. Editori Rúfusová Andrea, Beracko Pavel, Bulánková Eva. Bratislava : Univerzita Komenského v Bratislave, 2017. 161 s. ISBN 978-80-223-4461-6.
- [3] KRUMPÁL, Miroslav - HULEJOVÁ SLÁDKOVIČOVÁ, Veronika - MANGOVA, Barbara - KRUMPÁLOVÁ, Zuzana. Ekológia pre zoológov. Nitra : Univerzita Konštantína Filozofa v Nitre, 2018. 252 str. ISBN 978-80-558-1366-0.

2.5.6. Number of published academic course books

None

2.5.7. List of joint research laboratories/facilities with universities

- [1] Departments of Molecular Biology, Genetics, Physiology, Zoology and Ecology, Faculty of Natural Sciences, Comenius University in Bratislava
- [2] Institute of Biotechnology, Faculty of Chemical and Food Technology, Slovak University of Technology in Bratislava
- [3] Department of Biology and Ecology, University of Matej Bell, Banská Bystrica

2.5.8. Supplementary information and/or comments on doctoral studies and educational activities – focused on what changes have occurred since the last evaluation in 2016

a) doctoral study

IZ SAS functions as an attractive institution for PhD students in zoology, ecology, physiology, biochemistry, genetics and molecular biology. During most of the assessment period, the PhD positions were fully filled. On average, two students were admitted each year and two students defended their PhD theses. However, the covid pandemic in 2020 and 2021 has had a negative impact on PhD training. We hired two students from abroad, but none of them could study in Slovakia during the pandemic. In addition, the graduation of several PhD students has been delayed because of pandemic.

b) pedagogical activities

Most of researchers at IZ SAS supervise bachelor's, diploma and rigorous doctoral theses, mainly in cooperation with the Faculty of Natural Sciences at Comenius University in Bratislava. The topics of the theses were different research areas in zoology, ecology, parasitology, animal physiology, genetics and molecular biology. Some supervisors also lectured at the Faculty of Natural Sciences of Comenius University and the Faculty of Chemical and Food Technology, Slovak University of Technology in Bratislava. Several researchers of the Institute were members of doctoral committees, state committees for bachelor's and diploma examinations, rigorous committees and in the habilitation and inauguration committees.

2.6. Societal impact

2.6.1. The most important case studies of the research with direct societal impact, max. 4 for institute with up to 50 average FTE researchers per year, 8 for institutes with 50 – 100 average FTE researchers per year and so on. Structure: Summary of the impact; Underpinning research; References to the research; Details of the impact; Sources to corroborate the impact. One page per one case study

None

2.6.2. List of the most important studies and/or other activities commissioned for the decision-making authorities, the government and NGOs, international and foreign institutes (title, name of institution, contract value, purpose (max 20 words))

None

2.6.3. List of contracts and research projects with industrial and other commercial partners, incl. revenues (study title, name of institution, contract value, country of partner, purpose (max 20 words))

Joint workplace with industry.

Partners: Scientica, s.r.o, Kenya Agriculture Research Institute – Trypanosomiasis Research Centre, Kenya

Focus: Development aid for the Republic of Kenya and other countries in East Africa, transfer of scientific knowledge in the form of three projects:

- Introduction of sterile larvae therapy into clinical practise in human and veterinary health facilities in the Republic of Kenya.
- Improving vector resistance to trypanosome infections in tsetse spider mites.
- Ensure mass rearing of a colony of tsetse spider mites, *Glossina palpalis gambiensis*, in the fight against sleeping sickness in humans and Nagana disease in cattle in Senegal.

Contract: Monitoring of the Gabčíkovo water dam impact on environment and study of cladocerans and copepods fauna

Funding for organization: 7920 Eur

Sponsor: Waterworks Construction Company, state company

Contract: Monitoring of birds in the area of the planned wind farm near Popudinské Močidl'any.

Contract value: 1300 €

Commercial partner: WSB Invest j. s. a

Contract: Bird monitoring in the area of the planned wind farm near Rohovo.

Contract value: 1300 €

Commercial partner: WSB Invest j. s. a

2.6.4.1 List of intangible fixed assets (internally registered IP (confidential know-how), patent applications, patents granted, trademarks registered) denoting background IPR

Patent application No.: 62/230,923; Published on: 22/12/2016

Patent name: Novel thrombin inhibitors

Co-owners: National University of Singapore / Institute of Zoology SAS

Worldwide applications: 2016 - AU JP CA CN KR RU US SG MX WO EP

2017 - IL PH

2018 - HK

2.6.4.2 List of licences sold abroad and in Slovakia, incl. revenues (background IPR identification, name of institution, contract value, country of partner, purpose (max 20 words))

None

2.6.5. Summary of relevant activities, max. 300 words (describe the pipeline of valorization in terms of Number of disclosure, Number of registered IP internally, number of CCR/LIC contracts and their respective summary values, the support you are receiving in specific points internally at the institute, at SAS, externally – also the limitations and drawbacks.

Not relevant

2.7. Popularisation of Science (outreach activities)

2.7.1. List of the most important popularisation activities, max. 20 items

2017

- [1] Roller, L. – participation in TV “Rozhovor o entomológii a vedeckej práci”, Nočná pyramída, RTVS, 4.7.2017
- [2] Šustek, Z. – participation in radio “Les Insects et commerce”, Slovakia international, French section, RTVS, 13.10.2017
- [3] Václav, R. – participation in radio “Z prvej ruky – Vtáčia chrípka”, Rádio Slovensko, RTVS, 9.1.2017
- [4] Vidlička, L. – participation in TV “Nový druh jaskynného švába”, TV JOJ and TV Markíza, 10.3.2017 and 13.3.2017
- [5] Žitňan, D. – participation in TV “Rozhovor o hormónoch živočíchov”, Nočná pyramída, RTVS, 23.1.2017

2018

- [6] Darolová, A. – participation in TV “Rozhovor o vtákoch”, RTVS, 28.5.2018
[7] Derdáková, M. – participation in TV “Výskum kliešťov prináša nové zistenia”, RTVS, 10.6.2018
[8] Semelbauer, M. – participation in radio “Alternatívna starostlivosť o mestskú zeleň”, RTVS, 2.8.2018
[9] Vidlička, L. – participation in TV “Zo života švábov”, Nočná pyramída, RTVS, 21.6.2018

2019

- [10] Didyk, Y. – participation in radio “O kliešťoch a ich patogénoch vo svete”. Nove Rádio, Kyjev (Ukrajina), 12.7.2019
[11] Gáliková, M. – participation in discussion “Moja karierna cesta” – part of workshop “Naštartuj svoju karieru”. Vedecký park Univerzity Komenského v Bratislave, 17.10.2019
[12] Prokop, P. – participation in TV “Rozhovor o správaní zvierat a človeka”, Nočná pyramída, RTVS, 7.11.2019
[13] Semelbauer, M. – participation in TV “Vymieranie hmyzu”, ranné správy RTVS, 19.2.2019

2020

- [14] Semelbauer, M. – participation in TV “Naše pastevné lesy zanikli. No je tu ešte Panónsky háj”, Doma v záhrade, RTVS, 1.6.2020
[15] Vidlička, L. – participation in radio “Šváby v domácnosti”, Rádio Regina, RTVS, 5.6.2020
[16] Gáliková, M. – contribution “Vínne mušky a výskum civilizačných chorôb”, Noc výskumníkov, 27.11.2020
[17] Derdáková, M. – participation in radio “Kliešte prenášače Lymскеj boreliózy a význam vtákov v cirkulácii borélií”, TV JOJ, 4.6.2020

2021

- [18] Derdáková, M. – participation in TV “Ekológia kliešťov a Lymскеj borelióza”, program Experiment, STV2, 6.9.2021
[19] Vidlička, L. – participation in TV “Mravce a termity”, program Experiment, STV2, 22.11.2021
[20] Václav, R. – participation in radio “O vtácej migrácii”, Rádio Regina, RTVS, 23.8.2021

2.7.2. Table of outreach activities according to institute annual reports

Outreach activities	2016	2017	2018	2019	2020	2021	total
Articles in press media/internet popularising results of science, in particular those achieved by the Organization	1	6	24	19	17	16	83
Appearances in telecommunication media popularising results of science, in particular those achieved by the Organization	14	17	14	13	13	12	83
Public popularisation lectures	4	8	4	7	7	6	36

2.8. Background and management. Infrastructure and human resources, incl. support and incentives for young researchers

2.8.1. Summary table of personnel

2.8.1.1. Professional qualification structure (as of 31 December 2021)

	Degree/rank				Research position		
	DrSc./DSc	CSc./PhD.	professor	docent/ assoc. prof.	I.	II.a.	II.b.
Male	3	22	2	3	4	13	8
Female	0	11	0	0	0	7	4

I. – director of research with a degree of doctor of science/DrSc.

II.a – Senior researcher

II.b – PhD holder/Postdoc

2.8.1.2. Age and gender structure of researchers (as of 31 December 2021)

Age structure of researchers	< 31		31-35		36-40		41-45		46-50		51-55		56-60		61-65		> 65	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
Male	1,0	1,0	2,0	2,0	2,0	2,0	1,0	0,5	1,0	1,0	2,0	2,0	1,0	1,0	3,0	1,8	3,0	1,2
Female	0,0	0,0	0,0	0,0	3,0	3,0	3,0	3,0	1,0	0,5	0,0	0,0	0,0	0,0	2,0	2,0	0,0	0,0

A – number

B – FTE

2.8.2. Postdoctoral fellowships (list of positions with holder name, starting date, duration. Add brief information about each fellow's career path before and after receiving PhD degree, etc.)

2.8.2.1. MoRePro and SASPRO fellowships

MoRePro: Hormonal regulation of Drosophila metabolism via gonad-derived steroids and interacting peptides.

Holder name: Martina Gáliková

Starting date and duration: 1.1.2021 - 31.12.2024

Dr Gáliková completed her biology studies at Comenius University in Bratislava (Slovakia, 2004-2009). She continued her studies in genetics at the University of Veterinary Medicine in Vienna (Austria, 2009-2013), where she received her PhD in 2014. She then worked as a postdoctoral fellow at the Max Planck Institute for Biophysical Chemistry in Göttingen (Germany, 2013-2017) and subsequently at Stockholm University (Sweden, 2017-2019). Since 2019, she has been working as a Senior Researcher at the Institute of Zoology SAS.

2.8.2.2. Stefan Schwarz fellowships

None

2.8.2.3. Postdoctoral positions from other resources (specify)

None

2.8.3. Important research infrastructure introduced during the evaluation period with the information about the sources of funding (max. 2 pages)

During the evaluation period, the Institute of Zoology (IZ SAS) has significantly expanded its infrastructure to support state-of-the-art research in neuroendocrinology, animal models of human disease and ecophysiology. This new infrastructure includes facilities such as:

1. New facilities for rearing fruit flies (*Drosophila melanogaster*), including eight DigiTherm® CO₂ heating/cooling incubators (Tritech Research) and two rooms with controlled light and temperature regimes. Funding: MoRePro (Slovak Academy of Sciences), Seal of Excellence (Slovak Academy of Sciences), APVV-19-0196, and VEGA 2/0141/20 to M. Gáliková.
2. New laboratories for work with fruit flies. These include: a laboratory for basic work with flies and experiments in ecophysiology and evolutionary biology, plus a laboratory for experiments in molecular biology and biochemistry. We re-equipped the labs with the necessary furniture (laboratory benches, chairs, etc.) and basic equipment such as freezers, refrigerators, microcentrifuges, scales, shakers, pipetting devices, etc. Funding: MoRePro (Slovak Academy of Sciences), Seal of Excellence (Slovak Academy of Sciences), APVV-19-0196, and VEGA 2/0141/20 to M. Gáliková.
3. Anaesthesia and microscopy facilities, including two new CO₂ stations (Tritech Research and Motic). Funding: MoRePro (Slovak Academy of Sciences), Seal of Excellence (Slovak Academy of Sciences), APVV-19-0196, and VEGA 2/0141/20 to M. Gáliková.
4. Facilities for measuring fat, carbohydrates and proteins in fruit flies using colorimetric assays. This includes newly acquired equipment compatible with the Tissue Lyser II such as Tissue Lyser Bead Dispenser, Tissue Lyser Adapter Sets (all from Qiagen), a new shaker incubator (Ohaus) and others. We have also refurbished older equipment for these purposes, such as the spectrophotometry station. Funding: MoRePro (Slovak Academy of Sciences), Seal of Excellence (Slovak Academy of Sciences), APVV-19-0196, and VEGA 2/0141/20 to M. Gáliková.
5. Facilities for measuring the food intake of fruit flies using capillary feeder assay, including 10 individual monitors, each capable of holding 24 flies (customised equipment). Funding: MoRePro (Slovak Academy of Sciences) and VEGA 2/0141/20 to M. Gáliková.
6. Facilities for measuring basal metabolic rate of fruit flies using manometric respirometry, including measurement chambers in which 20 replicates can be tested simultaneously (customised equipment). Funding: MoRePro (Slovak Academy of Sciences) and VEGA 2/0141/20 to M. Gáliková.
7. Facilities for measuring sleep and spontaneous movement of fruit flies, including the DAMII system (TriKinetics), enabling 9 monitors, each capable of testing 32 individual flies. Funding: MoRePro (Slovak Academy of Sciences) and Seal of Excellence (Slovak Academy of Sciences) to M. Gáliková.
8. Facilities for semi-automatize the work with fruit flies, such as the fly kitchen facilities, a washing machine for recycling of fly plugs, etc.
9. Probes for measuring multiple physical and chemical water parameters, Aqua TROLL 400, with remote control under harsh field conditions, for ecological studies in running waters. Funding: extra-budgetary source
10. Rooms and chambers with controlled temperature and light for rearing different species of insects and ticks were reconstructed and their equipment modernised. Funding: VEGA and an extra-budgetary source.

11. Microscopy and imaging infrastructure was expanded with several Leica stereo microscopes for screening transgenic animals, dissection and sample processing. In addition, a high-resolution digital camera with operating software and a Z-stack projection tool, as well as a stereo microscope with various illumination accessories, were purchased to perform *in vivo/ in vitro* physiological and ethological recordings and to obtain high quality images of the samples studied (various fossil and extant invertebrates). Funding: VEGA and an extra-budgetary source.

The institute also maintains and upgrades the extensive infrastructure already in place. It has several laboratories and rearing facilities for research on model organisms and for analysis of samples collected in the field. The molecular biology and genetics laboratories are equipped for DNA analysis and gene cloning techniques and have several gradient PCR cyclers, real-time PCR cyclers, centrifuges, various incubators, including CO₂ incubator, freezers for -80°C and -20°C, UV transilluminators, luminometer, and equipment for gel electrophoresis. The GMO risk class 1 laboratory for transgenic manipulation of insects, insect cells and *E. coli* was renovated and equipped with new stereomicroscopes. Electrophysiology amplifiers, manipulators and electrodes for measuring neural and myogenic activities are also available. The epidemiology lab has equipment for handling tissue and bacterial cultures (laminar boxes, incubators) and a digital PCR system (BioRad) for highly sensitive PCR. The biochemical and proteomic laboratory is equipped with modern technical devices for separation of protein samples (HPLC, FLPC, UPLC, gas chromatograph with QDa mass detector, gel electrophoresis, etc.). Our rearing facilities include rooms and chambers with controlled temperature and light for rearing various insect and tick species. The microscopy and imaging facility is equipped for fluorescence immunohistochemistry and *in situ* hybridisation of whole specimens and tissue sections. It includes a fluorescence microscope (Nikon Eclipse) with differential interference contrast and digital camera; a Leica confocal system TCS SPE, suitable for 3D projections and calcium imaging; and Leica fluorescence stereomicroscopes for screening of transgenic animals, manipulation of labelled samples and macrophotography.

In addition, the institute constantly improves working environment for undergraduate and postgraduate students. For example, we have recently set up a study room and office for students. We believe that excellent research depends not only on equipment, but also on knowledge transfer and interdisciplinary collaboration. For example, to maximise interaction between the labs, we recently renovated social zones (seating areas in the common corridors).

The institute has been promoting national and international collaborations. As a result, our researchers now have access to the state-of-the-art facilities of all the top research institutes nearby. For example, thanks to joint work on several national and EU grants (APVV, EU Structural Funds), we have access to the facilities of the Comenius University Science Park, the Comenius University Faculty of Natural Sciences, and the Natural History Museum. When requested, we also share facilities with other SAS institutes on campus. We also have numerous collaborations with universities and research institutes in EU, USA, Korea and Japan (see 2.3.1.).

2.9. Supplementary information and/or comments on all items 2.1 – 2.8 (max. 2 pages in total for the whole section)

The most important results of the Institute's research activities are published in the journals included in the ISI databases (WOS, CC, etc). The number of these publications per researcher (excluding PhD students) per year was 1.5-2.46 during the assessment period. We have successfully published in journals with high impact factors (a total of 13 articles with IF above 5), which are on average above the median IF in zoology and equal to the medians of IFs in physiology, biochemistry and molecular biology (InCites Reports 2021). In addition to excellent papers published as part of an international collaboration (Attardo et al. 2018 in *Genome Biology*, Tybur et al. 2016 in *PNAS*; Nouzová et al. 2021 in *PNAS*), number of 'home-grown' papers published in high-quality journals (IF 2 - 5) increased during the assessment period (e.g. Roller et al 2016; Hamšíková-Svitálková et al 2016; Kazimírová et al 2017, Klepsatel et al 2018, Daubnerová et al 2021, Koči et al 2021). In three

studies published in very prestigious journals our researchers played a major role: Zhang, Daubnerová et al 2021 in *PNAS*, Vršanský et al 2019 and Sendi et al 2020 in *Gondwana Research*).

One of the most important scientific outputs are monographs and monographic studies. Nine of these were published by renowned publishers abroad during the assessment period. These are either large reviews (Anettová et al. 2018, Bonnet et al. 2018, Kazimírová et al. 2018, Thiebaut et al. 2021) or comprehensive original research studies (Mašán 2017, Macek et al. 2020, Vršanský 2020, Hamerlik & DaSilva 2021, Ošlejšková et al. 2021). Several monographs in Slovak language provide information on the distribution and abundance of terrestrial and aquatic animals and are very important at the national level. These publications (monitoring reports, checklists, identification keys, etc.) of national importance serve as reference manuals for other research branches (botanists, ecologists, foresters, etc.) and as supporting material for the implementation of guidelines on habitat and species conservation in Slovakia.

3. Implementation of the recommendations from the previous evaluation period

The management of the Institute of Zoology follows recommendations of the panel. According to the panel, we have been categorised as B.

1. It is our fundamental responsibility to constantly improve quality of research outputs. We have been developing new techniques and approaches to tackle important questions in science. This policy has resulted in increased productivity of interesting results published in high quality monographs and international scientific journals. We developed a model that takes into account the impact factor and the quartile of published scientific journals on the basis of which is each successful scientist remunerated. The management of the institute created suitable working conditions for recruiting very capable and productive scientists who gained skills and experience in renowned universities and institutions in the USA, Europe, Korea and Japan. These highly motivated young scientists set up their own laboratories where they have been developing interesting and progressive projects.
2. Improving the quality of doctoral studies. We are fully aware that highly motivated PhD students are essential for the progress and development of scientific research. We have well defined criteria for selection of supervisors and recruitment of PhD students. In spite of strong competition from foreign universities, academic departments and various companies, we manage to attract new talented PhD students from Slovakia and abroad every year. We also organise a regular meetings of young scientists, where all the interesting findings in science and technology are presented and discussed.
3. Career development of postdoctoral fellows and researchers. Long-term progressive policy and good working conditions have enabled the recruitment of several very capable and productive young scientists after long-term studies and fellowships at universities and scientific institutions in the EU, USA and Korea. These young scientists have been able to obtain grants from MOREPRO (2021), Horizon 2020 (2021) and recently from SASPRO (2022). The management is trying to attract other exceptionally capable young scientists from abroad to establish their own laboratories and working groups at the Institute of Zoology.
4. Increasing the success in ERA programmes (e.g. Horizon 2020) and other international research funding opportunities. In the past, the staff of the Institute of Zoology was very successful in obtaining foreign projects from the EU (FP3, 4, 5, 6 and 7, Alpe 2, MOLAR, EMERGE, STAR, ICCTD3, EDEN, EDENext, Interreg, LIFE) and the USA (three grants from the National Institutes of Health). Currently, our staff has been working on international UNESCO and LIFE projects. We are also involved in cooperation with the Slovak National Museum in the project from Structural Funds. As mentioned above projects from the Horizon 2020, SASPRO and MoRePro programmes has also been funded at our institute. In the future we will submit additional international projects in EU programmes.

5. VEGA and APVV projects. The Institute is very successful in obtaining grants from the local grant agencies VEGA and APVV. During the evaluation period scientists of the institute have been funded by 28 VEGA and 11 APVV grants. The research capacity on projects from both agencies have been filled to 100%. Since the basic duty of each scientist is to lead or participate in projects funded by domestic sources (VEGA, APVV) we do not need to develop a strategic plan for their acquisition.
6. Organisation structure. During the evaluation period the institute was composed of four departments involved in different aspects of ecology, systematic biology, parasitology, physiology, biochemistry and molecular biology using and studying various invertebrate and vertebrate species. We recently established additional Department of Genetics and Physiology.
7. Disposal of intellectual property. A patent filed in 2016 under PCT/SG2016/050278 entitled "Novel thrombin inhibitors" was registered in 2021 for Japan, Russia and USA. The co-authors of the project are two employees of the Institute of Zoology: Kazimírová Mária and Roller Ladislav. Co-owner of the patent is the Institute of Zoology of the Slovak Academy of Sciences.
8. Funding and management of research equipment. The management of the institute together with the scientific committee are responsible for effective utilization of all valuable equipment and instruments. Some instruments are also used by colleagues from other institutes or universities. On our website we provided a list of instruments and equipment that could be used by external parties from other scientific institutions.

4. Research strategy and future development of the institute for the next five years (Recommended 3 pages, max. 5 pages)

Research strategy of the institute in the national and international contexts, objectives, and methods (including the information on when the strategy was adopted)

3.1. Present state of the art in both the national and the international contexts

We have a long-term collaboration with numerous institutions and universities in Slovakia and other countries in Europe, USA, Korea and Japan. These collaborations involved various projects including basic experimental research focused on identification and function of bioactive substances, parasitology and epidemiology of ticks and tick-borne pathogens, ecology and taxonomy of various invertebrate and vertebrate animals, and applied projects in medicine and nature protection. One of the most important goals for our future work is to stimulate and expand these collaborations which usually result in successful projects and generation of novel and interesting data published in high quality journals and books. Cooperative efforts of skilled and motivated scientists are essential for exchange of the knowledge and improvement of theoretical and technical skills. They also provide opportunities to obtain financial support from various grant agencies and international sources. So far, we have been very successful in obtaining grants from domestic as well as international agencies (e.g. APVV, NIH, 7.FP, LIFE, Structural funds). This financial support was essential for obtaining necessary equipment (see infrastructure), chemicals, kits and provided salaries for several young scientists and technicians. To improve quality of our work and expertize it is important to constantly learn modern techniques and innovative approaches in various fields of biological sciences. For these purposes we built several specialized laboratories with specific equipment. Support from several grant agencies and Structural funds from EU was crucial for building these laboratories at our institute. We have well equipped facilities for molecular biology, genetic studies, analysis of metabolism, microscopy and imaging lab, biochemical and proteomic laboratory lab and epidemiology lab.

3.2. Research strategy of the institute in the national and the international contexts, objectives and methods

Our long-term strategy is to constantly improve and develop our expertise in viable and promising research areas in zoology and related biological disciplines. In the recent decade we spent a lot of financial resources and effort to build several laboratories. Now it is important to effectively utilize these labs and equipment for production of interesting data in experimental and applied research, as well as in various analyses of the field samples. To maintain and further develop technical and scientific potential of these labs, we need to create consortia with other institutes at SAS and abroad to obtain necessary funding. Results from the applied research have a great potential for further development in cooperation with biotechnology companies and medical institutes. Equally good opportunities provide ecological projects in hydrobiology, epidemiology or nature protection during apparent climatic changes associated with invasion of numerous pests in our waters, fields and forests. Even more alarming is migration of pathogen vectors (ticks, mosquitoes) along with increased number of new dangerous pathogen species into higher altitudes and different environmental niche. Ecologically and medically oriented projects tackling expansion of invasive pests or newly emerging diseases are funded by several agencies in EU and we will make arrangements to participate in these projects. Expected funds will be used to support important research areas and promising teams, as well as for reconstruction of some lab space and buying new useful equipment.

One of the most important challenges is to attract talented and motivated students and researchers that would create productive environment and generate data interesting for other scientists and general public. Successful institution should be able to mentor and educate creative people interested in science and therefore, we need to pay special attention to our local universities and academic institutions abroad, from where we could recruit students, postdocs and senior scientists. In a very competitive environment and much better salaries at academic institutions in EU this task is rather difficult, but there are several research teams in Slovakia which are quite productive and successful. Scientists at our institute provide attractive themes for bachelor, diploma and PhD studies, and to hire the best available students. We also have interesting projects which enabled us to hire several talented postdocs from Slovakia and foreign countries. To expand our research teams and learn new techniques we used grants that provided funding for exchange study programs and postdoctoral research positions abroad. This proved to be very stimulating especially for young and creative scientists. As a rule at our institute, our young scientists should visit labs abroad and attend international scientific conferences during their PhD studies. After successful defence of PhD thesis they are strongly encouraged to take postdoctoral positions at good universities or research institutes in EU, USA, Japan or Korea. Another important goal is to attract these trained and motivated postdocs and scientists back home after their position abroad has expired and provide them with appropriate lab space, equipment, services and salaries. We are making a lot of effort to create good lab conditions comparable to those in other EU countries. Moreover, scientists working at our institute have close professional relationships with numerous research institutions, so there is a good perspective for future work and opportunities to establish new collaborations and produce interesting results. Our priority is to maintain high productivity and increase quality of papers, as well as use modern techniques with the best available equipment.