



Training Course ‘Impact of invasive alien species on biodiversity and ecosystem services in extreme environments’

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REPORT



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1. Training Course background and objectives

Invasive alien species (IAS) are among the most significant and growing environmental concerns worldwide. They are considered as a driver of biodiversity loss and recognised as being a major cause of species extinctions. Biological invasions may alter fundamental ecological properties and processes of the native ecosystems, and may have economic and social impact. It is expected that biological invasions in Europe will increase.

Owing to the projected increase in frequency and magnitude of extreme climatic events and predicted increases in average temperatures, ecosystems could be further affected by global changes. On the other hand, the invasive alien species can increase the vulnerability of ecosystems to other climate-related stressors and also reduce their potential to sequester greenhouse gasses.

The networking, awareness raising and capacity building are underlined in several European and global documents as one of the key factors for successful IAS management. One of the main objectives of the ESENIAS-TOOLS project is to raise the public awareness and gain wide support for combating IAS in Bulgaria. These objectives are implemented within the project working groups WG8 'Capacity building' and WG9 'Awareness raising'. The present training course has been designed to address IAS impact on biodiversity and ecosystem services in extreme environments at regional level through promotion of knowledge sharing. Thus, the training course will allow improving skills and competencies of, as well as networking among scientists from the participating ESENIAS countries.

The training course aimed at:

- Capacity building and increasing awareness on IAS impact on biodiversity and ecosystem services in extreme environments among young scientists and PhD students from Bulgaria and the ESENIAS countries;
- Imparting basic skills and competencies on IAS, its related terminology, the relevant international regulatory framework, networks, projects and information systems;
- Networking and cooperation among scientists in the ESENIAS region.

The training course was organised by the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences (IBER-BAS), Bulgaria, Reykjavik University, Iceland, East and South European Network for Invasive Alien Species (ESENIAS), and the Danube Region Invasive Alien Species Network (DIAS). It was funded by the Financial Mechanism of the European Economic Area 2009-2014, Programme BG03 Biodiversity and Ecosystem Services, within the project: East and South European Network for Invasive Alien Species – A tool to support the management of alien species in Bulgaria (ESENIAS-TOOLS, Д-33-51/30.06.2015).

2. Training Course organisation

The Organising and Programme committee included ESENIAS-TOOLS project participants and representatives of IBER-BAS, ESENIAS and DIAS: Nadja Ognjanova-Rumenova, Vesela Evtimova, David Finger, Teodora Trichkova, Rumen Tomov, Violeta Tyufekchieva, Hristina Kalcheva, and Ivan Botev. Their tasks were to prepare the programme, to invite lecturers, to prepare and disseminate the information and materials about the course, to select participants based on their background and motivation, and to organise the sessions.

The programme was drafted after inviting 11 lecturers, covering different topics and aspects related to the invasive alien species in extreme environments. The course was announced on the web-pages of ESENIAS, IBER-BAS and the Bulgarian Academy of Sciences. Messages and invitation letters were sent also to other institutes of the Bulgarian Academy of Science (Molecular Biology, Forestry Institute, Institute of Oceanology, National Museum of Natural History, etc.), universities in Bulgaria (Biological Faculty of Sofia University, University of Forestry, and Plovdiv University), as well as other scientific institutions in Bulgaria and the ESENIAS region. The training course was open to young scientists, PhD and MSc students from Bulgaria and the ESENIAS region. No registration fee was required. The language of the course was English.

A total of 55 participants applied to participate in the course. All MSc and PhD students, as well as PostDocs and young scientists were considered for support and approved for participation in the training course. However, several participants from Turkey (7), Albania (1) and Kosovo (2) could not arrange visas on time and had to cancel their participation in the very last moment.

Training course materials (nametags, programmes, certificates of participation, feedback, forms) were prepared for all participants in the course. They were provided to the participants at registration.



3. Training Course instructors

Eleven instructors from seven countries (Bulgaria, Iceland, France, United Kingdom, R. Macedonia, Poland, and Turkey) participated in the course:

AGATA WOJTAL is a Professor at the Department of Karol Starmach Department of Freshwater Biology, Institute of Nature Conservation, Polish Academy of Sciences (PAS), Krakow, Poland. Before coming to the Institute in 2014, she worked at the Institute of Botany, PAS in Krakow, Poland. Her research is focused on the taxonomy, ecology and biogeography of diatoms. She focuses on understanding how environmental parameters affect the structure and functioning of diatom assemblages. Dr. Wojtal is interested in oligotrophic habitats and taxa that are highly sensitive to environmental variability and provide information about changes at the regional and global scale. Spring water diatoms were in her interest until recently. Her results from diatom analysis in natural and human-altered springs from geologically diverse area of southern Poland were published in 2013 in *Bibliotheca Diatomologica*.

AHMET ULUDAG is a Professor on weed science at the Faculty of Agriculture of Canakkale Onsekiz Mart University and Faculty of Agriculture and Nature Sciences of Duzce University in Turkey. He reads lectures and conducts research on different aspects of weed science and plant protection. He has been involved in the IAS science for over a decade. His work on IAS is not only limited to research and field studies but also to policy related issues. He has worked as project manager on IAS at the European Environment Agency and contributed to the IAS activities in the context of preparation of IAS legislation at EU level. Currently he is giving lectures also on IAS policy and networking. He is among the leading people who has established and maintained the functioning of the ESENIAS network so far. He is a leader of ESENIAS-TOOLS WG10 on networking and dissemination of project results. He is also a member of several other IAS related international and national organisations.

ALAIN ROQUES (D.SC., PH.D.) is Research Director at the French National Institute for Agricultural Research (INRA), and he is leading the Forest Zoology Research Unit of Orléans since 2004. He has 31 years of experience in the biology, ecology and behavior of forest insects. During the last ten years, his research activity focused on biological invasions and the effect of global warming on the populations of terrestrial invertebrates. He has participated in most of the recent EU-funded projects dealing with biological invasions. He coordinated the inventory of alien terrestrial invertebrates in Europe realised in the DAISIE project. Dr. Roques was the main editor of the book '*Alien terrestrial arthropods of Europe*', published in 2010, which provided the first comprehensive review of the fauna of alien terrestrial arthropods that colonised the European continent and its associated islands. The book summarises the present knowledge of the arthropod invasion process from temporal trends and biogeographic patterns to pathways and vectors, invaded habitats, and ecological and economic impacts. He was also the editor of another recent book devoted to the relationships between climate change and insects: "*Processionary moths and Climate Change: an update*". He published 167 peer-reviewed papers, 25 books and book chapters, and presented 93 communications at international conferences.

DAVID C. FINGER is an Asst. Professor at Reykjavik University, Reykjavik, Iceland. He reads lectures on Environmental modelling, Environmental Engineering and Environmental Impact Assessments. His main areas of research focus on preserving water resources and

freshwater ecosystems and increasing the resilience of mountain ecosystems. He has participated in numerous research projects focusing on mountain areas, including EU FP7 project ACQWA, Swiss research project Brienersee, NRP MontanAqua project, SNF fellowship at UC Davis and the ongoing ISAVIA project. David is a MC member of the COST Actions ES1306, ES1104, ES1303 and ES1404; he has authored over 70 scientific publications and international conference contributions and is currently guest editor at the Land Development and Degradation journal. More information is available here: <https://fingerd.jimdo.com/>

DAVID WILLIAMS is a Diatom systematist-taxonomist at the Department of Life Sciences - Division: LS Algae, Fungi and Plants Division, Natural History Museum - London, U.K. His research is divided more or less equally between empirical studies on the systematics and biogeography of diatoms (especially ancient lakes and circum-Pacific distributions) and theoretical studies related to advances in cladistic (systematic) theory. His main interests are diatom phylogeny, systematics and biogeography. During the last decade or so Dr. Williams has concentrated his efforts on the role fossils have in determining the evolutionary relationships in diatoms. Publications: 184 papers, 9 books; Abstracts, Reviews, Obituaries, Letters, Popular articles, etc.: 89 items.

INGI RUNAR JONSSON is a senior fish biologist at the Icelandic Marine and Freshwater Research Institute. He has been working at the institute since 1994. His main research has been on salmonids (Atlantic salmon, Arctic charr and brown trout), including assessment on stock size, exploitation, ecology, migration pattern and life-history. He has been taking part in research projects on invertebrates and diatoms. Participant in the ESENIAS-TOOLS project.

JÓN S. ÓLAFSSON has been the leader of the limnology group at the Marine and Freshwater Research Institute, Reykjavík, Iceland, since 2005, guest professor at the Agricultural University of Iceland since 2008, and affiliate academic at the University of Fairbanks, Alaska, since 2012.

NADJA OGNJANOVA-RUMENOVA is a Professor at the Geological Institute, Bulgarian Academy of Sciences, currently employed also at the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences. She is a diatom expert, who works on several fields of algology. She is taxonomist, paleoecologist but she works in the diatom based water monitoring system in Bulgaria.

RUMEN TOMOV is a Professor at the University of Forestry, Sofia, and the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences. He reads lectures on Integrated Pest Management, Biocontrol, Phytosanitary Control and Biological Invasions. His main areas of research are Applied Entomology – Bioecology and Control of IAS and Crop Pests. He is a participant in 14 projects on IAS, including EU projects CONTROCAM, DAISIE, ALARM, SEE-ERA.NE, SCOPES program of the Swiss Government and three IAS COST Actions FP1002, TD1209, Action FP1401. He participates in the Invasive Alien Species Working Group 2 – Early Warning and Rapid Response and the Scientific Forum on Invasive Alien Species at the European Commission. Prof. Tomov is a co-founder of ESENIAS and DIAS networks and a national representative of ESENIAS in Bulgaria. He is a sub-coordinator of ESENIAS-TOOLS project and leader of WG5 on Data collection, analysis, standardisation and harmonisation on alien terrestrial invertebrate species. He is an author of 86 scientific publications, including the book *'Non-indigenous insects and their threat to biodiversity and economy in Albania, Bulgaria and Republic of Macedonia'* (2013).

SVETLA BRATANOVA-DONCHEVA works at the Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences. Her main areas of research are: ecosystem research, functional ecology, forest ecosystem functioning, resilience and adaptation of ecosystems, and ecosystem services. She is an active participant in numerous research projects, such as ENVEurope, SENSFOR, Eurocoppice, and ESMERALDA, as well as a project manager for IBER-BAS and scientific coordinator of MetEcoSMap Project, funded by FM of EEA, focusing on the methodology of mapping and assessment of ecosystem services. Dr. Bratanova-Doncheva is a member of MAES Working group at the European Commission. She is also the Bulgarian representative in the ILTER network and National Coordinator of LTER-Bg. Author of more than 80 publications in national and international journal and conference contributions.

ZLATKO LEVKOV is a Professor at the Institute of Biology, Faculty of Natural Sciences in Skopje, Republic of Macedonia. His research is focused on diatomology, including taxonomy, phylogeny, biogeography, ecology, palaeoecology and forensic. In the last ten years the main focus is given to diatoms of Lake Ohrid, especially their diversity and taxonomy. The deep drilling project in Lake Ohrid allowed deeper research in palaeoecology, biostratigraphy and evolution of the diatoms. Additionally, the diatom research of Dr. Levkov comprises taxonomic analyses of several pennate diatom genera from all continents, such as *Amphora*, *Rhoicosphenia* and *Luticola*. However, most of the taxonomic research is orientated on water bodies from Macedonia, with special attention to high-mountain habitats (glacial lakes, bogs, ferns).

4. Venue and participants

The training course was held at Conference Hall 5 of Park Hotel Moskva, 25 Nezabravka Str., 1113 Sofia, Bulgaria; <http://www.parkhotelmoskva.net/lang-en.htm>.

The course was attended by 60 participants, including the lecturers and organisers. A list with the names, affiliation and contact details of all the participants was prepared. The participants included experts from universities and research institutes, governmental institutions, and students (PhD and MSc), from five countries (Bulgaria, Italy, Serbia, R. Macedonia and Turkey). The participants from Bulgaria were 13 PostDocs from the Bulgarian Academy of Sciences (the Institute of Biodiversity and Ecosystem Research, Institute of Forestry, Institute of Molecular Biology) and one PostDoc from the Sofia University (Biological Faculty, Department of Botany). There was one expert from a governmental institution. Most of the participants from Bulgaria were students (PhD and MSc) from the Bulgarian Academy of Sciences (the Institute of Biodiversity and Ecosystem Research, the Institute of Oceanology, Institute of Forestry) and Sofia University (Biological Faculty - different departments: Ecology and Environmental Protection; Zoology and Anthropology, General and Applied Hydrobiology), but there were students also from the Plovdiv University (five) and the University of Forestry (one). Most of the foreign participants were MSc students. Unfortunately, 13 participants from Turkey, Kosovo and Albania could not participate, due to visa issues.

5. Training course agenda and lectures

The training course was opened by Teodora Trichkova from IBER-BAS, coordinator of ESENIAS-TOOLS project and chair of the ESENIAS network. Every participant introduced himself and made a brief overview of the research activities and his motivation to participate in the training course.

On the 3rd April 2017, the course started with four introductory lectures.

Lecture 1. The first lecture was presented by Prof. Dr. Rumen Tomov and focused on some fundamental issues and most recent developments in invasion biology, focusing on environmental, economic and social impact, risk assessment, and pathways of invasive alien species (IAS) introduction. It emphasised on the risk assessment (definitions, elements of risk, risk analysis) and decision analysis methods with respect to their use for solving issues related to invasive alien species. He gave information about existing lists (results of prioritisation): black list, alert list, watch list, climate list, white and grey lists; and about environmental impact classification for alien taxa (impact categories).

Lecture 2. The second lecture of Prof. Tomov focused on the pathways of biological invasions, and human factor and climate change as drivers of biological invasions. He explained that human factors and the changing climate may directly or indirectly influence the biological invasions by altering the likelihood of introduction or establishment, as well as by modifying the geographic range, environmental impacts, economic costs or management of alien species.

Lecture 3. Dr. Bratanova-Doncheva presented on the ecosystem services assessment and mapping – development and application of the Bulgarian methodology and relation to IAS. She presented on how invasive alien species impact on the ecosystem services, about control methods, including scientific and policy recommendations.

Lecture 4. Prof. Ahmet Uludag shared his experience on the IAS strategy (prevention, early detection and control), international and regional policies, projects and information systems. Furthermore, he focused on EU Regulation on IAS and works of international organisations.

In the afternoon the training course continued with two specialised lectures.

Lecture 5. Dr. Jón S. Ólafsson's talk gave an overview with theoretical background on the effect of invasive alien species on native freshwater ecosystems. In most of the talk he was focusing on Arctic and sub-arctic regions and discussed some foreseeable threats of alien taxa on freshwater ecosystems in northern regions during climate changes. He used case studies from Iceland and elsewhere in the northern hemisphere.

Lecture 6. Dr. David Williams presented empirical studies on the systematics and biogeography of diatoms (especially ancient lakes and circum-Pacific distributions) and theoretical studies related to advances in cladistic (systematic) theory. On the case study of diatoms he illustrated the importance of biogeographical studies for defining the native range and status (native/ alien) of species.

On the 4th April 2017, specialised lectures illustrated by different case studies were presented.

Lecture 7. Dr. Alain Roques presented recent progress in the analysis of invasion patterns of introduced alien species in relation to globalisation. The building of a novel, worldwide database of ca. 46,000 first records of 17,000 established alien species from all animal and plant taxa allowed to study the temporal dynamics of alien species accumulations across regions and taxa, showing that there was no sign of saturation for the establishment of new alien species in most groups. The analysis of long-term changes in rates of species spread, following establishment, also revealed that, in insects at least, the species detected in Europe after 1990 spread roughly 3-4 times faster than the ones that arrived earlier. The relationships between this faster spread and the political changes in Europe following the collapse of the Iron Curtain and the further dismantling of customs checkpoints within an enlarged, free-trading European Union were discussed. The interactions between climate change and invasions were also considered using specific case studies such as the pine processionary moth and the colonisation by alien insects of tropical/subtropical trees planted in Europe.

Lecture 8. In his lecture, Dr. David Finger discussed numerical modelling approaches illustrated by case studies from Europe and North America. Increasing anthropogenic pressure and changing climatic conditions are affecting vital freshwater systems across Europe. Enhanced input of nutrients due to overfertilisation can lead to eutrophication, climate changes can enhance conditions for new species, pollution can endanger aquatic life and imported species can change the complex interaction within the ecosystem. Numerical modelling of aquatic ecosystems can provide valuable insights into the dynamic functioning of complex freshwater ecosystems, revealing the main threats to proper functioning of the systems. The lecture concluded with an outlook on how data from ESENIAS-TOOLS project could be used with modelling studies to assess and predict anthropogenic and climatic impacts on freshwater ecosystems.

Lecture 9. Prof. Agata Wojtal presented the unique high-mountain water bodies and several diatoms that are closely related with these conditions and possess high indicative potential. She pointed out that the autecology of many diatoms is still understudied. She presented some of her work on the influence of high-mountain oligotrophic habitats on diatoms in Poland and Bulgaria, based on fossil and recent materials. As a result, some data about their autecology and biodiversity in the past and present were provided. In addition, the current quantitative changes among the taxa that are scattered and those whose occurrence is limited to the oligotrophic alpine habitats were discussed.

Lecture 10. Prof. Nadja Ognjanova presented on the stalked diatom *Didymosphenia geminata* (Didymo), which has historically been found in cool oligotrophic waters of northern Europe and northern North America. Since the mid-1980s, this diatom has been observed increasingly in new areas, e.g. New Zealand, Iceland and at high elevation in the Alpine areas. Recently, the species has also been recorded in high-mountain areas in southern Europe. The diatom data from the Rila Mountains, Bulgaria, including both fossil and recent records, provide some evidence for the distribution of *D. geminata*. These data serve also as a basis to define more accurately the habitat preference of this species. Although Didymo does not present a significant human health risk it can form massive blooms and may have negative impacts on stream habitats, hampering fishery and degrading the recreational value of streams.

Lecture 11. In his lecture, Prof. Zlatko Levkov presented data from 20-year research on diatoms from Lake Ohrid. The lake is known as a centre for biodiversity with high degree of

endemism, but still there are many open biological questions about the origin and speciation of diatoms. What are the main factors influencing the speciation and what is the resistance and resilience of the lake. One of the question was why some relict diatom species were still living in the lake and what factors allow their long existence in the lake. The increasing threats as invasive alien species to endemic flora and fauna in the lake were discussed.

Lecture 12. The talk of Dr. Ingi R. Jónsson gave an overview on the invasive alien freshwater species in Iceland. He focused on fish, but presented also about the existence of the diatom *Didymosphenia geminata*. The subject was discussed in the context of angling fisheries in freshwaters in Iceland. He emphasised on the importance of risk assessment guidelines and management plans to guide the experts in their efforts to control the invasive alien species.

The topics addressed during the course were of great interest to the participants. Many questions arose regarding different aspects of IAS impact on biodiversity and ecosystem services in extreme environments, the methods for monitoring and control. Many discussions were held among the lecturers, scientists, and students about the imparting basic skills and competencies on IAS, its related terminology, the relevant international regulatory framework, and networks.

6. Field trip

Prior to the training course (on 2nd April 2017), a field trip was organised for the lecturers and the students that arrived earlier. During this trip the Rila National Park and the Iskar Reservoir were visited. The Rila National Park is the largest in Bulgaria and is among the largest and most important protected areas in Europe. Two thirds of its territory are taken by centuries-old forests, its biodiversity is impressive and its flora and fauna are rich of endemic and relict species. The Iskar Reservoir is one of the biggest reservoir in Bulgaria. It is a pristine water body, used for drinking water supply to Sofia city, the capital of Bulgaria. Information about the native flora and fauna as well as the potential threats from invasive alien species was presented to participants at the sites visited.



7. Feedback from participants

A feedback form was provided with the course materials at registration. At the end of the course all participants were asked to fill the form answering questions about the content and the organisation of the course. Overall, most participants evaluated the usefulness of the information and the training materials received, the structure and the pace of the training sessions, etc., as excellent or good. The majority of the participants pointed out as the best features of the training the following: the variety of the topics and examples, as well as of the backgrounds and nationality of the instructors; focus on different taxa and methods; new ideas, experience and contacts together with the possibility to interact with the lecturers and other young researchers from various fields of study. The students appreciated greatly the passion and enthusiasm of the lecturers and the helpfulness of the organisers. Some of the participants made recommendations including: shortening the lectures to allow for increasing the interaction among participants and the time for discussions; and expanding on the topics to include for example higher plants, marine habitats and vertebrates.

