



FINS

FRESHWATER INVASIVES NETWORKING FOR STRATEGY

Book of abstracts of FINSII conference

11th - 14th July 2016

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Introduction

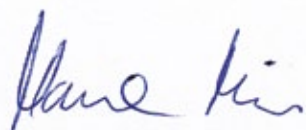
University of Zagreb, Faculty of Agriculture (UNIZG-FAZ) is dedicated to the education of highly qualified experts, development and broadening of professional knowledge in the field of agriculture and related sciences. Applying the highest academic standards we enable students to acquire competences based on the newest scientific knowledge, for the benefit of the society. In addition to teaching, the scientific research is a fundamental activity taken in pursuit of our mission - improvement in the Croatian agricultural sector. The University of Zagreb, Faculty of Agriculture holds a leading position in the Croatian agricultural science by the number of scientists, scientific projects and publications. The scientific research is frequently done in collaboration with other scientists and institutions both in Croatia and abroad. During the recent years, the Faculty has had permanent increase in scientific production, primarily in number of projects awarded, papers published in prestigious scientific journals, and in organization and active participation in scientific conferences and congresses. One of our main objectives in the scientific research is to enable transfer of knowledge and scientific results to the business sector, and to take part in their implementation.

European Inland Fisheries and Aquaculture Advisory Commission (EIFAAC) is a statutory, advisory body of the Food and Agriculture Organization (FAO) of the United Nations. Established in 1957, it is an inter-governmental forum providing advice, delivering effective research and encouraging stakeholder participation on inland fisheries and aquaculture issues across all European countries. Governments, institutions and agencies can benefit from international advice derived from the EIFAAC's network of policymakers, managers, scientists and others working on inland fisheries and aquaculture issues. It is for this reason that EIFAAC and UNIZG-FAZ share common goal in the development of strategies to address threat of aquatic invasive species.

Croatian Biological Society (HBD) is a non-profit legal entity operating on Croatian territory. The association is a direct successor of the Croatian Natural History Society (HPD) established 1885. Given that one of the objectives of HBD's is effect on the protection and preservation of nature, biodiversity and the environment, through the organization FINS Congress, UNIZG-FAZ shares a similar goal.

Biological invasions are recognized as a major threat to biodiversity and their impacts in freshwater environments represent a growing concern. Policy and legislation, citizen awareness and management approaches to deal with introduced aquatic species (IAS) in different countries in the Europe still are various. It is particularly of concern that still in several European countries, legislation and management for IAS entirely missing. Thus, the primary objective of the conference is to share new information's and provide a forum where international scientists, policy makers and stakeholders would be able to encourage the development of the management and policy in this increasingly important area.

Chairperson of FINS II



Assoc. prof. Marina Piria

University of Zagreb, Faculty of Agriculture

Prof. Zoran Grgić, dean

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PROGRAMME OF EVENTS

Monday 11th July

- 16.00-18.00 Registration at University of Zagreb, Faculty of Agriculture
18.00-20.00 Welcome / Opening address

Tuesday 12th July

- 8.00-onwards Registration
8.30-17.00 Poster session all day
8.30 Welcome from Conference chair

INVITED SPEAKER'S PRESENTATIONS

THE BEST PRACTICE FOR THE CONTROL OF FRESHWATER INVASIVE SPECIES, BIOSECURITY, DATA MANAGEMENT

CHAIRPERSON: FRANCES LUCY

- 8.45-9.30 **Gordon Copp**, Salmon & Freshwater Team, Centre for Conservation Ecology and Environmental Science, U.K.
Best practice in aquatic biosecurity: the GB experience
- 9.30-9.40 Discussion
- 9.40-10.20 **Quentin Groom**, Botanic Garden Meise, Domein van Bouchout, Belgium
Biodiversity data interoperability, the dreams, the opportunities and the challenges
- 10.20-10.30 Discussion
- 10.30-11.00 **Emanuelle Sarat**, IUCN French committee, France
Tools and networking for improved an management of IAS in aquatic environments: a French insight
- 11.00-11.10 Discussion

TEA/COFFEE

IMPACTS OF INTRODUCED FRESHWATER INVASIVE SPECIES, INVASION ECOLOGY OF FRESHWATER INVASIVE SPECIES

CHAIRPERSON: TEA TOMLJANOVIĆ

- 11.30-12.10 **Predrag Simonović**, University of Belgrade, Faculty of Biology, Serbia
Brown Trout Salmo cf. trutta L. – a Case Species for Fishery- and Aquaculture-Vectorized Invasiveness
- 12.10-12.20 Discussion
- 12.20-13.00 **Lorenzo Vilizzi**, Muğla Sıtkı Koçman University, Faculty of Fisheries, Turkey
Impacts of introduced freshwater invasive species: a case study for common carp Cyprinus carpio
- 13.00-13.10 Discussion

LUNCH

PATHWAYS AND VECTORS OF INTRODUCTIONS, RISK MANAGEMENT AND PREVENTION OF SECONDARY SPREAD

CHAIRPERSON: JOE CAFFREY

- 14.30-15.15 **Elena Tricarico**, University of Florence, Italy
How freshwater aliens are entering in Europe: old and new pathways to face
- 15.15-15.25 Discussion
- 15.25-16.00 **Božena Mitić**, University of Zagreb, Faculty of Science, Department of Biology (Botany)
Invasive alien plants in Croatia - situation and vision ten years later
- 16.00-16.10 Discussion
- 16.10- 16.45 **Jasna Lajtner**, University of Zagreb, Faculty of Science, Department of Biology (Zoology)
Invasive freshwater molluscs in Croatia: introduction pathways, current distribution, impacts and management methods
- 16.45-16.55 Discussion

TEA/COFFEE

FRESHWATER INVASIONS IN A TIME OF GLOBAL SOCIAL AND CLIMATE CHANGE,
CITIZEN SCIENCE

CHAIRPERSON: NIKICA ŠPREM

- 17.25-18.00 **Martin Weinländer**, REVITAL Integrative Naturraumplanung GmbH, Austria
Freshwater invasions in a time of global social and climate change
- 18.00-18.10 Discussion
- 18.10-18.45 **Dušan Jelić**, Croatian Institute for Biodiversity, Croatia
Ecological impacts of invasive fish species on Dinaric Karst poljes
- 18.45-18.55 Discussion
- 18.55-19.35 **Helen Roy**, Biological Records Centre, Centre for Ecology & Hydrology, UK
Alien species and citizen science: from individuals to communities and beyond
- 19.35-19.45 Discussion
- 20.30-21.30 ZAGREB CITY - GUIDED WALKING TOUR - optional

Wednesday 13th July

8.30-17.00 Poster session all day

WORKSHOP SESSION

9.00-10.30 Legislative EU / non EU countries & The best management and biosecurity practice for control

TEA/COFFEE

11.00-12.00 Legislative EU / non EU countries & The best management and biosecurity practice for control
(continued)

LUNCH

14.00-15.30 Data management and early warning & Pathways of introductions and Citizen Science

TEA/COFFEE

16.00-17.00 Data management and early warning & Pathways of introductions and Citizen Science (continued)

18.00-19.00 ZAGREB ZOO – GUIDED WALKING TOUR - optional

Thursday 14th July

Synthesis session

8.30 Introduction

8.45 Reports from Wednesday's workshop sessions

9.30 Discussion

10.00 TEA/COFFEE

10.30 FINAL SYNTHESIS

11.00 Busses depart for FIELD TRIP - The Croatian Center for the indigenous species of fish and crayfish of karst ecosystems, Otočac

14.00 Lunch – Motel “Mirni Kutak” (traditional trout dish)

20.00 Banquet in Zagreb – restaurant “Maksimir”

Congress ends on 14th July

Friday 15th July: excursion to the Plitvice Lake

8.30 Departure - Faculty of Agriculture

Estimate time of arrival 19.00

Workshop issues

LEGISLATIVE EU / NON EU COUNTRIES

Date: 13th July, 2016

Time: 9.00a.m.

Room: Mala vijećnica

Leader: Marina Piria

Co-Leader: Predrag Simonović

Rapporteur: Tea Tomljanović

Topics
Progress at national level after new regulation IAS (EU) Regulation No 1143/2014 come out
Effective laws and regulations at country level
Effective pet trade import control
Desinfection control at country level
Risk assesment regulation
Black list development and regulation
Online databasis regulation
IAS strategy

THE BEST MANAGEMENT AND BIOSECURITY PRACTICE FOR CONTROL

Date: 13th July, 2016

Time: 9.00a.m.

Room: Velika vijećnica

Leader: Emanuelle Sarrat

Co-Leader: Gordon Copp

Rapporteur: Joe Caffrey

Topics
Prioritization
Eradication or control
Risk assesment standardization
Knowledge gaps
Development of new techniques
Funding for research and development of biocontrol

DATA MANAGEMENT AND EARLY WARNING

Date: 13th July, 2016

Time: 14.00p.m.

Room: Mala vijećnica

Leader: Quentin Groom

Co-Leader: Martin Weinländer

Rapporteur: Frances Lucy

Topics
Data standardization
Data sharing policy
Data storage
Software development
Early warning tool development (eg. MISIN)
Trusted and untrusted data
Black list development

PATHWAYS OF INTRODUCTIONS AND CITIZEN SCIENCE

Date: 13th July, 2016

Time: 14.00p.m.

Room: Velika vijećnica

Leader: Elena Tricarico

Co-Leader: Aljoša Duplić

Rapporteur: Dušan Jelić

Topics
Action plan to manage pathways to prevent new IAS introduction and establishment
Measures to tackle transportation of IAS
Pathways identification at country level
Citizen science establishment at country level
Reliable of detections
Knowledge transfer

SPEAKERS
Biographies and Abstracts

THE BEST PRACTICE FOR THE CONTROL OF FRESHWATER INVASIVE SPECIES & BIOSECURITY

Prof. Gordon H. Copp



Following a BSc in Biology/Environmental Studies in his native Canada, Gordon undertook post-graduate training in environmental science & technology in Delft (Netherlands), worked for the Canadian National Research Council in environmental sciences and then completed his doctoral studies in the environmental biology of floodplain fishes at the “Université de Lyon” (France). Post-doctoral research in England with the Freshwater Biological Association, on 0+ fish recruitment in the River Great Ouse, was followed by 10 years as a lecturer/reader in ichthyology at the University of Hertfordshire (England). During this period, Gordon’s research expanded to include otter-fish interactions and initial studies of non-native fishes. He was awarded a “Habilitation à Diriger la Recherche” in ichthyology by the “Université de Toulouse” (France) in 1996, followed by his appointment

to Reader in Ichthyology. Following an 18-month research sabbatical in France, Gordon joined Cefas (England), and he is currently a Principal Scientist in Fish Biology, with visiting professorships at Bournemouth University (England) and Trent University (Canada). Since joining Cefas in 2002, Gordon’s research has focused on the environmental biology and impacts of non-native freshwater fishes and on the development and application of risk analysis protocols for the assessment of non-native species under both national (UK) and international (EU) legislation. For over ten years, Gordon coordinated a NATO-funded collaborative linkage network on the use of life-history traits to predict the invasiveness of freshwater fishes. This research has expanded in recent years to include the use of environmental DNA (eDNA) for the detection of non-native freshwater fishes. As part of his duties, Gordon provides scientific advice on non-native species and their risk analysis to the UK Department of Environment, Food & Rural Affairs. He is also a member of the UK-TAG Alien Species Group as well as a UK delegate on the ICES Working Group on the Introduction and Transfer of Marine Organisms (WGITMO).

Abstract

Best practice in aquatic biosecurity: the GB experience

Gordon H. Copp^{1,2*}, J. Robert Britton²

¹*Salmon and Freshwater Team, Centre for Environment, Fisheries and Aquaculture Science, Pakefield Road, Lowestoft, NR33 0HT, UK and Environmental and Life Sciences Graduate Program, Trent University, Peterborough, Ontario, Canada*

²*Centre for Conservation and Environmental Change, School of Conservation Sciences, Bournemouth University, Poole, Dorset, BH12 5BB, U.K.*

*corresponding author, e-mail: gordon.copp@cefas.co.uk

Biosecurity is a vast topic that is worthy of an entire lecture series, so this talk will focus on the biosecurity of aquatic taxa other than diseases (e.g. parasites, pathogens) and other infectious agents, which are usually addressed under separate legislation/regulations and risk analysis protocols. Using Great Britain as the case stu-

dy, this talk will touch on four pillars of aquatic biosecurity, including non-native species (NNS): 1) Strategy & Education, 2) Legislation & Regulation, 3) Research & Evaluation, and 4) Management & Review. The first of these involves a review of NNS policy to develop recommendations that identify essential elements for an effective strategy, such as underlying principles (e.g. CBD compliance, precautionary approach), legislative NNS drivers (national and international), a national NNS structure (e.g. mechanism, coordinating body), policy and practices for prevention and risk analysis (including horizon scanning, risk review and policy/practice revision), an early detection and rapid response strategy, as well as public and stakeholder involvement. The examples will include fundamental issues such as the choice between black or white lists of species for regulation and control, and how to balance the risks posed by the invasive species and the risks of impacts associated with the various management options, i.e. is the cure worse than the disease?

Keywords: non-native species, screening tools, risk analysis, environmental management, eradication, public awareness

Emanuelle Sarat



Emmanuelle is a scientific officer for invasive alien species at the IUCN French committee. She is in charge of the French Biological invasions in aquatic environments (IBMA) work group since 2014. The group serves as an interface for communication and discussion on how to manage IASs in aquatic environments. Its main objective is to assist managers and support decision makers by providing knowledge gained on how to manage invasive alien species. Many operational tools have been developed and are available on a dedicated internet platform (www.gt-ibma.eu), such as species factsheets, management insights and an information database. The work group has recently drafted a best practice guide on IAS, intitled “Invasive alien species in aquatic environments. Practical information and management insights”. Two volumes clearly present the situation and propose a scientifically based approach to assist freshwater managers in setting up management projects. Though no “cure alls” currently exist, the guide offers highly useful information while attempting to address the specific aspects of each situation, including the site, the species to be managed and the necessary technical and financial resources.

Abstract

Tools and networking for an improved management of IAS in aquatic environments: a French insight

Emmanuelle Sarat^{*1}, Yohann Soubeyran¹, Alain Dutartre², Nicolas Poulet³

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³*French National Agency for Water and Aquatic Environments, Research and development department, Allée du professeur Camille Soula, 31400 Toulouse, France*

Invasive alien species and their impacts in freshwater environments represent a growing concern for the managers of natural areas. Local stakeholders face common limits, such as low public awareness or limited access to information. In order to respond to these critical issues, a French work group on Biological invasions in freshwater environments, was created in 2009 with the objectives to increase management capaci-

ties by developing guidelines and operational tools intended for managers and decision-makers. Coordinated by the French National Agency for Water and Aquatic Environments (ONEMA) and the IUCN French Committee, this working group brings together more than 60 experts and stakeholders involved in the different aspects of IAS management including researchers, natural area managers, NGOs, local authorities, etc. The working group's activities are determined by the shared needs of the formed network. Examples of projects include: 1) the development of a dedicated website (<http://www.gt-ibma.eu/>) to provide access to information such as protocols for control, strategies and regulations in force and others useful websites; 2) the publication of a best practices management guide with fully detailed management feedback; 3) the setting up of a database on introduced aquatic species in France.

The working group is an original interface between different categories of stakeholders. It improves communication, ensures the integration and accessibility of the available information and helps the coordination of management actions. It provides a useful support for the French national strategy in progress on invasive alien species, by targeting the priority needs of managers in order to tackle biological invasions.

Keywords: IAS management, best practices, operational tools, guidelines, networking, freshwater environments

DATA MANAGEMENT

Dr Quentin Groom



Quentin Groom is a botanist and informatician at the Botanic Garden Meise in Belgium. Quentin has a degree in Botany and a PhD in plant physiology, he has worked in botanical research in the UK, USA and Belgium. His research career has involved many aspects of plant biology including molecular biology, biophysics and biochemistry. However, for the past fifteen years he has worked at the interface of botany and information technology. At the botanic garden he is responsible for the virtual herbarium and the digitization of literature, but he also conducts research on invasive species, biogeography, and ecology. Currently he is promoting the use of data management planning to ensure the openness, longevity and interoperability of biodiversity data. In 2016 he will be working on a task group for the Global Biodiversity Information Facility on invasive species data. He would like to improve the interoperability of data to automate many of the monitoring and modelling activities that are currently limiting the output of biodiversity research.

Abstract

Biodiversity data interoperability, the dreams, the opportunities and the challenges

Quentin Groom

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Assembling data, analysing it and crafting it into reliable information that is suitable for evidence-based policy making on invasive species is far from easy. A staggering amount of data is collected on the biodiversity

of the earth. These include observations, specimens, measurements of traits, interactions between organisms, their ecology and their genetics. Informaticians dream of being able to collect all these disparate strands of evidence together to obtain new information, to project future scenarios and better understand biological invasions to inform management decisions. By connecting these data we hope to predict the likely outcome of environmental change and in the case of invasive species we would like to be able to anticipate invasions and do this quickly enough to make effective policy and put into effect preemptive management decisions. Nevertheless, doing this presents numerous challenges. These data are held by a large number of people, institutions and countries. There are issues of data standardization, data sharing policy, a lack of resources and inadequate software. Yet the dream of full data interoperability is not technically impossible, it is just difficult. It is also a problem that can be broken down into smaller parts, each of which is manageable. Institutions and researchers can work towards this goal by valuing the data they collect and realizing that sharing it openly leverages those data most effectively. An important step to improve the situation is data management planning. This is becoming an important part of research management, ensuring that the investment in data collection is not wasted and that the collectors of these data are appropriately acknowledged. With a change in philosophy by researchers and their institutions problems of data loss and inoperability can be solved and we can approach the seemingly distant goal of joined up biodiversity data management.

IMPACTS OF INTRODUCED FRESHWATER INVASIVE SPECIES & INVASION ECOLOGY OF FRESHWATER INVASIVE SPECIES

Prof. Predrag Simonović



Professor Predrag Simonović is a lecturer in Vertebrate Zoology, Systematics and a reader in Ichthyology (Introduction to Ichthyology and Introduction to Fisheries Sciences) at the University of Belgrade – Faculty of Biology. Research group he leads works through the Center for Genotyping of Fisheries Resources on phylogeography, systematics and fishery management of salmonids in the Western Balkans region, as well as on impact of alien fish species and water quality assessments. Center was founded in Spring 2012 and hosted researchers from the Western Balkans region interested for collaboration. Analyses of brown trout populations aim to help in their sustainable management and conservation of their indigenous stocks in the region.

Abstract

Brown Trout *Salmo cf. trutta* L. – a Case Species for Fishery- and Aquaculture-Vectorized Invasiveness

Predrag Simonović¹, Ana Tošić¹, Danilo Mrdak², Dubravka Škraba¹, Marina Piria³, Vera Nikolić¹

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Use of the control region (CR) of mitochondrial DNA (mtDNA) as a molecular marker revealed occurrence of 18 haplotypes in brown trout *Salmo trutta* from four (Danubian Da, Atlantic At, Adriatic Ad and *marmo-*

ratus MA) phylogeographic lineages in the Danube basin of Western Balkans. Brown trout of the Da lineage aboriginal for the area in concern has a prominent overall diversity $H_d = 0.987 \pm 0.0097$ (SE). Assessment of over 60 brown trout samples revealed that majority (55.7%) is still pristine, with brown trout with only one Da haplotype. The importance of brown trout for fishery has led to introductions of non-indigenous and domesticated At1, Da2 and Adcs1 haplotypes into nearly 20% of trout streams that are mainly attractive for, and strongly subject to angling pressure. Uncontrolled stockings lasting over a century threatened the mostly streams which hold exclusive, either primitive, i.e., ancient (Da*Vr, Da*Dž, Da-s6), or advanced, i.e., derived haplotypes (e.g., Da*Vl, Da22, Da23c). In addition to widely distributed and indigenous Da1 haplotype, domesticated haplotypes with the long stocking history and of wide distribution were detected. All of them pose a great risk to indigenous brown trout in the recipient area, with the aquaculture and environmental sectors detected as the mostly affected. In addition to adverse effects in conservational sense, those in environmental (e.g., increase in competition and predation), population structure (e.g., loss of co-adapted gene complexes), fishery management (e.g., increase in fishing efforts) and aquaculture (e.g., introduction of diseases) senses should not be neglected. The setting of network for development of a common policy in precautionary trout fishery management and its implementation would stop further deterioration of the conservational status of all brown trout populations, without affecting the trout fishery in Western Balkans. That would lead to the effective control of the trade with brown trout stocking material in the Western Balkans region, with the reliable genotyping of brown trout hatchery brood stocks using both mitochondrial and nuclear genetic markers.

Keywords: Molecular diversity, Brown trout, Non-indigenous strains, Regional networking, Invasiveness, Conservation

Dr Lorenzo Vilizzi



Lorenzo is an aquatic scientist with extensive research experience with freshwater fishes and a solid background in statistical ecology. He is one of the world's leading experts in the biology of invasive common carp *Cyprinus carpio*, and as a complement to his fish biology background he is exceptionally strong in statistics and programming. In this respect, he has provided significant contributions to the mechanics of risk screening tools for aquatic invasive species, which have been applied successfully across all five continents. Over the past 25+ years Lorenzo has been working both as an academic researcher (UK, Australia and, currently, Turkey) and as an independent consultant to several academic and research institutions worldwide.

Abstract

Impacts of introduced freshwater invasive species: a case study for common carp *Cyprinus carpio*

Lorenzo Vilizzi

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As the most widely distributed freshwater fish worldwide, common carp *Cyprinus carpio* can be either invasive or 'naturalised' in most areas of introduction. This leads to different levels of perception regarding its role in freshwater ecosystems, with experimental research focusing either on its 'middle-out' impacts or overall function in limnological processes. At the same time, the large scales at which carp dynamics ope-

rate may severely limit the validity of laboratory and, oftentimes, field experiments in extrapolating results to real-world ecosystems. In this study, 129 laboratory, field and 'natural' experiments were systematically reviewed through causal criteria analysis, and within an historical/biogeographical and risk assessment context. Of the 19 countries where experiments were conducted, only four were considered as 'low risk' and one as 'no risk', the other being 'medium' to 'high risk'. Experimental findings from 373 component-wise assessments supported the framework of effects on water quality, vegetation, invertebrates and vertebrates, with the latter including also amphibians and waterfowl, previously unreported. Stronger evidence was provided by natural and field relative to laboratory experiments, reflecting the reductionism of the latter. Critical biomass for an impact was highly dependent on experimental set-up, even though the overall threshold of ≈ 200 kg ha⁻¹ under natural conditions supported recent findings. Management of carp should reflect the level of current and potential risk posed by the species in its different areas of distribution, thereby accounting for projections of further spread but also for unsuccessful colonisation. Future experimentation should favour a holistic \rightarrow reductionist over a reductionist \rightarrow holistic approach.

PATHWAYS AND VECTORS OF INTRODUCTIONS

Dr Elena Tricarico



Elena has received a strong training in ecological and ethological methods at the University of Florence (Italy), where she studied and gained her Masters and PhD on Ethology and Animal Ecology, working mostly on aquatic invertebrates. Since her Masters, she has dealt with the biological invasions problem, particularly in freshwater ecosystems, through different perspectives, from behavioural ecology to management aspects. Elena has participated to 15 national and 10 European projects (as DAISIE, IMPASSE, 3 LIFE projects, a Marie Curie ITN), mainly on alien species. After her PhD, she started to work on the predictive aspects of this problem (e.g. risk assessment), also in relation to the climate change. Her main fields of research range from biological invasions to social behaviour in invertebrates, leading her to travel around Europe, USA and Africa, and to establish many fruitful collaborations. Elena is involved in the COST Action TD1209 (Alien Challenge), and was co-responsible

for the revision of the freshwater species of the EASIN catalogue for the JRC, and, since 2014, has been on the editorial board of the EASIN. She has produced 63 papers in peer-review journals, mostly on alien species, 8 book chapters, 1 book, 31 technical reports for national and European projects. Currently, at the University of Florence she is a research fellow, working on alien crayfish management for the project LIFE+ NAT SOS TUSCAN WETLANDS, and for the Marie Curie ITN Aquainvad-ED (focussed on aquatic aliens), and lecturer for the courses Invasion Biology, Management and Conservation of the wildlife, and Zoology. She is also collaborating with NERC-CEH (responsible: Prof. Helen Roy) for updating and reclassifying the pathways of freshwater aliens in EASIN following the Convention for Biological Diversity standard.

Abstract

How freshwater aliens are entering in Europe: old and new pathways to face

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Introductions of freshwater alien species in Europe have been increasing throughout the years, especially in the last 60 years, thanks to the intensification in mobility and economic trade as well as the development of advanced aquaculture techniques and the opening of major inland waterway canals. In European freshwater ecosystems, there are currently 756 alien species, introduced mainly through aquaculture, pet/aquarium trade and stocking activities. Pathways differ according to the different European areas (e.g. introductions through corridors in Central/North-eastern Europe, through release in Central/Western Europe) and time (more intentional release through pet/aquarium trade today than in the past). Germany, the United Kingdom and Italy are the main entry gateways of freshwater alien species. Considering the severe impacts exerted by many aquatic invaders, management efforts should be promoted to tackle these pathways in order to decrease the rate of introductions and to comply with the current EU legislation on alien invasive species.

Prof. Božena Mitić



Božena Mitić is a botanist, working at the University of Zagreb, Faculty of Science, since 2013 as a full professor. At the beginning of her research career Božena has had a PhD degree in plant taxonomy and systematic, was sometimes involved in some nomenclature investigations, but she has also participated in researches of Croatian terrestrial and freshwater flora. In the past 10 years her research activities were extended on invasive alien plants and palynology. She is strongly involved in aerobiological researches in Croatia, especially those connected with monitoring of Ambrosia pollen in the air. Together with colleagues from her group she launched and developed national standards and the preliminary list of invasive alien plants for Croatia. As a collaborator of the database Flora Croatica Database she permanently works on the

mapping and distribution of invasive alien plants in Croatia, and at the moment on the revision and updating of the list of non-native plants in Croatia. Devoted to dealing with invasive alien plants, Božena is also very active in raising public awareness about the problem of invasive species, and often collaborates with colleagues in the national institutions responsible for nature protection and legislation on invasive alien species. At the Department of Biology, Faculty of Science Božena is the course leader and lecturer for students at the undergraduate, graduate and PhD level for different botanical courses (Plant Morphology, Palynology, Invasive Plants etc.). Under her mentorship more than 60 graduate theses, master's theses and dissertations were defended, some topics were related with the invasive alien plants in Croatia. Božena has so far published over 80 scientific papers and books (including one manual on Invasive alien plants in Croatia), some of them related to the problem of invasive plants in Croatia. She was the leader of the projects and a collaborator in a number of research projects, among others she is the substitute member for Croatia for the COST Actions ALIEN CHALLENGE and SMARTER.

Abstract

Invasive alien plants in Croatia - situation and vision ten years later

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Ten years ago there were no organized efforts in plant invaders inventory or appropriate actions in Croatia. The first national project on invasive flora was performed in 2006 and was the beginning of more organized

work on invasive alien plants in Croatia. Since then national standards, criteria, and terminology (harmonized with European standards for alien flora treatment) were adopted, and a preliminary list of invasive alien plants in Croatia was prepared. Furthermore, the new module “Allochthonous Plants” of the Flora Croatica Database (<http://hirc.botanic.hr/fcd/InvazivneVrste/Search.aspx>) was developed, as a platform for national monitoring and mapping of alien/invasive plants. According to our current knowledge, in Croatia we have 74 invasive alien plants, most of them terrestrial. At least one invasive alien plant was detected on 49% of the state territory (57,000 km²). The greatest number of invasive plants was recorded in the major urban centres, increasing in the south-east direction and the most endangered are Mediterranean areas. Only eight freshwater alien plants were reported, out of them six are invasive (*Azolla cristata*, *A. filiculoides*, *Elodea canadensis*, *E. nuttallii*, *Paspalum distichum* and *P. dilatatum*). Their current status, impacts and other available data will be briefly discussed. Additional problem for freshwater ecosystems in Croatia is the fact that some native plants (e.g. *Hippuris vulgaris*) in specific circumstances show great invasiveness.

The success of a decade of intensive work is reflected in better collaboration of botanists, ecologists, agronomists, foresters, policy makers, experts in the national institutions responsible for nature protection and legislation on invasive alien species etc., to gain more success in solving the complex problem of invasive plants. However, there are still a lot of “gaps” - no organized and documented monitoring, eradication actions, prevention measures etc. Nevertheless, results from the continuous ten-year work on invasive alien plants in Croatia should provide a reliable national and regional framework for strategic planning regarding the IAS management.

Keywords: Croatia, invasive alien plants, freshwater alien plants, Flora Croatica Database

Prof. Jasna Lajtner



Jasna Lajtner is Assistant Professor at the Department of Biology, Faculty of Science, University of Zagreb. She is a lecturer for students at the undergraduate, graduate and PhD level and teach a few different courses, among them Malacology, General Zoology and Invasive Species. More than 50 graduate theses were done under her mentorship, as well as one master thesis and one doctoral thesis. At the beginning of her research career Jasna has accomplished Master degree in Ecotoxicology (acute and sub-chronic toxicity tests with freshwater molluscs, histopathological changes as a result of toxicity). For the past 15 years her main research interest was ecology, distribution, taxonomy and phylogeny of freshwater snails and bivalves. The current focus of her research is distribution and impacts of invasive mollusc species in Croatia. Regarding the problem of invasive species she often collaborates with colleagues in the national institutions responsible for

nature protection and legislation on invasive alien species.

Abstract

Invasive freshwater molluscs in Croatia: introduction pathways, current distribution, impacts and management methods

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Invasive mollusc species may have dramatic impacts on native biota and ecosystem functioning because they are direct competitors for food and space with the native species. Eight alien invasive mollusc species have

been confirmed in Croatia to the date: the bivalves *Dreissena polymorpha*, *D. bugensis*, *Sinanodonta woodiana*, *Corbicula fluminea* and *C. fluminalis*, and gastropods *Potamopyrgus antipodarum*, *Physella acuta* and *Ferrissia fragilis*. *D. polymorpha* has become one of the most dominant species in many lakes and rivers of Europe and North America since it began spreading from the Caspian area in the early 19th century. Big invasive success of this species could be attributed to ability of adults to adhere to hard surfaces with their byssus, to development of free-swimming veliger larvae, and to its extraordinarily high fecundity. In Croatia, *D. polymorpha* was recorded in rivers Danube, Drava, Sava, Kupa and Dobra, and in the Vrana Lake. Similar to the previous species, *D. bugensis* is also of the ponto-caspian origin but in Croatia was recorded only in the Danube River. *S. woodiana* is native for the Eastern and South-Eastern Asia. The spread of this species in some areas of Europe, Central and North America is mainly due to the introduction of some Asian indigenous fish species acting as a host of mussel's parasitic larvae and therefore *S. woodiana* has become direct competitor for fish hosts with the native unionids. This species has the widest range of distribution in continental part of Croatia, including large rivers and their tributaries, as well as fish ponds and lakes. *C. fluminea* and *C. fluminalis* are native species in Eastern Asia. In Croatia, *C. fluminea* was recorded in rivers Danube, Sava, Drava and Kupa while *C. fluminalis* was up to now recorded only in the Danube River. The main pathway for these two species was construction of the connecting canals between Danube, Rhine and Main. Snail *P. antipodarum* is native to the freshwater streams and lakes of New Zealand. However, species have become invasive in Australia, Europe and North America. In Croatia, this species has established stabile populations in rivers Mirna and Drava. Snails *P. acuta* and *F. fragilis* are native to the North America. Both species have been widely introduced across Europe to the point where they became almost cosmopolitan. In Croatia, *F. fragilis* was recorded in rivers Sava and Korana, and also in some oxbows of the Sutla River, while the species *P. acuta* has a wide range of distribution. Finally, because negative impacts of some mollusc invasive species on native species were already recorded, and the process of their expansion in Croatia will continue, monitoring of these species is required in the future.

Keywords: Dreissena polymorpha, Sinanodonta woodiana, Corbicula fluminea, Potamopyrgus antipodarum

FRESHWATER INVASIONS IN A TIME OF GLOBAL SOCIAL AND CLIMATE CHANGE & CITIZEN SCIENCE

Mag. Dr Martin Weinländer



Martin Weinländer studied at Innsbruck University and received the Master degree in Zoology and Terrestrial Ecology in 2007 on “Effect of *Austropotamobius torrentium* on zoobenthos structure and function in small forest streams” and the Ph.D. degree in Limnology and Invasion Biology in 2012 on “The alien crayfish *Pacifastacus leniusculus* in Carinthia (Austria): invasiveness, threats and ecological effects“. He has worked from 2007-2012 within the River and Conservation Research Group (Head: A.o. Univ. Prof. Mag. Dr. Leopold Füreder) at the Institute of Ecology (University of Innsbruck). His research includes benthic animal communities with a special focus on the ecology, management and conservation of freshwater crayfish as well as landscape analyses (habitat

suitability and fragmentation) within riverine landscapes. From 2012-2013 he worked at the Tyrolean Regional Government in the Department of Environmental Protection. Since 2013 he is an employee at REVITAL Integrative Naturraumplanung GmbH with the focus on freshwater ecology, herpetology, neobiota and conservation.

Abstract

Freshwater invasions in a time of global social and climate change

Mag. Dr Martin Weinländer

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The movement of species into new areas is a natural phenomenon that has occurred throughout evolutionary history (e.g. retreat during ice ages). In a globalised world species invasions are facilitated by human activities allowing alien species to overcome long distances within a brief time. Some introductions of alien species are intentional (e.g. stocking, aquarium release, biocontrol), some are unintentional (e.g. escapes, canals, stow-aways, ballast water release).

However, freshwater invasions can cause a wide range of ecological impacts, including loss of native biodiversity, altered habitats, changes in water chemistry, altered biogeochemical processes, hydrological modifications, and altered food webs. Furthermore alien species are not only affecting ecosystems, but also show socio-economic impacts on local economies, such as fisheries, tourism, and water production.

An aspect associated with the movement of non-native species that is often neglected are the socio-economic implications of their use and spread. Economic activity, particularly globalisation, is the fundamental human cause of alien species introductions. Transcontinental transportation, travel and trade lead to the spread of many alien species. As there is a time lag from the first introduction of a species, its establishment and spread the future invasion problems will be visible in the next decades.

In addition climate change is affecting us faster than anyone projected and will play an increasingly important role in the coming decades. The predicted effects of climate change include physical (e.g. increased temperature and frequency of heavy precipitation events) and ecological (e.g. altered ecosystems and species life cycles, shifts in species ranges) changes. Its consequences (e.g. drought, floods, altered habitat suitability) can enhance invasion processes from initial introduction through establishment and spread.

This keynote gives an overview of freshwater invasions in a time of global social and climate change looking at potential pathways, ecological and socio-economic impacts, future hotspots of invasions as well as management strategies.

Keywords: overview, invasive alien species, pathways, ecological and socio-economic impacts, management strategies

Dr Dušan Jelić



Dušan Jelić (mag. edu. biol. in Reptile Biology-Ecology) (1982) is the President of Croatian Institute for Biodiversity and former director of Croatian Herpetological Society HYLA. His work includes different aspects of Fish, Amphibian and Reptile research, like distribution, ecology, morphology, taxonomy, phylogeny, phylogeography, conservation, etc. He started his PhD in Reptile ecology (focusing on biogeography and species ecological niche overlap) in 2009 and has successfully defended his thesis in October 2013. He worked for 5 years in State Institute for Nature Protection as expert for Amphibians and Reptiles and during this time he edited the second “Red book of Amphibians and Reptiles of Croatia” and worked as expert in designation

of Natura2000 ecological network in Croatia (important sites for Amphibians and Reptiles). In 2009 and 2010 he also led the Amphibian and Reptile inventory project of the border river Una. During his career he was a project leader in over 10 biodiversity projects and some of the longest herpetofauna monitoring projects in Croatia: 6 year (2007-2012) long project for inventory and monitoring of *Vipera ursinii macrops*, 4 year (2009-2012) long project for distribution mapping and monitoring of *Ablepharus kitaibelii*. In 2012-2013 he was engaged as key expert for herpetofauna on MANMON project for NATURA2000 management and monitoring in Croatia. His work on conservation of herpetofauna was recognized internationally when he was asked to film wildlife documentary “In too Deep” with Animal Planet and later “Attenborough Ark” with BBC. He is editor in charge of journal HYLE – herpetological bulletin, editor and reviewer in several scientific journals, author of 7 books and 41 scientific papers (17 in CC or SCI) dealing with amphibians, reptiles and fish.

Publications

<http://scholar.google.hr/citations?user=Bp11AygAAAAJ>

https://www.researchgate.net/profile/Dusan_Jelic

Abstract

Ecological impacts of invasive fish species on Dinaric Karst poljes

Dušan Jelić^{1,2}

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Dinaric Karst is one of the largest karstic regions in the world and its rugged terrain is carved by its complex hydrological network. It represents one of the biodiversity hotspots and region known for high endemism. Freshwater fish belong to a group with very high endemism and this is attributed to level of hydrological complexity and isolation among watersheds. Karstic rivers are exclusively oligotrophic by origin, characterized by large water level oscillations and low yearly mean water temperatures (6 - 14 °C). Due to climatic characteristics, altitude and terrain slope, majority of these waters are naturally inhabited by small number of cold-water fish species. These communities usually do not have a classical composition with all trophic levels being occupied. This leaves a lot of opened ecological niche for possible invaders which become established very quickly. These “first” invaders then start with terraformation and change the habitat by accumulation of alien biomass. This leads to system eutrophication, increase of water temperature and opens new habitats for more invaders. And the endemic fish species are retreating into upper parts of small tributaries and underground cave systems. Recent study of the Lika region showed that 21 out of 31 freshwater fish is invasive. This represents the over-domination of introduced species by the astonishing 300%. But the over-domination in biomass is ~1000 times bigger. The aim of this study is to give review of negative impacts of invasive species on endemic fish populations in a selection of isolated karstic poljes. From presented examples we conclude that: 1) invasion are not directional (or predetermined) but they follow the stochastic model; 2) invasive species can not survive extreme conditions (ex. cave systems); 3) to endemic species, competitive invader is a much more serious problem than predator; 4) fresh water fishes of Dinaric Karst are adapted to retreat into caves, whereas introduced species are not, and establishment of any kind of permanent water bodies should be strictly forbidden.

Dr Helen Roy



Helen is a community ecologist with a particular focus on the effects of alien species on insect communities. As the Head of Zoology within the Biological Records Centre (part of the Centre for Ecology & Hydrology), Helen has the privilege of working with volunteers with expertise in recording wildlife to compile long-term and large-scale datasets on terrestrial and freshwater species. Helen's work focuses on the collaborative use of these large-scale and long-term datasets to understand and predict the effects of environmental change on biodiversity. The current focus of her research is predicting the biological impact of invasive alien species. Helen has led a number of European-wide initiatives on alien species including projects on horizon scanning and risk assessment to underpin the EU Regulation on invasive alien species. Helen is proud to be the chair of the COST Action ALIEN Challenge and has thoroughly enjoyed leading the network of people from more than 35 countries. She has a passion for natural history and science communication. Helen also has extensive expertise in citizen science and coordinates the UK Ladybird Survey as a volunteer but has also developed a number of other citizen science initiatives including the Big Bumblebee Discovery. She recently published a guide to citizen science which has been widely adopted. Helen has recently been awarded the Zoological Society of London prestigious Silver Medal in recognition of her contribution to understanding and appreciation of zoology.

Abstract

Alien species and citizen science: from individuals to communities and beyond

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The number of new species arriving in the UK, and indeed across Europe, is increasing rapidly. There are now more than 14 000 alien species documented across Europe (2000 established alien species in the UK) and about 15% of these species threaten biodiversity, the economy and/or society. Here I provide an overview of invasion biology specifically focusing on recent trends and future predictions. I highlight the invaluable contributions of volunteers to our understanding of invasion biology through citizen science. There is a need to increase understanding of community and ecosystem-level effects of invasions and I suggest that detailed field observations, in part through citizen science, will provide the spatial, temporal and taxonomic breadth required for such research. There is no doubt that innovative technologies and the development of statistical approaches are taking citizen science in new and exciting directions. Citizen science has a bright future with benefits for people, science, and nature.

POSTER ABSTRACTS

Biology of topmouth gudgeon (*Pseudorasbora parva*) in newly invaded waterbodies

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Abstract

The topmouth gudgeon (*Pseudorasbora parva*, Schlegel 1842), a small non-native cyprinid fish, is considered an undesirable species in carp (*Cyprinus carpio*) pond farms as it is an important competitor for food with non-predatory commercial fishes. Both its feeding habits and high numbers can lead to a considerable deterioration in pond environmental conditions. Comparison of severely (14 331 ind.ha⁻¹, 8.12 kg.ha⁻¹) and less severely (370 ind.ha⁻¹, 2.28 kg.ha⁻¹) invaded ponds indicated a significant ($p < 0.05$) increase in BOD₅, N-NO₂, N_{org}, P_{tot}, bacteria and colourless flagellate counts in the former, and significantly ($p < 0.05$) higher zooplankton density (rotifers, copepods, cladocerans and ostracods) in the latter. Topmouth gudgeon diet in ponds consisted mainly of chironomid larvae and zooplankton, most of which were cladocerans (*Daphnia*, *Bosmina*). Periphyton (*Sphaerotilus*, *Oscillatoria*, *Scenedesmus*), macrophytes, copepods and rotifers (*Brachionus*) were also ingested but in comparatively lower proportions. Food similarity (competition) between topmouth gudgeon and carp, the most important commercial fish pond species, was approximately 10% on average (max. 35%) for natural food resources (zooplankton and zoobenthos).

In the small streams and canals connecting pond and reservoir systems, topmouth gudgeon do not display any obvious habitat preference with respect to depth or bottom substrate. Current velocities exceeding 20 cm.s⁻¹, however, do appear to limit their occurrence in streams. The only time topmouth gudgeon were found in stretches with such current velocities was during and just after ponds supporting high numbers of topmouth gudgeon were drained, the fish usually moving away over the following weeks. Despite their inability to withstand long periods of high discharge, canals and streams connecting ponds are considered as reservoirs for the spread of topmouth gudgeon around pond systems.

Keywords: pond aquaculture, common carp, water quality, zooplankton, zoobenthos, food competition, habitat, current velocity

Invasive flora of the Una river

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Abstract

Una River is located in the northwestern part of Bosnia and Herzegovina with a total length of 212 km. It makes a large part of the natural border between Bosnia and Herzegovina and Croatia. Given that the Una River flows through the area that separates the 25 municipalities within the two entities (the Federation and the Serbian Republic) and two countries (Bosnia and Herzegovina and the Republic Croatia), alien plants in water resources in recent years has become more frequent,

primarily due to the facilitation of communication between different regions and the negative anthropogenic impacts. The bed of the river, water structures and travertine Una River are often covered with alien plant species, which could damage the structure and ecological relationship within the community, to have a negative impact on biodiversity and consequently could lead to diversity loss. The aim of the survey is to determine the incidence of invasive plants in the course of the River Una and its littoral zone, due lack of literature data and the results of previously conducted studies. Part of the research carried out during the winter and spring of 2015/2016. The results of changes in the floristic composition and the possible influence of anthropogenic and detailed experimental investigations will be carried out in the summer and autumn of 2016. For this study three sites (site of Martin Brod, site of Bihač and Bosanska Krupa site) were selected. The usual methods of determination, collection and recording of invasive plant species, which are present in the preliminary list of invasive species in Bosnia and Herzegovina, will be conducted.

Keywords: Una, invasive species, site, anthropogenic influence.

Inland Waters: proposal for an international non-governmental organization focused on management and eradication of aquatic invasive species

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Abstract

The present study was undertaken to investigate the need and potential role for a new international non-governmental organization (NGO) focused on conservation of freshwater biodiversity by specializing in eradication of invasive species that threaten endangered species. Aquatic invasive species (AIS) pose a serious threat to freshwater biodiversity. About one quarter (25.9%) of threatened freshwater species are threatened by a problematic invasive or native species, based on an analysis of species on the IUCN Red List (n = 5044). This figure rises to 36.2% among chordates (n = 3134). It is critical to identify and eradicate problematic species in order to prevent future extinctions. At the same time, there is still insufficient international oversight of freshwater invasive species management. With most invasive species management occurring on a local or national basis, approaches and policies differ widely across regions. By creating an international database of past eradication attempts, we can centralize expertise and learn from past efforts, and make this knowledge accessible to others. Additionally, a database is needed of species that are endangered by invaders; such a database should also describe the ecological and political factors that will affect conservation efforts. This will facilitate systematic and strategic prioritization of the most feasible and urgent eradications. We propose that an international NGO focused on freshwater invasive species would provide this much-needed oversight, centralize existing knowledge, and enable prioritization of management and eradication, thereby filling an empty niche in the freshwater invasive species network.

Range expansion of Ponto-Caspian peracarids (Crustacea: Malacostraca): factors of success and future risks

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Abstract

Ponto-Caspian peracarids (amphipods, isopods, mysids and cumaceans) represent one of the most successful groups of aquatic invaders comprising several high-impact species, such as the 'Caspian mud shrimp' *Chelicorophium curvispinum*, the 'killer shrimp' *Dikerogammarus villosus*, or the 'bloody-red mysid' *Hemimysis anomala*. The rate of invasions has not been constant in time; after a surge around the millennium, presently no further large-scale expansions of additional species have been detected for more than a decade.

We compared ecologically relevant traits of invasive and non-invasive members of the group based on both literature and field data (Joint Danube Survey 3, 2013), with the goal of identifying factors of invasion success and making conclusions on future invasion risks. Both datasets indicated substrate preference as the most important factor in spontaneous range expansion; all invasive species are lithophilous, whereas the majority of non-invasives are psammo-pelophilous. The remaining seven presently non-invasive lithophilous species deserve special attention when considering potential future invaders; however, due to their rarity and possible negative interactions with earlier colonists we consider the probability of their expansion in the foreseeable future as low. Their potential expansion would most likely be of minor consequence for stony habitats anyway, since no considerable functional novelty can be attributed to them in addition to species already present. Nevertheless, possible navigation development projects both in the Danube-Main-Rhine and Dnieper-Pripyat-Bug-Vistula systems might substantially alter conditions in favour of non-lithophilous species; therefore, further invasions of Ponto-Caspian peracarids should be considered among their environmental risks.

Keywords: Amphipoda, colonization rate, Cumacea, Isopoda, Mysida, risk assessment, substrate preference

Biosecurity and Disposal of Japanese Knotweed-Contaminated Spoil in Ireland: A Case Study

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Abstract

Fallopia japonica (Japanese knotweed) is a highly invasive herbaceous plant subject to restrictions under Irish legislation (Statutory Instrument 477 (2011)). It is widespread in Ireland, reflecting the ease with which it is dispersed *via* viable stem and rhizome fragments. It adversely impacts native biodiversity in infested habitats, can destabilise the banksides of rivers, has a detrimental effect on hard infrastructure (e.g. roads, walls, bridges) and obstructs signage on roads. *Fallopia japonica* is extremely difficult to eradicate once established, with approved herbicides and physical removal offering the best options. On construction sites or road construction schemes where space (and time) are at a premium, *Fallopia* infestations need to be dealt with effectively and expeditiously. Often, physical removal *via* excavation is the only effective, long-term option. Because of the presence of deeply penetrating rhizomes, capable of growing to 2 metres deep and 7 metres beyond the last visible stem, effective removal involves deep and extensive soil excavation at infested sites. If the *Fallopia*-contaminated spoil cannot be disposed of on-site, it must be removed to an approved landfill facility. Because of the risks to environment and to ecosystem services that *Fallopia* represents, all disposal operations and each phase of all such operations must be conducted in a rigorously biosecure manner. This can be particularly challenging when the infested site is located in a busy urban area. This case study describes each phase that must be conducted in order to biosecurely dispose of *circa* 2,000 tonnes of Japanese knotweed-contaminated soil from a construction site in Dublin city. This include

preparing detailed management and biosecurity plans, obtaining a licence from the regulatory body in charge (National Parks and Wildlife Service) to transport the spoil, meeting the Waste Acceptance Criteria, ensuring biosecurity at the landfill facility, creating a biosecure zone at the site and organising that the excavated spoil is handled and transported in a manner that will ensure no spillage of soil. The operation will be described and the level of expenditure indicated.

Distribution and year-cycle of the new non-indigenous crayfish species established in Croatia

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Abstract

The marble crayfish (*Procambarus fallax* f. *virginalis*) is a relatively new non-indigenous crayfish species (NICS) that has established populations in Europe. Established population of marble crayfish was recently discovered in a gravel pit in Northwest Croatia, making it the third NICS present in Croatian freshwaters. In this study we looked into marble crayfish distribution in this region of Croatian territory, and examined some basic population characteristics such as year cycle characteristics and size structure. Fieldwork showed that the marble crayfish is only present in the gravel pit and its canals, while in neighboring waterbody (only 0.45 km away) – the Drava River, the signal crayfish (*Pacifastacus leniusculus*) presence was recorded. Marble crayfish in the gravel pit were reproductively active during the whole sampling period (from May to November 2015). Peaks of reproduction activity were recorded from September to November, when both individuals with pleopodal eggs or juveniles as well as individuals with ripe ovarian eggs were recorded. The smallest reproductively active female was 40.81 mm TL. Gonadosomatic index was the highest in May and September, indicating the most pronounced egg production in that period. Size structure of caught crayfish also varied during the sampling period, with significantly increased proportion of smaller-sized individuals in the catch during the peak reproduction activity period. Collected information regarding distribution, size structure and fecundity of the marble crayfish in Croatia represents baseline data for the development of management strategies aimed at its control.

Keywords: marble crayfish, fecundity, reproduction activity, size structure

Invasion pathway of the signal crayfish *Pacifastacus leniusculus* (Dana, 1852) in the southern Baltic coastal river

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Abstract

Signal crayfish *Pacifastacus leniusculus* (Dana, 1852) belongs to the most successful invasive species and is known as the most widespread crayfish invader in Europe. Such species responses as e.g. growth and reproduction in the new invaded environment can determine the invasive success. We analyzed sex ratio, total length and body condition of signal crayfish *P. leniusculus* in different parts of the Wieprza River – southern Baltic coastal river and its tributaries. Different sex ratio, maximal length and body condition depending on the part of the river were observed. The best condition (the

highest value of b parameter of length-weight relationships $b=3.5225$), the highest maximal total length ($T_{lmax}=155.9$ mm) and domination of males over females were observed in the river mouth region of the Wieprza River, in 2013. After a year, in 2014, in this part of the river, b parameter was lower ($b=1.9046$), $T_{lmax}=117.53$ mm was low and higher proportion of females were recorded. This section of the river already lost character of invasion front. In the central part of the river, in 2014, females dominated over males (sex ratio 4:1), b parameter was 3.3923 and $T_{lmax}=119.7$ mm was low. This section was the core of invasion – the crayfish was stocked to neighbor ponds in 1995. In the upper part of the river system, parameter $b=3.1864$, $T_{lmax}=142.14$ mm and sex ratio was about 1. This section did not the typical invasion front and seems to be the older settlement of signal crayfish. Only in 2013 invasion front was observed – it suggest that *P. leniusculus* made transition through the stage of invasion to become successful invader in the river. The study highlights the importance of examining trait variability in different parts of the river as important step of invasive process, shows the shift between establishment and expansion of invasive species.

Keywords: sex ratio, total length, length-weight relationship

The Vistula River mouth as a gateway for Ponto-Caspian gammarids to the brackish waters of the Baltic Sea

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Abstract

The Vistula River is the largest river in Poland and one of the major European water courses. The Vistula River mouth is a gateway for Ponto-Caspian gammarids spreading to the large brackish water reservoir, the Baltic Sea. Penetration of these species was through the central corridor (via the Vistula River, which is the part of this invasion route). All analyzed gammarid species are of Ponto-Caspian origin. These species probably migrated along water routes connecting the catchment areas of the Baltic Sea, as well as the Azov, Black and Caspian Seas. The aim of investigations was to determine the Ponto-Caspian gammarids composition at the Vistula River mouth since 2007. Animals were collected in the warm months of the year (in April 2007; April 2008; May 2009; May 2010 and May 2015), by two people with hand net for 45 min. In that way fairly large and representative samples could be collected. Studies carried out in 2007 revealed the presence of such Ponto-Caspian gammarids as: *Pontogammarus robustoides* (G.O. Sars, 1894), *Obesogammarus crassus* (G.O. Sars, 1894) and *Dikerogammarus haemobaphes* (Eichwald, 1841). In subsequent years: *P. robustoides*, *O. crassus* and *D. haemobaphes* were observed in various percentage shares depending on the year. Last investigations showed presence of *P. robustoides*, *O. crassus*, *D. haemobaphes* and additionally *D. villosus* (Sovinsky, 1894). Water salinity during sampling of the material varied from 0.2 to 0.7 PSU, water temperature – from 11.4 to 25.3°C. Investigations confirmed that the Vistula River mouth is the important place for new species establishment.

Keywords: alien gammarids, species composition, *Pontogammarus robustoides*, *Obesogammarus crassus*, *Dikerogammarus haemobaphes*, *Dikerogammarus villosus*

Dikerogammarus villosus – known or less known invader: dispersal to new regions

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Abstract

Dikerogammarus villosus (Sowinsky, 1894) is known as „freshwater invader” because it has been reported in many European inland waters: rivers and canals. It has recently invaded most part of Western Europe. The species has migrated along the central and southern corridors connecting the catchment areas of the Baltic Sea, as well as the Azov, Black and Caspian Seas. *D. villosus* is one of the most successful immigrant from the Ponto-Caspian region. Because of its extremely aggressive behavior towards other species (e.g. invertebrates and young fish), through its ability to kill and shred its prey, it is called the “killer shrimp”. Although the species is recorded in freshwater reservoirs, it invaded also brackish water stretches of rivers and other brackish water reservoirs. Individuals of this species were first recorded in the Śmiała Vistula (one of the Vistula branches) at 4.8 PSU in 2011, in the Vistula Lagoon at 1.7 to 1.8 PSU in 2011 and in the Gulf of Gdansk (close to the Vistula outlet) at 5.6 to 6.8 PSU from 2010.

D. villosus is potentially able to colonize various water bodies. Today we can observe the transition of this species from early established freshwater to brackish habitats. This species may replace the native gammarids and in this way effect on biodiversity.

Keywords: killer shrimp, Ponto-Caspian gammarid

Morphological comparison of *Misgurnus anguillicaudatus*, Cantor 1842 individuals in a Piedmont population

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Abstract

Among Italian vertebrates, freshwater fishes are particularly interesting due to the high number of endemic species described (Chiesa *et al.*, 2016). Despite this, an increasing number of allochthonous species threatening Italian freshwaters is reported. Among the 51 introduced species (Kottelat and Freyof, 2007), 6 are recently established, 37 are already established, 5 are probably established and 3 are non-established (Bianco, 2013). The oriental weather loach *Misgurnus anguillicaudatus* (Cobitidae, Cipriniformes) inhabits the muddy bottoms of creeks, ponds, wetlands across East Asia (Kitagawa *et al.*, 2011), and showed an increase in Piedmont from 1991 to 2009 (Forneris *et al.*, 2011). From 40 specimens of *M. anguillicaudatus* captured in one location in Vercelli Province (Piedmont, Italy), we point out 3 different coloring patterns. In order to investigate potential individual diversity, we performed morphological analysis using the following parameter: distance of fin insertion from nose * total length⁻¹; we used pectorals, dorsal, caudal and anal fins as keypoints. We described 3 different patterns: i) Type 1, a brown and dark countershaded coloration with distinctive brown spots on the back and the belly (n. 17); ii) Type 2, a light countershaded coloration with no spots or brown pale spots only on the back (n. 13); iii) Type 3, a pale light brown coloration with no countershading nor spots (n. 10). Despite these different patterns, we didn't observe significant differences (using Fisher's test) among the three groups morphometrics: F=0.24 for pectoral fins, F= 1.09 for dorsal fin, F=0.20 for caudal fins and F=1.29 for anal fin (df=39 for all groups). Due to this morphological homogeneity, we decided to rely on genetic analysis still in progress.

Keywords: IAS, morphometrics, oriental weather loach

Preliminary results of genetic divergence among marine and freshwater populations of *Atherina boyeri* Risso, 1810 in Turkey

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Abstract

Atherina boyeri (sand smelt) is a marine species widely distributed throughout the north eastern coasts of Atlantic Ocean, Mediterranean Sea, Black Sea and Caspian Sea. This euryhaline species is known to live in lower parts of rivers, estuaries and coastal lakes. This species inhabits all coasts of the seas surrounding Anatolia and it was also recorded from lagoons and lakes having connection with the sea. During the last decades there were many new records from different natural lakes and man-made lakes in Anatolia, i.e. reservoirs on Sakarya, Aksu, Kızılırmak and Orontes rivers. The lakes and reservoirs mentioned here are isolated freshwater systems, no connection with seas, which are not the natural distribution are of *A. boyeri*. Although ontogeny, morphology and its impact on lake ecosystem and fisheries were studied in marine and freshwater ecosystems in Turkey, no detailed comparative data on genetic characteristics of sand smelt is available in marine habitats and freshwater environments invaded by this marine species.

Genetic differentiation and phylogenetic relationships among 13 *A. boyeri* populations from marine, lake and reservoirs in Turkey were investigated using mtDNA analysis.

Samples were collected from; Blacksea, Marmara sea, Eagen sea, Mediterranean sea and 4 different inland populations from western, central and eastern Anatolia. Total DNA was isolated from the muscle tissue and PCR reactions were carried out with D-loop and cytochrom c oxidase gene primers. Genetic differentiation observed in DNA sequence analysis between populations is highlighted by the dendograms obtained using ClustalW2 web application of EBI-EMBL web site. Fish DNA samples from geographically close places are clustered in the same branches.

Keywords: sand smelt, mtDNA, Inland water populations

Ichthyofauna structure of the Save River within the riprap zone as a specific habitat type, with emphasis on the presence of the round goby *Neogobius melanostomus* (Pallas, 1814)

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Abstract

Over the past decade, the spread of invasive species has become a global issue concerning the protection of native

and threatened fish species. Invasive species degrade ecosystem balance, occupying habitats not otherwise inhabited by native species. Riprap is a specific manmade habitat type, installed to prevent river bank erosion. Cracks and interstitial space within the riprap are inhabited by numerous invasive species, including gobies from the genus *Neogobius*. Many studies have stressed that riprap is a suitable habitat for such species, enabling their longitudinal migration. In 2015, field studies were conducted on the ichthyofauna of the Sava River to collect quantitative data on the composition and abundance of fish species present. The collected data were used to examine the potential of riprap as habitat for invasive species settlement. The research area was divided into three zones based on the presence of rock: riprap 100%, riprap 50% and riprap 0%. To analyse the structure of the fish communities in these habitats, univariate and multivariate statistical methods were applied using the program PERMANOVA + for PRIMER, while graphic analysis was performed using multidimensional scaling (MDS) based on the Bray-Curtis similarity matrix. Statistical analysis showed that all three zones had a similar structure in terms of the number of species present ($p=0.094$). A similar pattern was found in the grouping of zones in the MDS analysis. Considering community structure, invasive species did not dominate in the composition or in abundance. In the findings, gobies were separated based on habitat type, and it was found that the round goby (*Neogobius melanostomus*) was more abundant in riprap habitats, while the monkey goby (*N. fluviatilis*) preferred silty substrates without riprap, with earthen river banks. It was also found that an increased abundance of round goby was associated with the abundance of other species, for which it likely serves as a food source, particularly the burbot (*Lota lota*). Future surveys of the riprap zones are necessary to obtain a more complete overview of the manner of spread of invasive species and to prevent their detrimental impacts.

Keywords: *Neogobius melanostomus*, Sava River, Riprap, invasive species

Feeding habits of the invasive non-native black bullhead *Ameiurus melas* in Lake Sava (Serbia)

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Abstract

The black bullhead (*Ameiurus melas* Rafinesque, 1820) is one of the most abundant and successful non-native fish species in European freshwaters. Recent studies indicate that it is also one of the most dominant invasive fish species in Serbian waters.

The aim of this research was to determine feeding habits of the black bullhead in Lake Sava, as it is known that this species may negatively affect the native fauna through predation or competition for food/space.

Black bullhead samples were collected monthly from 2009 to 2012, for four days in a row. Gastro-intestinal contents were analyzed in 2349 specimens. The analysis was done macroscopically, where possible, or under a binocular microscope. Prey categories were identified to the lowest possible taxonomic level. For the diet analysis, we used the following indices: the vacuity index, frequency of occurrence, numerical abundance, and prominence value. In addition, the seasonal trophic niche breadth was calculated according to the Shannon's diversity index.

Vacuity index ranged between 72.86% and 100%. The diet spectrum consisted of 14 different prey categories from five groups: Mollusca, Crustacea, Insecta, Teleostei, and plants. Fish were the main prey in all seasons, followed by aquatic invertebrates. Plant material and terrestrial insects were used as food in relatively small quantities. Fish-egg predation was also detected. Our research confirmed that this species is an opportunistic generalist, foraging on the most abundant and available prey. Ontogenetic diet shift was also detected. The lowest value of trophic diversity was found in the largest black bullheads, while the highest was found in the medium sized individuals. The widest niche breadth was recorded in the spring of 2011.

Keywords: black bullhead, feeding habits, gastro-intestinal content, opportunistic generalist, ontogenetic diet shift

The effects of gonopod removal on survival and mating ability of males in the invasive crayfish, *Procambarus clarkii*: preliminary results

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Abstract

The Sterile Male Release Technique (SMRT) has been successfully used to control populations of pest species for more than a half of century. This technique is based on rearing or capturing, sterilizing and releasing large numbers of males into the wild to mate with females, which will then produce non-viable eggs. This species-specific technique provides also one really important additional advantage that makes it stand out when compared to others: it works even at low densities, since sterile specimens may seek and mate with fertile individuals. Even though the original idea was developed to control economically important insect species, it was later applied to control some aquatic species as well. Up to now, only ionizing irradiation was investigated for production of sterile males on the red swamp crayfish, *Procambarus clarkii* populations and the highest dose that was found to not compromise the survival or mating ability of males, 40 Gy, determined a 57% reduction in offspring production. Manual removal of gonopods, specialized pleopods in males for sperm transferring, has never been investigated on *P. clarkii* and the purpose of our study here is to see its potential for a subsequent application as a part of the SMRT. A preliminary study (Stebbing et al. 2014) done on signal crayfish *Pacifastacus leniusculus*, has shown that the removal of the gonopods did not impact males' ability to compete with native males in finding a mate allowing them to mate as per normal. However, the technique significantly impaired spermatophore deposition causing 100% male sterilization. This study aims to analyze the effect of gonopod removal on the survival and mating ability of *P. clarkii* males in the lab. After randomly choosing the same number of sexually responsive males for treatment and control, they were both paired with sexually responsive females and their behavior was recorded and analysed. Preliminary results of this study are presented here.

Keywords: *Procambarus clarkii*, invasive crayfish, control, Sterile Male Release Technique, gonopods

Interactions of native and non-native fishes in eutrophic lakes Bara and Jamarice in Croatia

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Abstract

Ecological impacts of invasive species being prerequisite in recent times due to their most significant threats of local ecosystems, in this study for the first time structure of native and non-native fish species and their feeding interactions of Bara and Jamarice lakes were displayed. Specimens were collected by electrofishing from both lakes of eutrophic character, muddy bottom and surrounded by low aquatic vegetation located in continental part of Croatia in the Sava River basin. The abundance of Jamarice lake was dominated by stone moroko (*Pseudorasbora parva*) (42.80%) followed by rudd (*Scardinius erythrophthalmus*) (23.8%), pike-perch (*Sander lucioperca*) (19%) and black bullhead (*Ameiurus nebulus*) (14.3%). The species composition of Bara lake was considerably different from the former one. Of the overall number, introduced species were dominant, such as pumpkinseed (*Lepomis gibbosus*) (50.70%), pike-perch (2.9%) and stone moroko (1.41%); although in biomass native species were dominated such as roach (*Rutilus rutilus*) (13%), perch (*Perca fluviatilis*) (13%), freshwater bream (*Abramis brama*) (13%), *Alburnus arborella* (2.9%), ide (*Leuciscus idus*) (2.9%) and pike (*Esox Lucius*) (1.5%). To determine the dietary preferences, stomach contents were analyzed and expressed as 27 prey items comprising the most preferable food such as Chironomidae, Oscillatoria, Copepoda, *Daphnia*, *Bosmina* etc. Chironomidae has had the most part in the diet of stone moroko and pumpkinseed indicating on food competition with the native species. Perch and roach have showed the higher feeding interspecific competition. The decline in some native fishes was found with the increasing numbers of invading species and the feeding behavior between them.

Keywords: fish composition, non-native fishes, feeding interactions

Morphological Differences, Condition and Length-Weight Relationship in Marine and Translocated Inland Populations of the Sand Smelt in Turkey

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Abstract

The sand smelt, *Atherina boyeri* is an euryhaline fish with short life span that inhabits mainly coastal and estuarine waters. It has also been translocated into freshwater lakes and reservoirs for fisheries purposes. In Turkey, many freshwater reservoirs that have no connection with sea were rapidly invaded by *A. boyeri* especially during the last two decades. Both ecological and economical impacts of sand smelt in inland waters have been under discussion.

The aim of the present study was to assess the length-weight relationships, body condition and morphological variability in natural (marine, brackishwater) and introduced (freshwater) populations of *A. boyeri*. Fish samples were obtained from eastern and western coasts of Mediterranean and Blacksea, Sea of Marmara, Aegean Sea, Lake Köyceğiz lagoon, and from different regions of Anatolia such as Aslantaş and Hirfanlı reservoirs, freshwater lakes Eğirdir and İznik. The total length and the body weight were ranged between 33.4-149.1 mm and 0.24-18.10 g in the sea populations, 37.8-97.0 mm and 0.41-6.60 g in the lagoon, 23.9-113.2 mm and 0.11-10.94 g in the freshwater populations. The difference among the sea, lagoon and inland populations for b value in length-weight relationships were significant ($P < 0.05$) for all samples. The R^2 values ranged from 0.87 to 0.99. In terms of growth, positive allometry ($b > 3$) was observed especially in freshwater and marine populations, however lagoon population tended to have negative allometric growth ($b < 3$). Mean value of Fulton's condition factor ranged between 0.51-0.69 in marine populations, 0.57 in the lagoon and 0.60-0.64 in

freshwater populations. In addition, twenty four morphometric characters of individuals from different environments were measured and morphological differences of populations were compared.

Besides the obtained results studies on reproduction traits of these population are going on to evaluate the invasion and adaptation success of the sand smelt to different environments having various salinity.

Keywords: *Atherina boyeri*, morphological variability, length-weight relationship, translocated species

The relation between condition, angling pressure and restocking of the populations of pumpkinseed, *Lepomis gibbosus* (Linnaeus, 1758)

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Abstract

Pumpkinseed, *Lepomis gibbosus* (Linnaeus, 1758), was first brought to Europe from eastern part of North America in the late 19th century as an aquarium species. It has spread all across Europe since then. Widespread distribution of pumpkinseed is a result of its competitive behavior and biological and ecological traits, such as nest guarding, long life span and adaptability to poor environmental conditions.

In Croatia, it inhabits most of water bodies, both in Black Sea and Adriatic Sea basins. We present results of ichthyological researches conducted on several locations of Croatian part of Black Sea basin in year 2015, during which pumpkinseeds were caught. Following locations were included in the study: oxbows along the river Mura, lakes in the Maksimir park, Savica lakes near Zagreb and Karašica river in Podravina county. In the course of our research, 279 pumpkinseed individuals were caught and measured for total length (TL), standard length (SL) and total weight (TW). The investigated sites were divided into three categories, depending on the level of angling pressure and restocking (1-banned angling, 2-allowed angling and 3-allowed angling with regularly restocking). According to the collected data, parameters a, b and mean condition factor (K) were calculated. Data was subjected to ANOVA and PCA statistical analysis. The results show that the populations of pumpkinseeds from the 3rd site category (allowed angling with regularly restocking) were significantly different from other two site categories in a way that populations were large in number of individuals, but mean condition factor (K) of individuals was lowermost in respect to other two site categories. From results obtained, it is assumed that restocking has a greater impact than angling pressure on the pumpkinseed population.

Keywords: condition factor, *Lepomis gibbosus*, angling pressure, restocking

Spatial and temporal sorting of Behavioral Types in a feral guppy population from Germany

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Abstract

Invading species from the tropics or subtropics do not usually occur in Germany due to its temperate climate. However, there are several sites where suitable conditions to establish self-sustaining populations can be found. The Gillbach/Erft river system in North-Rhine Westphalia receives warm wastewater from the power plant Niederaußem as well as from ongoing opencast mining and thus the temperature never drops below 19°C all year round. Besides thermotolerant native species, guppies (*Poecilia reticulata*) and convict cichlids (*Amatitlania nigrofasciata*) have been found for more than 40 years. Even though the Gillbach/Erft receives warm water influx throughout the year, tropical species are expected to survive harsh German winters only in the core area few meters away from the influx and should then recolonize the periphery during spring and early summer again. It was proposed that individuals of the migrating part of an invasive population might exhibit a certain “invasion syndrome”, e.g., a correlated suite of behaviors/phenotypes that facilitate the colonization of new habitats. Our prediction is therefore, that individual guppies recolonizing downstream areas in spring and early summer should differ from those that reside at the core area. To test this prediction, we caught guppies along the Gillbach in early spring, summer and fall. From each site, 40 guppies were transferred to the lab and we assessed several personality traits after an acclimation period of 2 weeks. Though the sampling is still going on, we will show first results that indicate the existence of an invasion syndrome in the guppy population from the Gillbach.

Keywords: spatial sorting, invasion, personality, behavioral syndrome, *Poecilia reticulata*

Translocated predators in freshwater ichthyofauna of the Adriatic basin

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Abstract

The Adriatic basin is renowned for its highly endemic freshwater ichthyofauna, in which almost every river has its own unique freshwater fish community. These fish communities are also characterized by the lack of true predator species. However, the translocation of predator species (pike, European catfish and pikeperch) from the Danube drainage to the Adriatic basin has caused changes to fish communities, and the repercussions are yet to be systematically analysed. While pikeperch and European catfish populations, as a translocated species, do not readily expand in open watercourses, pike is an excellent example of an invasive species whose populations expand rapidly in all invaded watercourses. To date, pikeperch has only been recorded sporadically in open rivers (Mirna and Neretva), though it has well established populations in artificial reservoirs (Butoniga and Tribalj) and European catfish has been recorded in Tribalj reservoir, Vrana Lake near Biograd and Lika River with Kruščica reservoir. On the other hand, pike has been recorded to have established populations in the following watercourses: Mirna River with Butoniga reservoir, Gacka River with Švičko reservoir, Lika River with Kruščica reservoir, Cetina River with its reservoirs, Vrana Lake on Cres Island, Vrana Lake near Biograd, Prološko Blato Lake, Šarana jezera Lakes near Knin. Recent findings suggest that pike has also invaded the Krka and Vrljika Rivers. At most of these localities, the pike populations have been present for several decades and the impact on local ichthyofauna can be assessed. Recent findings in the Krka and Vrljika Rivers, however, suggest that it is yet to be seen how the fish communities will respond to this invasion. It will be especially important to monitor the impact that pike invasion has on endangered soft-muzzled trout in order to take prompt and appropriate conservation actions.

Keywords: pike, pikeperch, European catfish, endemic fish communities, translocated species, invasive species

Behavioural differences as a driver of invasion success in non-native amphipods

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Abstract

The opening of the Main-Danube canal in 1992 has led to an influx of non-native species, particularly invertebrates into German water bodies. This also accounts for the introduction of invasive amphipod species from the Ponto-Caspian region into East German lakes.

Certain behaviours, such as increased exploration, activity, boldness and increased feeding and/or mating behaviour are predicted to increase the chance of success of invasive species and the speed with which they disperse into new habitats. Additionally, behaviour may also influence interspecific trophic interactions, i.e. predation, further influencing a potential invader's chance of success.

Here, I tested for species differences in exploration, hiding, feeding, and mating behaviours between invasive *Dikerogammarus spp.* (Stebbing, 1899) and in Germany naturalised *Gammarus roeseli* (Gervais, 1835). Contrary to predictions, the invasive *Dikerogammarus spp.* were less explorative ($p = 0.049$; $n = 0.049$), spent more time hiding ($p < 0.001$; $n = 200$), and less time feeding ($p = 0.037$; $n = 200$) and mating ($p = 0.023$; $n = 200$) compared to the naturalised species.

These results suggest that the invasion success of *Dikerogammarus spp.* may be related to their increased hiding behaviour and consequently being less likely to be predated upon, rather than a tendency to be more active and explorative.

Future research will investigate how these differences affect food-web interactions between invasive prey species, such as *Dikerogammarus spp.*, and a native predator, the European perch (*Perca fluviatilis*), and ultimately corresponding changes within their aquatic ecosystem.

Keywords: amphipods, behavioural differences, invasion success, *Dikerogammarus spp.*, *Gammarus sp.*, food-web interactions

Invasive microalge in the Danube River and floodplain waters (Croatia)

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Abstract

This report provides a summary of the current knowledge about the invasive microalgal species in the Kopački Rit floodplain, one of the largest preserved river-floodplain systems in the Middle Danube (Croatia). Benefiting from their small size microalgae have a potential to spread very quickly between the main river bed and various floodplain biotopes, such as permanent and temporary shallow lakes, wetlands and channels. During the almost half century of algal research, several alien or potentially invasive species were observed. Among toxic cyanobacterial species, *Raphidiopsis mediterranea* blooming was registered only in the past. Nowadays (from 2003 onward) ubiquitous cyanobacteria of tropical origin *Cylindrospermopsis raciborskii* periodically formed massive blooms in the floodplain biotopes during the long isolation period from the income of floodwater in summer. Other potentially invasive cyanobacteria (*Cus-*

pidothrix issatschenkoi and *Dolichospermum compactum* in phytoplankton, *Gloeotrichia echinulata* in periphyton) and chlorophytes (*Monactinus simplex* and *Staurastrum planctonicum* in phytoplankton, *Hydrodictyon reticulatum* in periphyton) occur sporadically in the floodplain biotopes. Alien diatoms are found to be prominent in the river phytoplankton. Regular blooms of *Skeletonema potamos* and abundant populations of *Actinocyclus normanii* during the conditions of high water temperatures and low water levels in summer-autumn periods represent nowadays the characteristic feature of the Danube phytoplankton. Due to ongoing spread and severe bloom formation, diatom *Didymosphenia geminata* can be potentially invasive, but until now it was found in low abundance in phytoplankton and phytobenthos of the main river bed.

It seems that introduction and spreading of these invasive algal species can be linked to the Southern Invasive Corridor going from the Black Sea along the Danube Canal–Main–Rhine. Further international and multidisciplinary investigations focused on the alien and invasive species in the Danube River Basin are needed to ensure a long-term conservation of this unique floodplain and the preservation of its biodiversity.

Keywords: Kopački Rit, *Cylindrospermopsis raciborskii*, *Skeletonema potamos*, *Didymosphenia geminata*, phytoplankton, periphyton

Response of benthic macroinvertebrate assemblages to round (*Neogobius melanostomus*) and tubenose (*Proterorhinus semilunaris*) goby predation pressure

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Abstract

One of the main assumed impacts of invasive gobies is predation on benthic macroinvertebrates. Despite numerous dietary studies, however, quantitative evaluations of impact in European river systems are scarce. Here, we investigate the impact of tubenose (*Proterorhinus semilunaris*) and round (*Neogobius melanostomus*) gobies on macroinvertebrates in a lowland river (River Dyje, Czech Republic) by allowing and preventing gobiid access to rip-rap substrate naturally colonised by invertebrates at two sites (Site 1 - tubenose goby only, Site 2 - tubenose and round gobies). Gobies had a negative impact on invertebrates at both sites, with density reduced by 15% (ca. 17.9 g.m⁻² p.a.) at Site 1 and 36% (ca. 23.6 g.m⁻² p.a.) at Site 2. Both species ingested larger invertebrates preferentially, resulting in an overall reduction in invertebrate body size. Tubenose gobies had a significant impact on Annelida, Gastropoda, Crustacea and Ephemeroptera nymphs; while tubenose and round goby together impacted Annelida, Bivalvia (*Dreissena*), Gastropoda, Crustacea, Ephemeroptera nymphs, Odonata nymphs and Chironomid larvae.

Our results confirm that round and tubenose gobies have a significant negative impact on bankside invertebrate density. On the Dyje, however, rich local food resources and habitat segregation result in little or no competition with native fish species.

Keywords: invasive species, gobies, macroinvertebrates, impact, European rivers, diet

Comparison of Different Methods of DNA extraction from colonies of *Pectinatella magnifica* (Leidy 1851)

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Abstract

Pectinatella magnifica is freshwater organism, which colonies are most often found attached to the different submerged parts/branches of coastal plants stones or free-floating. These organisms can be found mostly in oligotrophic to mesotrophic waters, and appear to thrive in temperatures that reach 20°C during colonisation (Balounová, et al., 2007). Although *Pectinatella magnifica* originates from North America, it has recently become an invasive species on the other continents. The first recorded occurrence in Europe was during the 1983 in Hamburg (Balounová, et al., 2013), in the Czech Republic it was recorded for the first time in rivers Vltava and Labe in the first half of the 20th century (Schachanowskaja, 1929). The most common method of its propagation is through internal buds, called statoblasts, fitted with hooks that make it able to cling to any surface, and allow easy distribution over long distances and otherwise impossible terrain. The aim of this study was to evaluate different methods of isolation of DNA from colonies of *Pectinatella magnifica*. Three different techniques of DNA extraction from zooids and statoblasts were tested, namely two kit-based methods: DNeasy Plant Mini isolation kit (QIAGEN), Nucleo Spin isolation kit (Marcherey-Nagel) and one isolation method based on cetyltrimethylammonium bromide (CTAB-PVP). Material for analysis was collected at the Protected Landscape Area (PLA) and a Biosphere Reserve (BR) of Třeboňsko.

Keywords: *Pectinatella magnifica*; statoblasts; zooids; DNA

Legislative provisions for control of spreading of the common slider, *Trachemys scripta* in Europe

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Abstract

The common slider, *Trachemys scripta* is native to the southeastern part of North America. It has spread across the World by the pet trade. Because of these irresponsible actions, adult individuals are often released into the environment, where they compete with native fauna and present a serious threat to biodiversity. This species has already spread across Europe. For instance, in Croatia, a significant population of the most invasive subspecies, *T. scripta elegans*, has been reported in the Zagreb city area as well as on the island Krk. Research performed on the island of Krk suggested that the common species population may be able to reproduce.

By adopting its Biodiversity Strategy to2020, the EU made a commitment to combat invasive alien species (IAS). Several projects financed by LIFE program funds have been conducted, with the goal of eradicating *T. scripta* from Natura 2000 sites. Since some populations were already established, the complete eradication of the species was not possible. The recently adopted Regulation (EC) 1143/2014 is a dedicated EU instrument for addressing IAS. Since *T. scripta* has been included in

the “List of IAS of the EU concern“, this invasive species is subject to restrictions regarding surveillance, handling, and management measures.

The provisions outlined in Regulation (EC) 1143/2014 are binding for EU Member States only. However, according to the Recommendation No. 125 (2007) of the Bern Convention, the contracting parties suggested that non-EU states employ stricter regulations on the trade of the invasive subspecies, *T. scripta elegans*. Future recommendations on management practices, similar to those determined by Regulation 1143/2014, could provide effective control of the spread of *T. scripta* throughout EU and non-EU member countries.

Keywords: common slider, *Trachemys scripta*, control of spreading, legislative provisions

Improving of fish viral diseases monitoring through the development of rapid diagnostic tests

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Abstract

The FISHGUARD project, funded by the European program Eurostars-2, aims to optimize existing tools for the detection and control of viral infections known in aquaculture in the northern hemisphere of the planet. The goal is to develop a rapid tests that will detect viral hemorrhagic septicemia virus (VHS) and infectious hematopoietic necrosis virus (IHN). The test is aimed to be more profitable, but also more easy to use for the owners of the basins.

Keywords: fish farming, viral diseases monitoring, rapid immunochromatographic tests, VHS, IHN

Prussian Carp (*Carassius gibelio*, Bloch, 1783) – the most successful invasive species in waters of Nature Park Kopački Rit in eastern Croatia

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Abstract

Today, Prussian Carp (*Carassius gibelio*, Bloch 1783) is considered the most abundant invasive fish species in Europe. It can be found abundantly in the fishery waters of the Danube delta in the Republic of Croatia, a part of which is Kopački Rit Nature Park. Inventory and commercial fishing during season 2014/15 confirmed 20 fish species in three locations (lakes Kopačko, Bijelo and Sakadaško) in Kopački Rit waters. The caught fish (n= 2432; total mass 1549.4 kg) belonged to four families: Ciprinidae (cyprinids), Percidae (perciformes), Esocidae (pikes) and Siluridae (catfishes).

The caught fish (n= 2432; total mass 1549.4 kg) belonged to four families: Ciprinidae (cyprinids), Percidae (perciformes), Esocidae (pikes) and Siluridae (catfishes). There are 15 species of cyprinids, three of perciformes and only one species of pikes and one of catfishes. In total quantitative structure, Prussian Carp (n=438; total mass=461.8 kg) participates with 18.01% and in complete biomass its share is 29.81%. Average total length (cm x ind⁻¹±SD) of Prussian Carp in Kopački Rit is 32.99±8.00 and its average mass index (kg x ind⁻¹±SD) is 0.80 ± 0.41. Fulton's condition factor (CF) of Prussian Carp is 1.98 ± 0.64 (mean±SD) and average gonadosomatic index (GSI u %) of males is 2.4±0.80 (mean±SD) and females 6.9 ± 6.2 (mean±SD). In the population of sampled Prussian Carp there were 39.0% males and 61.0% females. The profile index of Prussian Carp in Kopački Rit is on average 2.9 ± 0.3 (mean±SD). High invasiveness of this fish species in Kopački Rit waters could be explained by its excellent adaptability to unusually high summer temperatures of water, which rise above 30°C, favorable spawning conditions, high rate of cyprinid species with which it spawns (gy-nogenesis), a growing number of males in the population, increase in female mass index, the lack of predatory species, low predation by the cormorants that rarely feed on Prussian Carp etc.

Keywords: fish community, Kopački Rit, eastern Croatia, *Carassius gibelio*, invasive species

Contaminants occurrence in the main allochthonous invasive species (*Silurus glanis*): an alert from Northern Italian freshwaters

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Abstract

The European catfish (*Silurus glanis*, Linnaeus 1758) is a native specie to Eastern Europe and Western Asia. It is a top food-chain predator, and then can well reflect freshwaters environmental contamination. In Italy this alien species has received an increasing interest also for commercial purposes, as it is the case for the Eastern European market, where its flesh is greatly appreciated. A monitoring was carried out from 2007 to 2015 in northern Italian freshwaters; European catfish (n. 119) were captured using electro-fishing boat. Samples size ranged from 60 to 120 cm, with weight ranging from 1.5 to 10.5 Kg. The aims of this study were: 1) to investigate heavy metals contamination (Hg, Cd, As and Cr) in order to verify if metals levels exceed the maximum levels (MLs) established by the European Regulations (1881/2006 UE and 629/2008 UE, setting the MLs for Hg, Pb, Cd in fish muscle); 2) to characterize the human exposure to polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs), polychlorobiphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) contamination associated with *S. glanis* consumption, analyzing samples collected from Po river basin (PAH) and from Varese Lake (PCDD/Fs, DL PCBs, NDL PCBs). The ML of 0.5 mg Kg⁻¹ for Hg was exceeded in 18% of samples, while Pb and Cd were always lower than the MLs. As and Cr concentrations in *Silurus glanis* flesh were comparable to published data (Mendil and Uluzlu, 2007; Matasin *et al.*, 2011). All samples presented detectable levels of PCDD/Fs, PCBs, PAHs; in particular the levels of DL-PCBs and benz[a]pyrene could constitute a health concern, especially to individuals whose diet consist of a high percentage of this fish. Our results wish to contribute to investigating the potential risk related to the frequent consumption of European catfish, implementing the knowledge about the pollution status of a nonnative species that is rapidly spreading in European rivers and lake.

Keywords: environmental contaminants, European catfish, heavy metals, PAHs, PCDD/Fs, PCBs, Po basin

Native and non-native fish translocations in Croatia: The Danube and Adriatic basins

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Abstract

Due to hydrogeological features of Croatia, the country is divided into a Pannonian and a karst part that include two basins, namely the Danube and the Adriatic, with the former being dominated by the large rivers Sava, Drava and Danube plus their smaller sub-basins. The rivers of the Adriatic Basin are short and isolated, and often flow through deep canyons where they create waterfalls and lakes. Also, they are connected with a number of small streams and underground watersheds. The freshwater ichthyofauna of Croatia is diverse and includes a total of 150 riverine species of which 21 are found in brackish and salt waters. Croatia's ichthyofauna is also rich in endemic species, with 38 present in the Adriatic Basin and 12 in the Danube Basin. In total, 28 alien fish species were introduced in Croatia, 32 were translocated from the Danube to the Adriatic basin (18 native and 14 non-native) and 2 from the Adriatic to the Danube basin (1 native and 1 non-native). First known translocation, excluding carp, date back to the 18th century when pike (*Esox Lucius*) and tench (*Tinca tinca*) were translocated to the Lake Vrana located on the Island Cres. Reasons for translocations in Croatia were 1) accidental: during translocation of other fish species (e.g. pumpkinseed) and 2) intentional: angling, to fill empty niche, for general improvement of fisheries and aquaculture. Most of translocated species naturalized in their new habitat. Researches on impact of translocated species in Croatia are entirely absent.

Keywords: translocation, Adriatic basin, karst area, invasive species

Introductions of nonnative and transplantations of native freshwater fishes in Slovenia - case study: *Onchorynchus mykiss*

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Abstract

Inland waters of Slovenia consist of two river basins: smaller Adriatic and larger Danube. There are 97 fish taxa of which 77 species are indigenous, 20 species have been introduced, and 11 native species have been translocated between the Danube and the Adriatic Basins.

Protection of freshwater fishes in Slovenia is provided under the Freshwater Fisheries Act 1976 (OG SRS 25/76) and related decrees. Conservation measures include, among others, a ban on species introductions and translocations.

The translocations of native species between two basins and introductions of nonnative fish into Slovenia were performed mainly by fishermen either intentionally for the sake of angling, or accidentally. It began in 1891 with the introduction of rainbowtrout *Oncorhynchus mykiss*. Rainbowtrout is the most important sportfishing object in Slovenia. Every year some ten thousand catchable size pieces of rainbow trout are releasing in the rivers and streams just for sake of sportfishing.

The overview of nonnative fish species in Slovenia included historical and recent distribution data derived from various

published and 'grey' literature sources, and revealed that 16 species of non-native fish have been introduced into both the Danube and the Adriatic Basins. Of the 16 species introduced to Slovenia since 1891, two species have disappeared and 14 are still present. Ten of them have spread and reproduce naturally. Information on the ecology of introduced fish species in Slovenia is extremely limited. Based on available information, we assume 8 of the introduced species have moderate-to-strong impacts on native species. Three species are not able for reproduce naturally but exert negative impacts nonetheless.

The area of recent distribution of each non-native fish species was assessed as a proportion of the total area of Slovenia using the UTM world grid zones.

Keywords: alien fish species, Slovenia, rainbow trout

Occurrence of the invasive red swamp crayfish (*Procambarus clarkii*) in a Piedmont Natural Reserve: the Candia's Lake biotope

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Abstract

The introduction of allochthonous species is a major threat for biodiversity conservation (Genovesi, 2002). The problem affects also crustacean decapods, with the decline of native European crayfishes (Family: Astacidae) starting in 1860 due to the outbreak of the crayfish plague (*Aphanomyces astaci*) and the progressive habitat degradation, followed by the introduction of the exotic *Orconectes limosus* (Family: Cambaridae). The red swamp crayfish (*Procambarus clarkii*) is considered the most invasive Non Indigenous Crayfish Species (NICS) in Italy, where it is responsible for the decline of several native communities of flora and fauna. Piedmont was probably the bridgehead of *P. clarkii* invasion in Italy: the first record dates back to 1989 (Delmastro, 1992). In 2010, *P. clarkii* was observed for the first time also in the Candia's Lake (Dora Baltea Basin, Turin Province, SCI IT1110036). The aims of this study are: 1) to investigate the presence and habitat use of this crayfish; 2) to describe the life cycle of the species within the lake. From July to October 2014, we evaluated the presence and distribution of the species using baited fishing traps. A tin of cat food was used as bait, appropriately perforated to allow the release of the flavours. We placed the traps every Monday and we collected the crayfishes for a total of four sampling days per week. A total of 19'971 individuals were captured. For each specimen, we determined the sex and measured the following morphometric parameters: cephalothorax length, weight, number of chelae (2 or only 1). We also determined the presence of ovigerous females. Our results confirm a stable presence of the crayfish in the lake with an active reproductive population. In addition, we observed that the species caused mechanical damages by digging and consequent infiltration of water in the banks of the lake. For these reasons, we underline the need of reliable eradication measures to control the diffusion of this NICS in Northern Italy.

Keywords: Alien crayfish, Candia Lake, decapods

Introduced alien signal crayfish (*Pacifastacus leniusculus*) in Finland – uncontrollable expansion despite the numerous management strategies

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Abstract

In Finland, the experimental introductions of the alien signal crayfish (*Pacifastacus leniusculus*) in selected water bodies took place in the end of 1960s. This attempt was carried out because of the poor recovery of the native crayfish (*Astacus astacus*) populations after repeated crayfish plague outbreaks. Massive introductions of the signal crayfish started towards the end of 1980s. The Finnish fisheries authorities have implemented three national management strategies setting guidelines for the crayfish introductions amongst other related issues since 1989. The main aims of the strategies have been conservation of native noble crayfish stocks and a so-called controlled spread of the alien signal crayfish within designated region. In this study, we report the current known distribution of alien signal crayfish in Finland in comparison to the guidelines for the spreading set in the national crayfish-related strategies.

The present distribution area of the alien signal crayfish covers most of the southern Finland. The signal crayfish has been introduced with a stocking permit to over 450 water bodies. In addition, there have been numerous stockings without a permit. In total, populations resulting from unlicensed stockings have been reported from 226 water bodies. Outside of the designated region, there are stockings to over 100 waters, which are mainly situated next to the region designated for the signal crayfish in the crayfisheries strategies. However, there are also several observations of reproductive signal crayfish populations in Central and Eastern Finland far from the region designated for its stockings. On the basis of our results, we conclude that crayfish management strategies have had limited effect on the spread of alien signal crayfish in Finland.

Keywords: distribution, introduction, management strategy, *Pacifastacus leniusculus*

Occurrence of non-native fish species in the river-mouth stretch of the coastal Baltic tributary

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Abstract

Most non-native fish species inhabiting the coastal Baltic waters originate from escapes from inland fish farms and releases by aquarists and anglers.

Between June 2005 and July 2007, 24 fishing surveys of 2-5 days were carried out in monthly intervals in the river mouth area of the Reda River to investigate the fish species composition and seasonal changes in ichthyofauna structure. Fishes

were collected by a river pound net (10 mm mesh) that covering total river width and the water column. Each fishing trial lasted for 6 hours. Among 318.500 specimens caught 39 fish and lamprey species were identified with five alien fish species: Prussian carp *Carassius gibelio* (Bloch, 1782) (n=2504), white-eye bream *Ballerus sapa* (Pallas, 1814) (n=13), round goby *Neogobius melanostomus* (Pallas, 1814) (n=23), Siberian sturgeon *Acipenser baerii* Brandt, 1869 (n=12) and rainbow trout *Oncorhynchus mykiss* (Walbaum, 1792) (n=44). In 15 months the share of specimens of the non-native species (SNNS) in catches in number did not reach 1%. The catches consist of SNNS between 1 and 10% occurred in 8 months. The most numerous SNNS were observed in September (90.0%) and October (34.4%) 2006. The biomass of SNNS was not higher than 1% in 13 months and in 8 varied between 1 and 10%. The highest shares of SNNS in biomass of catches occurred in April (25.4%), September (61.1%) and October (13.6%) 2006. The Prussian carp was the most common in catches and dominated in number in September and October 2006, when on average 755.5 and 103.5 specimens were caught daily. Its mean biomass in catches varied between 0 and 5110.85 g. The round goby occurred in low number, although it inhabits neighbouring Puck Bay in high abundance. The presence of the Siberian sturgeon and rainbow trout in the catches was the evidence of escapes from fish farms.

Keywords: non-native species, Reda River, Baltic Sea

Distribution and abundance of non-native Ponto-Caspian gobies in the river mouth areas of the Lower Vistula River tributaries

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Abstract

Some Ponto-Caspian gobies increased their native range of distribution and colonised the large European river systems by artificial waterways and transport with ballast waters at the end of 20 century.

Four non-native Ponto-Caspian gobiid fish have been noted in the Lower Vistula River: round goby *Neogobius melanostomus* (Pallas, 1814), monkey goby *Neogobius fluviatilis* (Pallas, 1814) racer goby *Babka gymnotrachelus* (Kessler, 1857) and Western tubenose goby *Proterorhinus semilunaris* (Heckel, 1837). In order to know their distribution and abundance in the 18 river mouth stretches of the Vistula tributaries located between the Gulf of Gdańsk and the Włocławek Reservoir (Zuzanka, Zgłowiączka, Dopływ z Gnojna, Mień, Tażyna, Drwęca, Zielona Struga, Dopływ z Solca Kujawskiego, Brda, Struga Niewieścińska, Dopływ z Gawrońca, Fryba, Wda, Osa, Mątawa, Młyńska Struga, Wierzyca, Drybok) the survey was carried out in 2012. The material was collected by electrofishing. Despite morphological traits species membership was also confirmed by analysis of full cytochrome b barcode sequences for three specimens from single species, respectively. Abundance was calculated as a number of specimens per 100 m². The gobies were not caught in the Struga Niewieścińska stream and in two tributaries located the closest to the Vistula River mouth (Wierzyca and Drybok). Western tubenose goby (n=522) was the most common fish and occurred in 15 examined sites. Following species, the racer goby (n=512) was confirmed in 7 tributaries whereas the monkey goby (n=20) only in 3. No round goby was caught. The highest abundance of the Western tubenose goby and racer goby were in the Zuzanka River (35.0 and 23.6 specimens per 100 m², respectively), below the Włocławek Reservoir. Monkey goby was the most abundant in the Mień River (80% of collected fish; 2.1 specimens per 100 m²). Among gobies caught, the Western tubenose goby seems to be more eurytopic, because it invaded the Vistula River the last, but now it is the most widespread.

Keywords: non-native species, Vistula, *Neogobius melanostomus*, *Neogobius fluviatilis*, *Babka gymnotrachelus*, *Proterorhinus semilunaris*

Conduits of Invasive Aquatic Species into the UK: The Angling Route?

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Abstract

Invasive non-native species (INNS) cause substantial environmental and socio-economic impacts in the UK. Costing approximately £1.7 billion yr⁻¹ to the British economy, once established in the environment INNS are often impossible to eradicate. Placing prevention at the forefront of management of INNS, a new EU Regulation of Invasive Alien Species (143/2014) means EU Member States including the UK are now obliged to investigate and prioritise human pathways of INNS introduction. Angling has been identified as one of these pathways. An online survey of 680 British anglers was conducted to establish their movement patterns abroad, and awareness of biosecurity practices. 44% of British anglers travelled abroad, visiting over 70 different countries. The majority of these trips were to Western Europe. Travel time from Western Europe into the UK is within the time frame that INNS can survive on damp angling equipment. Without biosecurity, it is therefore likely that anglers could unintentionally transport INNS into the UK.

The number of anglers cleaning their equipment after every trip has doubled since 2011. A further 80% clean and dry their equipment occasionally after a fishing trip. Therefore, anglers' awareness of INNS and their implementation of biosecurity are increasing. However, greater work is still required. Most anglers are not conducting adequate biosecurity after every trip. 50% of anglers also use cold water to clean their equipment, accounting for the sole cleaning method for 37% of anglers. This is despite studies showing hot water is the most effective method to treat INNS. Greater clarification is required on what constitutes correct cleaning procedure. Angling biosecurity has increased over the last four years. However, with evidence of substantial movement of British anglers to Europe for angling, further research is required to identify what INNS are present in European fishing lakes and their tolerance to desiccation on angling equipment.

Keywords: angling, biosecurity, pathways, invasive species, UK

Risk screening of non-native and translocated freshwater fish species in the catchment of a highly productive wetland, Lake Marmara (western Anatolia, Turkey)

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Abstract

Simplified and rapid risk screening tools to identify species with a high or low risk of invasiveness are being increasingly used for effective management purposes. Amongst the available risk assessment tools, the Fish Invasiveness Screening Kit (FISK) has been used extensively and successfully in large risk assessment (RA) areas (including at the country level). Recently, FISK

was upgraded to the new generic tool Aquatic Species Invasiveness Screening Kit (AS-ISK). The aim of the present study was to assess using AS-ISK the invasive potential of introduced non-native and translocated fishes in a Mediterranean-type shallow lake (Lake Marmara) located in western Anatolia (Turkey). Based on independent evaluations of 35 species by two assessors, calibration of AS-ISK resulted in a threshold score of -3.65, which reliably distinguished between potentially invasive (high risk) and potentially non-invasive (low risk) fishes for Lake Marmara. 17 fishes were categorised as 'low risk' (i.e. native/endemic and translocated natives), and the remaining 18 as 'high risk' (non-natives and translocated natives). The highest scoring species were *Carassius gibelio*, *Pseudorasbora parva*, *Gambusia affinis*, *G. holbrooki*, *Atherina boyeri* and *Clarias gariepinus*, whereas endemic *Cobitis kurui* and *Oxydemacheilus theophilii* were the lowest scoring. *C. gibelio* had the highest score in the Climate Change Assessment section, suggesting that it could potentially impact on the native fish fauna under likely climate change scenarios for the RA area. Some cool water and endemic species of the catchment including *Oncorhynchus mykiss*, *Salvelinus fontinalis*, *Ladigesocypris mermere* and *Luciobarbus lydianus* will likely be affected negatively by predicted climate change conditions. The results of the present study indicate that AS-ISK is a useful and viable tool for identifying potentially invasive non-native and translocated fishes in a relatively small RA area of Turkey.

Keywords: AS-ISK, endemic species, biological invasions, Lake Marmara, Turkey

From networking to a coordinated management strategy for the invasive alien species of the Loire basin

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Abstract

Since its creation in 2002, the objectives of the working group "invasive alien species of the Loire basin" led to the realization of common tools and to scientific and technical advances concerning the freshwater invasive plants management. Between 2007 and 2013, several regional groups have emerged on the greatest part Loire watershed, relaying the basin actions and multiplying the dissemination of the information. The basin working group is formed by a wide range of stakeholders (experts, awareness and management project leaders, community representatives, institutions, etc.) and relies on a network of practitioners. Based on the learnings of more than 10 years, a strategy and its action program were validated in 2015.

The Loire basin invasive alien species management strategy 2014-2020 is articulated with the strategies at European, national and regional levels. It aims to coordinate relevant actions at the scale of a large river basin and to exchange on the management of freshwater invasive plants and animals methods. The strategy identifies guidelines for emerging invasive alien species management projects.

The 24 priority actions for this period (2014-2020) are grouped in 5 main subjects: Coordination, Knowledge & exchanges, Monitoring & early intervention, Management and Awareness, communication & training. These allow the implementation of this strategy and for each of these actions the aim, context, partners, evaluation and expected products are described.

The deployment of the strategy will take place in the frame of the Loire nature program 2014-2020. It will promote the surveillance, the rapid response to new populations (e.g. new species or on colonization fronts). An accent is also given on awareness rising and information exchange in this European funded program.

Keywords: strategy, management, coordination, mutualisation, shared tools, Loire catchment

Blue crab *Callinectes sapidus* Rathbun, 1896 continues invasion: first case of entering into freshwater ecosystem in the Mediterranean (Nature Park Vransko Lake, Adriatic Sea)

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Abstract

Three specimens of the adult blue crab *Callinectes sapidus* were caught inside the Nature Park Vransko Lake on May 2013, during the regular monitoring of ichthyofauna. All individuals were males and can be considered as large. After the initial discovery, trap nets were placed on several locations within the lake, but no blue crabs were caught afterwards to this date. Regardless, due to the invasive characteristic of this species and potential negative impact on indigenous species, further monitoring of the blue crab population in the Mediterranean and especially within the protected areas should gain more interest and support.

Keywords: blue crab *Callinectes sapidus* Rathbun, 1896, invasion, freshwater lake, Nature park Vransko Lake

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