Alfred Toepfer Natural Heritage Scholarship, 2017
Study Tour Report

Combating against invasive alien species in Central- and Eastern-Europe

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Hungary
2019

Content

Acknowledgement

First of all, I would like say a huge thank you to Europarc Federation for creating this scholarship programme for young experts of nature conservation in order to learn and deepen their knowledge, and share experiences. The study tour financed by the scholarship was one of my biggest opportunity to learn new things during my professional career so far. I would like to thank all the staff member of the federation, who works on this programme to work.

I also like to express my gratitude for the generosity of Alfred Toepfer Foundation, who provide the fund of this exceptional scholarship programme.

My study trip would not be possible without the help of the colleagues at the hosting organizations. They really helped me a lot with the application, organizing the trips, sharing information, knowledge, practices. I really want to thank all the people: Gábor Takács at Fertő-Hanság National Park Directorate; Csaba Vadász and Zoltán Vajda at Kiskunság National Park Directorate; Urszula Biereżnoj-Bazille, Sylwia Gadomska, Cezary Werpachowski at Biebrza National Park Administration; Jaroslav Ponikelsky, Robert Stejskal, Lenka Reiterová and Zdeněk Mačát at Podyji National Park Administration; David Freudl at Thayatal National Park Administration; Romana Roučková, Martin Starý, Filip Chrapan and Ludek Bufka at Šumava National Park Administration; Tajan Ban-Ćurić Marijan Ocvirek at Medvednica Nature Park Administration; the colleagues at Croatian Agency for Environment and Nature; András Schmotzer, Roland Csipkés and Ádám Pongrácz at Bükk National Park Directorate.

I appreciate the support of Hortobágy National Park Directorate and my colleagues, who let me go to this tour and worked instead of me during these weeks.

Finally, my fiancée, who was strong enough to do the most of whole tour with me, despite of not being a conservationist. Thank You, Erni for bearing my profession and taking care of our globe-trotting dog, Patrik.

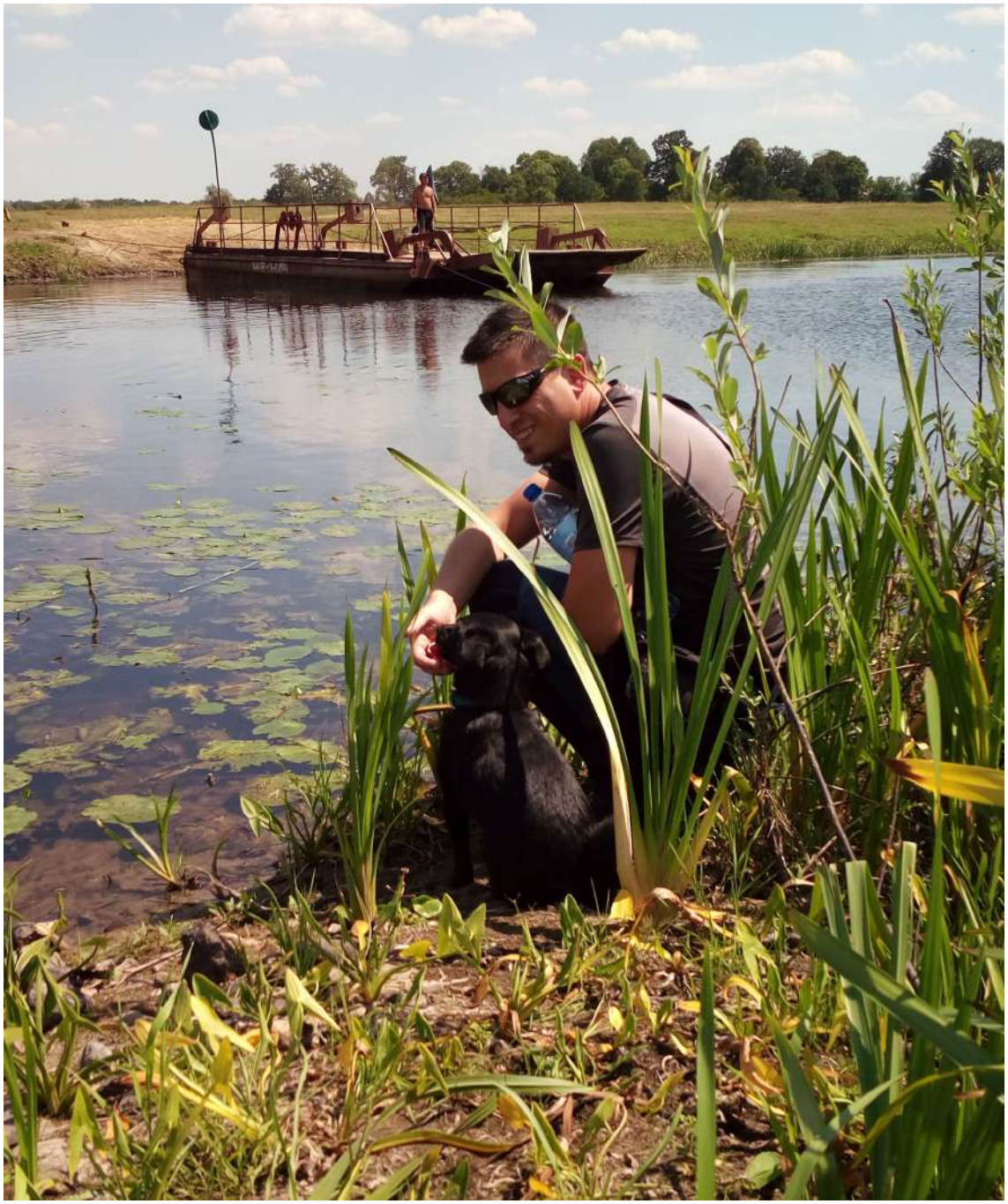
Summary

Invasive alien species (IAS) threatens the biodiversity globally. Our general knowledge is getting bigger and deeper every day. However, we need to share these information in order to prepare ourselves to future challenges considering IAS. With the help of Alfred Toepfer Natural Heritage Scholarship I visited protected areas in Poland, Czech Republic, Croatia, Austria and Hungary, who have gained extraordinary experiences in the field of combating against IAS. I have deepen my knowledge regarding IAS in the field of detection and data collection, monitoring and mapping, eradication practices. Additionally, I have become acquainted with new species, which might be problematic in the near future at my protected area. I would like to emphasize the great ideas I have experienced considering layman involvement into combat against IAS.

1 - Introduction

1.1 - Introduction of authors' curriculum, motivations and expectations

I was born on 11th October 1983 at Karcag, an agricultural town in Hungary. The love of nature accompanied me since my childhood. I was active member of local school environmental protection study group and choose nature conservation camps during summer holidays to spend my spare time. I began my university years in 2002, and chose to learn biology in order to get engaged to nature conservation, especially water habitats at that time. I graduated in 2007 as biologist specialized in ecology.



Pic 1. Biebrza river, Biebrza National Park, Poland

My professional career started at Balaton Uplands National Park Directorate, where I worked as a ranger-officer, then a tourism-officer. I spent only one year there, but it was enough to deepen my engagement towards nature conservation. Afterwards, I made a detour to the scientific life and academic medium as an assistant lecturer at University of Pécs. I have learnt a lot doing my Ph.D. thesis, but this was something far away from practical nature conservation. In 2013 I got an opportunity to join the staff of Hortobágy National Park Directorate as a nature conservation officer at the Department of Nature Conservation, and I have been working here since then.

Pic 2. Tree of heaven at the border of Fertő- Hanság National Park, Hungary

Besides many other issues, I am dealing with the growing problem of invasive alien species at the jurisdiction area of the Directorate. I am responsible for coordinating the mapping of these species, summarizing the data and suggesting measurement and action, sometimes propose project ideas.

Since there were nobody before me at the Directorate who was designated for coordinating almost everything regarding invasive alien species (hereafter: IAS), I have to learn myself and have to look for best-practices, experiences elsewhere. Alfred Toepfer Natural Heritage Scholarship (hereafter: ATS) gave an extraordinary opportunity for me to broaden my knowledge on IAS, and to learn how to detect, map, control or eradicate them efficiently and effectively.

The basic idea of doing the study tour is formulated during a workshop held at Hortobágy National Park in 2016. The Central- and Eastern European Section of the Europarc Federation organized a workshop for its members on the topic of IAS, where conservation professionals share their experiences and recent practices on detecting, mapping and combating IAS. The event drew my attention, that there are huge gaps in the knowledge of particular organizations on the issue of IAS, however, it was very profitable to learn from each other and share experiences. My personal feeling was that those ideas, practices and measurements demonstrated at the workshop would help my organization in the combat against IAS, so we have to deepen and broaden those knowledge in order to be more effective and efficient, and maybe our practices in details would help others, too.

At that time the Duna-Ipoly National Park Directorate published a handbook titled “ROSALIA Handbooks 3. Practical Experiences in Invasive Alien Plant Control” (Ref 1.), which summarized the best-practices of mapping and eradicating IAS in Hungary, basically providing a technical manual for national park directorates, area managers of natural areas, nature conservation authorities and NGOs. It also focused my attention on different practices applied at similar habitats that occurs also at my Directorate, or different techniques applied against the same species.

With the help of the extraordinary opportunity provided by ATS, my aim was to broaden my knowledge on IAS generally, to collect most of the available best-practice methods on eradicating those plant species that occur at the area of the Directorate. Also, I tried to collect information regarding species that are no yet introduced in Hungary, but the spread of those is very likely (because of the global climate change) in the near future and can cause serious nature conservation problems. The acquired information would be

very useful for the Directorate and for me personally in order to get prepared for the effective combat against IAS. The learnt information would help to mitigate this type of threat connected to climate change and biodiversity loss.

1.2 - General introduction to the topic

Generally, alien species are determined as plants, animals, fungi and micro-organisms that have been transported across ecological barriers and become established in areas outside their natural range. Obviously, not all alien species turns into invasive, however it can happen very frequently. The species can spread rapidly across the natural environment, displacing and out-competing native species. It is a global phenomenon, that the number of IAS is growing year by year in almost every country.

Pic 3. *Solidago* sp. next to a forestry road in Medvednica, Croatia

IAS cause serious problems worldwide in areas of nature conservation, forestry, agriculture, public health and the economy. In other words, they threaten human livelihoods and biodiversity globally. Regarding nature conservation, IAS threaten the rare, unique, and often endemic species and habitats, which are very sensitive to this kind of disturbance. Namely, the unlimited spread of IAS threatens native biodiversity the most. Additionally, global climate change could support to the quick spread of IAS by providing suitable “new” habitats for those.

The challenging task of controlling IAS also appears in Hungary. Because of the global climate change more “exotic” species find suitable habitats in the Carpathian-basin, and populations of previously known IAS get bigger, which threatens native biodiversity. With the high adaptive ability, IAS successfully squeeze the native, endemic and sensitive species out of their natural habitats, perish sensitive and unique habitats, or even cause the disappearance of those.

Nowadays, IAS plants, like black locust – *Robina pseudoacacia*, milkweed – *Asclepias syriaca*, false indigo – *Amorpha fruticosa*, green ash – *Acer negundo*, tree of heaven – *Alianthus allissima*, etc.), cause the biggest problems in Hungary, and particularly in the Hortobágy National Park. Besides, new plant species might spread from the Mediterranean-region and from the mountainous regions.

Pic 4. Spinycheek crayfish from Körös-river, Hungary

Furthermore, some IAS animals appear in Hungary, however the spread of those is also likely to happen in the near future. For example raccoon (*Procyon lotor*), raccoon dog (*Nyctereutes procyonoides*), different fish species (mostly Gobidae) or aquatic Decapodas (e.g. spinycheek crayfish - *Orconectes limosus)*, etc.

Pic 5. Mass of bullheads (*Ameiurus* sp.) from Lake Tisza

Defence against IAS is very challenging, because it strongly depends on the early detection, the prevention of their spread and the immediate intervention based on the best-practice methods available. Learn, apply and share all these methods help experts to combat against IAS.

Combat against IAS is also one of the targets aimed by the EU 2020 Biodiversity Strategy (Ref 2.). Under the new Biodiversity Strategy the Commission proposed a dedicated legislative instrument by 2012 to address common challenges associated with IAS in the EU. Particular attention has been paid recently and will be paid in the future to establishing an EU-wide early warning system and rapid response mechanism to promptly

detect and control the spread of the Invasive Alien Species, and share good practices amongst Member States in their eradication.

1.3 - Objectives of the study visit

My personal aim was to fulfil as many gaps as I can from those I saw during the workshop in 2016. I tried to find protected areas (hereafter: PAs) the staff members of which have exceptional experience and results in IAS. With the help of their information and knowledge Hortobágy National Park Directorate could be more successful in the combat against IAS. Furthermore, our experiences could help others to improve their practices in detection, mapping, eradication, etc. During the study trip I was looking for the answers to the following questions:

- detection: how can we detect IAS?; is there any established system of detection?
- new species: what are the new IAS species to come to the Carpathian Basin, that might cause serious problems in the near future?; how can we prepare ourselves?
- mapping and monitoring: how can we monitor IAS effectively in order to avoid further damages?; is there any established system of mapping or monitoring?
- control/eradication/combating: what are the best practice methods in eradicating those species (black locust, tree of heaven, common milkweed, etc.) that cause the most problem at Hortobágy National Park Directorate?
- gathering information about best practice techniques in eradicating those species (black locust, tree of heaven, common milkweed, etc.) that cause the most problem at my PA?
- animal species: is there any established programme (detection, monitoring, control) on IAS animals?
- laymen involvement: how can nature conservation experts involve tourist, locals, stakeholders into the combat against IAS?

1.4 - Overview of the tour

In 2016 our Directorate organized a workshop within the framework of EUROPARC Central and Eastern Europe Section, which gave the idea to visit the attendant PAs in order to have bigger overview on how IAS are controlled, what special techniques and methods are applied. Mainly based upon the presentations at the workshop I chose the PAs mentioned below in order to gain information and knowledge about the most important issues regarding IAS.

My tour included several parts, depending the opportunities that the PA administration could give to me. In addition to the planned tour, there were some other opportunities and events to attend regarding the topic of my proposal, the result of which are also included in this report.

Information day on IAS in the Ministry of Agriculture, Hungary - 23rd March 2018

The Hungarian Ministry of Agriculture (hereafter: MA) puts a great emphasis on IAS. Their activities includes information sharing campaigns for laymen (Ref 3.), supervising authorization processes and organizing information sharing events for expert in order to share the latest news and experiences.

During this particular event the MA summarized the activities done in the near past, and also the activities needed to be done in the next period. Also, nature conservation experts, mainly from PA administrations, reported about their activities, and particularly successes (Ref 4.).

One of the most relevant presentations for me at this event was about the appearance and eradication of Sosnowsky's hogweed (*Heracleum sosnowskyi*) at Kiskunság National Park. This species appears at basically random place in Hungary, with no certain explanation of origin, and no best-practice eradication method to use.

Fertő-Hanság National Park Directorate, Hungary - 28th April-4th May 2018

The first station of my tour which was planned in the proposal also was at the Fertő-Hanság National Park Directorate (hereafter: FHNPD) (Ref 5.). On the first day visited the most characteristic parts of Lake Fertő (Neuseelander), and talked about invasive

and non-native fish species in the lake. It seems, that the lake is quite in a lucky position, since there are not so may aggressive IAS fish occurred. However, they have some scattered appearance of pond sliders (*Trachemys* sp.) Also, sometimes exotic tangles appear at random places, which are from different sources, but most probably originated from house-aquariums.

Secondly we visited the Soproni-mountains and overview the most problematic valleys, which are infected by *Fallopia* sp. The experts of the Directorate showed also the results of different chemical treatments, which they applied in order to optimize the use of the chemicals.

Pic 6. *Fallopia* sp. next to a canalized small watercourse in Sopron-mountains, FHNP, Hungary

The other day the staff members showed the different methods of mapping and detecting invasive species. They use mobile application in order to ease this process; the application also gives the opportunity even for laymen to get involved into the mapping

of IAS. The experts and the amateurs can use different projects within the application, so the validation process could be also different.

I also had the opportunity to see how the national park work together the nature conservation authority in order to put bigger pressure on owner and land managers to eradicate IAS. The authority has started to oblige the land owners and managers to get rid of IAS. Together with the obligation they suggest to get in contact with the experts of FHNPD in order to optimize the eradication processes, who help happily.

Pic 7. Tree of heaven after last year's chemical treatment at the border of Fertő-Hanság NP, Hungary

Lastly, during a field trip at Győrszentiván, we talked about a nature conservation and habitat (Pannonic sand steppe, which is presented at HNPD, too) restoration project (Restoration and conservation of priority-listed Pannonic sand land habitats in military owned area of the Hungarian Little Plain - LIFE08 NAT/H/000289; Ref 6.) financed by LIFE programme, and visited those site where eradication of IAS were implemented. All

the information talked through the trip would be extremely important and useful during the future planning of a similar project at HNPD.

Pic 8. Landscape after eradication of invasives and complex restoration of sand steppe habitat at Györszentiván, FHNPD, Hungary

Kiskunság National Park Directorate, Hungary – 12nd-13th June 2018

The main topic of my visit at Kiskunság National Park Directorate (KNPD) (Ref 7.) was to get an insight of the OAKEYLIFE (Multilevel and multisite complex restauration of key ecosystem services of the calcareous sand forest steppe habitat – LIFE16/NAT/HU/000599; Ref 8.) implemented at Peszér forest. The main objective of this project is to restore and develop the calcareous sand forest steppe habitat by eradication of IAS and make it sustainable at long-term by structural modification of the forest. During the couple of days here, we talked about different techniques and compare their effectiveness, different species and the possible solution against them.

Pic 9. Sand steppe habitat next to Peszér forest, KNPD, Hungary

In addition, the KNPD struggled with eradicating one of the newest IAS plants occurred in Hungary recently, the Sosnowsky's hogweed (*Heracleum sosnowskyi*). We talked through the three year struggle and combat against the species, and saw the recent status of the habitat.

Biebrza National Park, Poland – 4th-8th July 2018

The polish Bierbza National Park Administration (Ref 9.) has large coherent wetland-grassland habitats, which are similar to the habitats that occur at Hortobágy. The IAS are different but the way we can control them is similar. During the couple of days spent here, I met the most important IAS at the PA (*Heliatnthus tuberosus, Lupinus polyphillus, Echinocystis lobata*). In this PA, interestingly, the red oak also has invasive characteristics, and the administration continuously has problems with the species. I visited the sites where different techniques were implemented.

The Bierbza NP has some monitoring project on IAS animals like raccoon (*Procyon lotor*), raccoon dog (*Nyctereutes procyonoides*), spinycheek crayfish (*Orconectes limosus*) and American mink (*Neovison vison*). I have the opportunity to get an insight into the activities implemented by the administration against the damage of American mink on wader population.

Pic 10. Meadow of Biebrza, Poland

The administration has some successful campaigns among young people on IAS, and also organizes activities in order to get young people, laymen, tourists involved actively into the nature conservation management. I luckily had the opportunity to take part in one of these programmes.

Podyjí National Park, Czech Republic – 9th-11th July 2018

The two most important IAS plants in the Podyjí National Park (Ref 10.) is the black locust (*Robinia pseudoacacia*) and the tree of heaven (*Alianthus altissima*). The HNPD also struggles with both species, so during these couple of days we could discuss about

different eradication practices. It was very fruitful to share experiences, which might have continuation in the near future. Additionally, we talked about other species (*Impatiens glandulifera, Amorpha fruticosa, Solidago sp., Sophora japonica, Lupinus polyphyllus)*.

Pic 11. View of Vranov settlement in Podyjí NP, Czech Republic

The administration had some successful activities in order to get rid of invasive fish species (Prussian carp - *Carassius auratus gibelio*, stone moroko – *Pseudoraspora parva*) from small mountain reservoirs. Beside the information about american mink at Biebrza NP, this was the only relevant information about IAS animals. Podíjy NP also gives bigger attention on protecting native moor frog (*Rana arvalis*) population by controlling IAS mammals (American mink, raccoon and raccoon dog).

Thayatal National Park, Austria – 12th July 2018

The staff members of Podyjí were so kind, that they organized a one day trip to the neighbouring Thayatal NP (Ref 11.). While the whole PA is very small (cca 2000 ha), they

have little problem with IAS. Most of the species are connected to the settlement (*Fallopia* sp., *Robinia pseudoacacia, Impatiens* sp. *Solidago* sp.). On the other hand, the NP has quite good mapping of IAS, since they have small area to map, so they can be very precise.

Pic 12. View of Hardegg settlement in Thayatal NP, Austria

Šumava National Park, Czech Republic – 14th-18th July 2018

The Šumava National Park (Ref 12.) also struggles the most with IAS that are originated from human settlements, often from gardens. On the first day we visited the most affected sites around settlements by IAS (mainly *Lupinus polyphyllus*) and discussed the causes of the spread and opportunities of combating against the spread. The other day we visited those sites that are quite far from settlements but still affected seriously by garden IAS. The experts shared the ongoing management activities regarding IAS, and also showed the partial result of different student/tourist involvements into combating against IAS.

The other most important IAS is Himalayan Balsam (*Impatines glandulifera*), which is a little bit easier to handle but yet occurs at more and more sites. We visited some of the sites affected by the species, and made some eradication in practice.

Unfortunately, the monitoring of IAS animals is only about to launch, but I had the opportunity to discuss about the technical background of it and about the expected results.

Pic 13. Šumava National Park, Czech Republic

Medvednica Nature Park, Croatia – 6th-8th July 2018

Black locust (*Robinia pseudoacacia*) is the main threat to native beech and oak forest at Medevednica Nature Park (Ref 13.). During the couple of days of my visit I saw the different stages of Robinia infection, and also discussed about some other IAS.

On the other hand, the staff of Medvednica made a huge work on mapping the whole nature park regarding IAS. We talked through the process and the most important data and results.

Pic 14. Medved Castle in Medvednica Nature Park, Croatia

Croatian Agency of Environmental and Energy- 9th July 2018

The staff members of Medvednica Nature park were so kind, that they organized an information sharing day to me with staff of Croatian Agency of Environmental and Nature (CAEN) (Ref 14.), which is the governmental body responsible for any kind of issues regarding IAS. This extraordinary opportunity really gave me a lot knowledge to understand how they deal with IAS. Based upon the information shared we compare the authorization processes between Croatia and Hungary, share the information about how the different national list of IAS were designed, and what are the main difficulties during the combat at the level of conservationists and authorities.

Lastly, they shared some data of the information campaigns they have made among different levels of laymen (amateurs, tourists, exotic gardeners, aquarists, anglers, young people, etc.)

Mini-conference on IAS, HNPD, Hungary – 19th October 2018

Since the beginning of 2018 all public bodies under the supervision of Ministry of Agriculture have to hire on employee responsible for IAS connected issues. The HNPD organized a mini-conference on the topic of how the different organizations deal with this, and what results, problems occurred during the first period. (Ref 15.)

Bükk National Park Directorate, Hungary – 14th-16th November 2018

Pic 15. View of Bükk National Park, BNPD, Hungary

During the visit of Bükk-mountains, I got an insight of how another national park directorate deals with IAS generally in Hungary, how could they take advantages from

the obligatory staff member dealing with IAS. Furthermore, it turned out during one of the field trips, that not only exotic species have invasive characteristics, but sometimes native (or almost native) plant species could behave like IAS. The native oak forest of Bükk-mountains is threatened by European smoketree (*Cotinus coggygria*), which prevents the natural forest habitats to regenerate naturally.

The Bükk National Park Directorate (BNPD) (Ref 16.) also took part in the national programme of monitoring Decapoda species in Hungary, same as HNPD. The partial results show that the invasive spinycheek crayfish suppresses the native species. The whole programme is a good example of national monitoring of invasive species. On the other hand, the survey method (electric fishing) gave the opportunity to collect data about invasive fish species, as well.

3rd Croatian Symposium on Invasive Species, Croatia – 26th-27th November 2018

The staff member of CAEN invited me and some of my colleagues to the 3rd Croatian Symposium on Invasive Species held in Zagreb. Our Directorate compile to posters to share the most interesting news about IAS at HNPD. During the two days, we listened interesting scientific presentation from all around Europe. Unfortunately, the main outcome for me was, that the scientific world has little connection to practical nature conservation.

1.5 Short description of visited protected areas

Fertő-Hanság National Park, Hungary

The Region of the Lake Fertő is a meeting point of climatic zones, floristic and zoogeographic provinces. These properties, unique for Europe and the diversity of habitats on a small area have determined the look of the landscape for thousands of years. The whole area of the Fertő-Hanság National Park is 23 731 ha. The Fertő part was appointed 1977 a landscape protection area, since 1979 it is member of the UNESCO Network of Biosphere Reserves, since 1989 a Ramsar site (significant wetland). It received the national park title in 1991.

Pic 16. Reeds of Lake Fertő, Fertő-Hanság NP, Hungary

The Hungarian side of Lake Fertő consists largely of reedy marshes. The marshland is interrupted only by inner lakes and the network of waterways (channels) that were established to ensure traffic. Among the reed there are patches of bulrush and saw-sedge, near the shore populations of tall sedges, wet meadows and marsh meadows. The fish fauna of the lake is outstanding not only on Hungarian but also on the international

level. Among the forests on the hills adjacent to the Lake Fertő the most important – from the conservationist's point of view – is the Szárhalmi Forest. Flora and fauna of the forest are very similar to that of mountains due to the climatic effects here.

Pic 17. One of the eldest trees of Szárhalmi-forest, Fertő-Hanság NP, Hungary

Little Plain Life+ project (LIFE08 NAT/H/000289) is realised on the calcic sand steppe used for army purposes around Győr on 247 ha. Due to the anthropogenic effect (military activity) the micro-terrain shows only a slight topographic diversity. The area and its surroundings are covered with chernozem-type sandy soils. Typical habitats include open sandy grasslands, sand steppe grasslands and habitats transitioning into shrubs and forests to different extents. Secondary habitats are represented by black locust and black pine forests, patches of common milkweed as well as secondary or degraded grasslands. The project area has been used as a military practice and shooting range where apart from military activities, forest management and wildlife management activities also regularly take place. The breeding of grazing livestock, which used to be typical even a few decades ago, has practically vanished by now.

Kiskunság National Park, Hungary

Kiskunság National Park is located in Danube–Tisza Interfluv, it was established in 1975. The park covers an area of 570 km^2 and stretches across the Little Cumania region of the Great Hungarian Plain. It is not a single territory, but comprises seven disjoint units, scattered throughout the area.

The Peszéradacs meadows is one of the most northern part of the national park with the area of 5757 ha. The habitats here are very versatile as bogs, fens, marshes, meadows, sand steppes and sand steppe forests, and any kind of mixtures of these.

Pic 18. Open sand steppe forest at Peszér forest, Kiskinság NP, Hungary

The visited Peszér forest is covered by mosaic of broad-leaved deciduous forests, plantations and grasslands. The forest is clearly the most valuable representative of the calcareous sand forest steppe habitat complex in Hungary, acting as a regional hotspot

of biodiversity, hosting extensive habitats of Community interest and several populations of species of Communitiy interest.

Biebrza National Park, Poland

The Biebrza National Park is located in Northeast Poland, in the Podlaskie Voivodship. The Narew River and its confluence with the Biebrza River form the southern boundary. The park was established in 1993, and with a total area of 59 233 ha, it is the largest of the Polish national parks. The Park includes 15 547 ha of forests, 18 182 ha of agricultural land, and 25 494 ha of wetlands - the most valuable habitats of the park - the famous Biebrza marshes. Unique in Europe for its marshes and peatlands, as well as its highly diversified fauna, especially birds- the Park was designated as a wetland site of global significance and is under the protection of the RAMSAR Convention.

Pic 19. Bogs of Biebrza NP, Poland

Podyjí National Park, Czech Republic

Podyjí National Park was declared on 1 July 1991 in the Government Regulation No. 164/1991. A protection zone was set up to manage the park and to ensure the protection of nature on the territory. Podyjí NP primarily includes the valley of the middle reaches of the Dyje river between Vranov nad Dyjí and Znojmo, along the state border with Austria. On 1st January, 2000 the Austrian bank of the river was declared as National Park Thayatal to form a unique, bilateral territory of European importance.

Pic 20. Coppice oak forest in Podyjí NP, Czech Republic

The national park represents an exceptionally well-preserved example of a river valley landscape in the hill country level of central Europe. The canyon of the Dyje creates a unique river phenomenon with numerous meanders, the deeply incised valleys of sidestreams, a wide variety of rock formations, boulder fields and rocky cliffs. Most of the similar river valleys in this country have been modified by the construction of dams, roads, railway lines and recreational areas. The territory is home to a great variety of plant and animal communities, which is predetermined by the varying slope exposition in the Dyje valley, the complicated relief and the variety of geological basements. The natural backbone of the territory is the Dyje river which has carved a canyon-like valley up to 220 m deep in the rocks of the Bohemian Massif on its 40 km flow from Vranov to Znojmo. The whole valley is almost completely covered by near-natural forests.

Thayatal National Park, Austria

Pic 21. Thaya river, Thayatal NP, Austria

On 1 January 2000 the National Park Thayatal became a reality. Since then, the national park administration has been endeavouring to protect and develop this area so that nature may be allowed to follow its course without human interference, in transborder cooperation with its Czech neighbour, the National Park Podyjí.

The Thayatal is an impressive valley with steep cliffs and gentle meadows, natural forests and a fascinating fauna. In places where economic interference has left its marks, where conifers were planted in inappropriate locations, the national park staff is trying to foster the growth of indigenous trees. In other areas, they only observe how fauna and flora are developing. Research is an important activity in national parks as it enables to gain insight on natural processes through long-term observation.

Šumava National Park, Czech Republic

Pic 22. Šumava NP, Czech Republic

The Šumava National Park or Bohemian Forest National Park is a PA in the South Bohemian regions of the Czech Republic along the border with Germany and Austria. The Šumava mountain range is covered by the most extensive forest in Central Europe, whose natural composition was, however, changed and today spruce plantations prevail in most of the area. In many places non-native spruce varieties were planted. These are not well adapted to the harsh local climate and are therefore susceptible to a range of elements, such as strong winds (e.g. in the 1980s or recently at the beginning of 2007) and bark beetle (*Ips typographus*).

Numerous large plateaux with raised peat bogs, glacial lakes and remnants of primeval forests (e.g. Boubín) complete a mosaic of habitats which are little disturbed by human settlements as most of the predominantly German-speaking inhabitants were expelled after World War II, and the area became a part of the deserted zone along the Eastern Bloc border. Since the 1970s there has existed a stable population of lynxes.

Medvednica Nature Park, Croatia

Medvednica is one of the mountains in north-west Croatia with an appearance which reminds of an island: it is surrounded by fruitful valleys and small knolls. The northern side of the mountain steeply descends towards Zagorje, while its south hillsides mildly descend towards the Sava Valley, merging with Zagreb, which is pleasantly situated between the green Medvednica and the whirring Sava. Even though the inhabitants of the nearby villages and Zagreb settlements located under Sljeme have always lived by the mountain and exploited its natural resources, only in the second half of the 19th century they started to value the importance of its preserved nature and fight for its protection. The final victory in more than 100 years of this battle was achieved by mountain rangers in 1981 when Medvednica was declared a nature park. In 1998 the park got its public institution which manages the protected area in accordance with the principles of sustainable development, keenly preserving and emphasising all values of this forest beauty – Medvednica.

Pic 23. Medvednica Nature Park with the city of Zagreb, Croatia

Bükk National Park, Hungary

Bükk National Park is a PA in the Bükk Mountains of Northern Hungary. It was founded in 1976 as the third national park in the country. It contains 431.3km^2 (of which 37.74km^2 is under increased protection). Mountainous and forested, Bükk is Hungary's largest national park and is situated in the northern mountains.. Bükk's important geological features include various karst formations within its limestone mountains - particularly caves (once inhabited by pre-historic people), swallow-holes, and ravines. The country's longest (4,000 metres) and deepest (245 metres) cave, Istvánlápa, is located in the park. Bükk National Park also contains ninety species of nesting birds, some considered endangered.

The flora of the Bükk National Park is very rich and diverse, it is rightly deserves protection and attention. There are approximately 2500 vascular plants in Hungary, 1500 of them can be found also in the Bükk National Park. 500 plants are protected in

Hungary and more than 200 live in the Bükk National Park. The presence of various plants and associations is due to several factors, thus the geological characteristics, the bedrock, the special types of soil, the climate and the usage of the land. Due to the differences in height, there are special floral zones in the Bükk National Park.

The most common plant associations are the zonal, closed forests, with Austrian oak-oak woods in the lower zones followed by hornbeam and then beech-groves. There are other tree associations different from the before mentioned zonal forests, regarding both their species and their appearance. The difference is due to the extreme habitats, like steep slopes or rocks. These natural values of these habitats exceed those of the zonal forests. As a result of earlier human interference several valuable plant associations could develop, their presence also depends on the natural agricultural activity of man. The extensive, chemicals-free gardens and orchards of the hill-foot, as well as the montane hayfield meadows of the Bükk-Plateau belong to these associations.

Pic 24. View of Bükk NP from Bélkő, Hungary

2 – Analysis

2.1/2.2 - Main outcomes/Comparative analyse between home and visited countries

Detection

The first and most important step in the combat against IAS is detection. In my opinion, the detection is composed of two different parts. One is to discover, to localize the first individual or stock of a known IAS at a new locality or habitat (Type A). In this case the species itself is described as having invasive characteristics and being non-native to a certain place. Most of the time, these species caused serious problems elsewhere and harshly affected local native species communities and habitats. In some lucky situations, the eradication practices has already been developed, which can be applied directly or after some adjustment to local circumstances.

The other part of detection, in my opinion, is to recognize the invasive characteristics of a non-native, new came species, which is not known to be invasive before (Type B). This situation could be very tricky, because species could behave differently between different circumstances. Sometimes, even native species could act as invasive species, if the circumstances changed in way, that they can overgrow their natural competitors and overcome their natural limiters.

One of the presentations at the 3rd Croatian Symposium on Invasive Species was about wild boar (*Sus scrofa*) populations in Croatia. It seems, that under certain circumstances, wild boars behave like an IAS. They overpopulate the habitat, squeeze out any kind of competitor (e.g. ruminants) and quickly change the habitat's characteristics. This phenomenon could be observed in Hungary, also within HNPD. Actually, one of the biggest problems of today's nature conservation is the overpopulation of wild boars.

Another, but a little bit different example would be the northern red oak (*Quercus rubra*), which is a non-native tree species originated from North-American. The first individuals were introduce like more than 400 years ago, and most of the time the stocks do not cause any kind of problems. However, in Biebrza NP it seems that under certain (unknown) circumstances invasive characteristics of the species might occur. In Biebrza NP red oak individuals grow really fast within forest habitats, faster than native oak

species, and soon overgrow huge patches within the habitat. In addition, the vegetative reproduction of the red oak is also quite significant, while the native species do not have such characteristics. The experts at Biebrza have not found the right solution yet to control the species. It seems, that despite of their revulsion against using chemicals, they have to apply, otherwise the problem might overcome them.

Pic 25. Treated red oaks with shoots, Biebrza NP, Poland

The case of European smoketree (*Cotinus coggygria*) in Bükk NP is quite similar. The species has been in Hungary since centuries, with no proper explanation of origin. During the Turkish invasion, the troops might have brought the species as spice, but other resources consider the species as a native to the Carpathian-basin. For centuries, the species has not caused any problems and has not got any invasive-like features. Today, in the Bükk Mountains, the natural rejuvenation processes failed because of the dense stocks of the smoketree. After the appearance of a natural or artificial clearance within the forest, the smoketree quickly overgrow the ground, letting insufficient amount of sunlight for the oak seeds to germinate and the seedling to grow. There is no effective

best-practice eradication method against the species, additionally, there are not so many ideas to test.

Pic 26. Dense smoketree layer under open oak forest Bükk NP, Hungary

One more very interesting example is *Telekia speciosa* which is a protected species in Hungary, but introduced artificially to the Czech Republic as a garden flower. Similarly to *Lupinus polyphyllus* the individuals escape from settlements along roads within Šumava NP.

Type A detection often happens accidentally. During daily field work of nature conservation experts, or sometimes enthusiastic amateurs, they just simply run up against one of the IAS. Finding of only one single individual of a species usually launches an avalanche, and the species is going to be found nearby, at other localities. This process was quite usual at the PAs I visited.

It also happened at almost all of the PAs that they were able to detect an IAS which was expected to occur. Either because of “natural” spreading processes, or just because all similar habitats nearby are already infected by the species, so it should be present there as well. In this case, systematic surveys often bring quick success. For example, the *Impatiens glandulifera* at Podyjí NP basically spread gradually from upstream to downstream; every year it was able to reach lower and lower section of the valley. The other example could be the case of *Lupinus polyhyllus* at Šumava NP. The species is very popular among villagers to have as a garden flower. However, it grows very fast, produces huge amount of seeds. The excess individuals usually get out illegally somewhere more natural habitats, to forest edges, meadows next to settlements, banks of watercourses, next to roads, etc. From these new locations the species could easily move forward and could infect new habitats. The conservationists still find new and new localities of *Lupinus* infected habitats more and more deeper in the woods.

Pic 27. Different coloured *Lupinus polyphyllus* in Šumava NP outside Kvilda settlement, Czech Republic

The Type B detection (recognizing invasive characteristics of new-comer species) is a little bit out of the scope of practical nature conservation. In order to determine these kinds of characteristics usually scientific institutes are involved. They can experimentally investigate the species and raise attention if needed.

The best and well-established systematic detection (Type A) I heard of during my trips is in Croatia and applied at harbors, where international commercial takes place. They have strict and particular rules of what and how to survey depending on the country of origin, the transported product and the species to be found. I assumed, that all the European countries have something similar system of detection, but the significance is different.

New species

Heracleum sp. - hogweeds:

Heracleum is a genus of about 60 species (depending on taxonomic interpretation) of biennial and perennial herbs in the carrot family Apiaceae. They are found throughout the temperate northern hemisphere and in high mountains as far south as Ethiopia. Some species in the genus are native to Europe (e.g. common hogweed, - *Heracleum sphondylium*), however few species occur nowadays in the nature originated from Southeast-Asia. The two most significant and threatening IAS for Europe are Sosnowsky's hogweed (*Heracleum sosnowskyi*) and giant hogweed (*Heracleum mantegazzianum*).

During my visits, one of the standard questions was if the staff has any relevant information and experience on hogweeds or not.

The first information was mentioned during the information on IAS organized by the MA. Basically, all Hungarian National Park Directorate mentioned, that they have the species within PAs, but luckily only one or some individuals, so it seems everybody could handle the problem. However, the staff member of KNPD presented their struggles of getting rid of Sosnowsky's hogweed. The species appeared four or five years ago at a fen surrounded by grasslands. It was known before, that the owner of the grassland restored the grassland by seeds originated from Germany. The hogweed appeared after the restoration on the grassland and on the fen, as well. The conservationist applied heavy

chemical treatment and then laid back thinking that all the individuals have been eradicated. In 2017 the ranger there realized that the eradication was not successful, since there is approximately a huge stock of at least 1000 individuals in the area! In order to get rid of the species they used motor mower, mulcher, and chemicals, and they had to repeat all the measures more (detailed practice later). However, the species is still in the area.

Pic 28. Eradication of hogweed (*Heracleum* sp.) at KNPD, Hungary

In Šumava NP, conservationist used chemicals for about 15 (!!!) years to eradicate the species from one location outside the PA. To 2018 it seems it will not return.

In Biebrza NP, they tried to eradicate the hogweed without chemicals, but they failed. So they decided to replace the whole soil at the location in order to get rid of any remnants of the species. It was a very expensive measure, but it seems they were successful.

Lupinus polyphyllus:

The garden lupine (*Lupinus polyphyllus*) originates from North America where it commonly grows along streams and creeks, preferring moist habitats. It is a perennial herbaceous plant with stout stems growing to 1.5 metres tall. The flowers are most commonly blue to purple in wild plants. The lupine variety in particular make up a great number of the hybrids which are generally grown as garden lupines, they can vary dramatically in colours.

Pic 29. Eradication of *Lupinis polyphyllus* in Šumava NP, Czech Republic

It is commonly used in gardens for its attractiveness to bees, ability to improve poor sandy soils with their nitrogen fixing ability and flowers; numerous cultivars have been selected for differing flower colour, including red, pink, white, blue, and multicoloured with different colours on different petals. It produces a huge amount of seeds.

In Europe, it is also classed as an invasive species in Sweden, Norway, Switzerland, the Czech Republic, Finland, Lithuania, and Ukraine, however it is very likely to spread all around Europe. It does already occur in Hungary as a garden plant, but yet does not cause any nature conservation problems. However, in the near future it is very likely to become a real and very problematic IAS.

During my visits the biggest problem caused by *Lupinus polyphyllus* was in Šumava NP. In the mountainous settlements people are very likely to cultivate this species, which is quite undemanding and very attractive. It has numerous different colour-variations, and it really grows fast, and produces a huge amount of seeds. And that causes the problem. People do not know how to deal the increment, they just try to get rid of the excess, which means they cut out the extra individuals and most of the time throw outside the yard. The backyards are next to meadows, grasslands, watercourses or roads, which all give an extraordinary opportunity for the species to spread.

It is very spectacular to observe how the species “walk” along the roads and watercourses, reaching remote meadows deep in the woods, where it can cause serious problems from a nature conservation point of view.

The process detailed above is about to start within Podyjí NP. The conservations have realized the problem and try to do their best, but the species spread very quickly. They said that *Lupinus polyphyllus* is not a problem yet, bet in the near future it would have been one of the biggest threat to native, sensitive plant communities along small watercourses and the river Dyje.

Himalayan balsam (Impatiens glandulifera):

Himalayan balsam is a large annual plant originally native to the Himalayas, however thanks to introduction it is now present across Europe. It is considered as an IAS in may

countries. Himalayan Balsam is sometimes cultivated for its flowers. The aggressive seed dispersal, coupled with high nectar production which attracts pollinators, often allows the Himalayan Balsam to outcompete native plants and changes natural communities. Due to climate change it is very likely to appear more and more in the Carpathian-basin

I heard the most relevant information about the species from the colleagues from Šumava NP and Podyjí NP. It was common, that none of the knows about the origin of the species, it might come from gardens or somewhere else. It was also similar, that they were quite successful in the eradication of the species. It seems that the species disappeared from the riverbank of Dyje in Podyjí NP, thank to the systematic measurements lasted for several years. During my visit, we could not find a single individual, luckily. However, in Šumava NP, they continuously struggle with the species. It appears in more and more new localities, they eradicate it from a place and a next year it appears at another.

Pic 30. Himalayan balsam in Šumava NP, Czech Republic

Animals:

One of the most expected information and data for me from the whole study trip was to hear about invasive animals, especially mammals and insects. Unfortunately, I had to realize, that the knowledge about IAS animals is very limited, especially considering eradication methods. However, below I introduce some of the most relevant species which are likely to appear in the Carpathian-basin.

Mapping and monitoring

Mapping and monitoring is strongly connected to detection. After detection (or even as a part of it) conservationists try to find new localities systematically, determine the recent distribution and follow the spread. Most of the time, this step is for preparing the eradication measures. Monitoring is also a very important activity everywhere during and after the eradication processes in order to follow the effect of the interventions.

At all the visited PAs, monitoring and mapping is part of everyday tasks of the staff members. Luckily, most of the time, the process and the methods are determined and regulated by strict legislation frameworks either derived from EU directives or national laws. It was very good to see, that all countries and PAs put a great emphasize on monitoring IAS. Mostly, monitoring activities of IAS are part of nation biodiversity monitoring schemes.

The most comprehensive mapping activities I experienced were in Kiskunság NP. The mapping was implemented in the framework of the LIFE-Nature project titled “Multilevel and multisite complex restauration of key ecosystem services of the calcareous sand forest steppe habitat” (OAKEYLIFE). Basically, they mapped the whole target area using 25m x 25m quadrats, and within one quadrats they estimated the individuals for one species and also categorized the individuals considering the eradication technique should be implemented to get rid of it, which were based on the size of the individual. They also used a similar method to map after the treatment in order to estimate the efficiency of the eradication activities and to determine further activities to do as post-treatment.

The staff of Fertő-Hanság National Park Directorate also conducted a precise and very comprehensive mapping of IAS during the design of Győrszentiván LIFE. The results were used as baseline studies in order to properly design the eradication activities. During the mapping the whole project are was scanned for IAS, all the localities were determined, and the population of the species was determined, which was the basis of the chosen eradication method.

In Medvednica Nature Park the stuff members also did a quite extraordinary work in order to have information on all the IAS presented within the park. Experts involved amateurs and tourists to localize all the localities of IAS plants, so basically they have now a detailed map of distribution of all IAS within the Park. For every localities, they also estimated the population of the species. It helps them to organize their eradication activities and prioritize the interventions. This type of mapping was quite general at all PAs I visited. Most of the PAs try to identify the most localities of IAS, however the intensity and the comprehensiveness differed.

In 2016, the BNPD presented a mapping procedure which is one of the most precise method available nowadays in Hungary. During my visit, we started to modify the procedure in order to be appropriate for HNPD. In the annex I attach the original presentation describing the procedure.

The conservationist at Thayatal NP are quite lucky, having a very small PA and only one settlement. IAS problems are basically only around Hardegg, meaning most of the species are from gardens. This case really ease the work of the experts, they can precisely map all the infected localities around the settlement.

Monitoring of the IAS is usually connected to eradication activities. Experts try to follow the processes after the eradication, they like to know the effectiveness and efficiency of the implemented eradication technique. This information underlies the further actions to be done or the modification of the techniques implemented before. This process was general at all the PAs.

Eradication

One of the biggest difference between Hungary and basically all other visited countries, that at protected areas only the Hungarian legislation gives the opportunity to use chemicals in order to eradicate IAS plants. Beside the legislative limits, the way of thinking is also different considering the issue of chemical usage at PAs. For Hungarian nature conservation experts it is basically completely natural, when it comes to eradication they use chemical treatment to get rid of IAS plants. We think that it is easier, time-saving, effective and efficient. On the other hand the experts of the visited PAs outside Hungary try to eliminate all chemical usage at PAs, and it was quite natural for them to refuse using chemical treatment against IAS. However they admitted, that most of the time mechanical treatment was not effective and efficient enough, and they struggle to eradicate patches of certain IAS plants for years or so to say forever.

In my opinion the book “Practical Experiences in Invasive Alien Plant Control” (Ref 1.) summarizes all best-practice method relevant to Hungary. Here, in this chapter I would like to introduce the differences I experienced abroad and new techniques and information only. Additionally I share here some good and bad examples.

Fallopia sp.:

The species occurs basically in all of the visited PAs. The most relevant experiences on the eradication of it was at FHNPD. The species occurs mostly along small watercourses and roads, which make the eradication difficult sometimes, especially next to watercourses. The continuous mechanical treatment mulching is very expensive, and most of the time not feasible. The chemical treatment is very dangerous because of the closeness of open water surfaces.

At FHNPD experts try to optimize the mixture of mechanical and chemical treatment. The investigations and surveys are still on, there are only partial results. It seems that in order to get rid of the species we could not avoid chemicals. The species should be treated by chemicals during spring, then mulched at the end of summer (dry weeds and shoots) and during autumn another spot-spraying chemical treatment is needed. Applying this, one year of treatment is effective and efficient against the species.

Pic 31. Pilot treatment of *Fallopia* sp. in Fertő-Hanság NP, Hungary

Russian olive (*Elaeagnus angustifolia*):

Previously, chemical treatment was used generally against the species. After the dying and drying out of the tree, it was cut and later the trunk was removed. It was effective, no doubt. However, the experts at FHNPD, in order to reduce the use of chemicals, tried to pull out the whole living tree entirely, which seems to be appropriate. Having the appropriate machinery for this activity you can reduce the chemical load of nature, and the result is the same.

Pic 32. Meadow with orchids after the elimination of Russian olives in Fertő-Hanság NP, Hungary

Tree of heaven (*Alianthus altissima*):

In Peszér forest at KNPD I had the opportunity to compare different practices against the tree of heaven. From the description it might seem minor differences between the methods, but the results differ hugely.

<u>Practice A:</u>

- the area was cut completely as a clearance
- thanks to shooting, the number of tree of heaven individuals multiplied;
- chemical treatment by painting the bark of the tree (used up to 10 cm trunk diameter)
- chemical treatment by drilling the trunk, filling the whole with glyphosate, closing the whole (over 10 cm trunk diameter).

Pic 33. Result of chemical treatment (Practice A) of tree of heaven in Peszér forest, KNPD, Hungary

Practice B:

- no clearance, so the density of the species is smaller and more bigger individuals occur;
- chemical treatment by wounding the bark and then painting it with glyphosate (used up to 5 cm trunk diameter)
- chemical treatment by drilling the trunk, filling the whole with glyphosate, closing the whole (over 5 cm trunk diameter).

I think the pictures speak for themselves. Although the treated individuals died and dried out in both cases, after Practice A a heavy shooting process occurred. Practice B needs a little bit of more time and more manpower, but it is way more effective than Practice A. Additionally, the amount of chemical used during the treatment is less in the case of Practice A.

Pic 34. Result of chemical treatment (Practice B) of tree of heaven in Peszér forest, KNPD, Hungary

The experts at Podyjí NP also realized a serious result of a very bad decision considering eradication practices. Couple of years ago one of the staff found a stock of tree of heaven (*Alinthus altissima*) including four or five individuals at a steep slope. They immediately clear-cut them, but they forgot about the area. During my visit was the first time after the treatment that they returned to locality. They were shocked. Because of strong shooting process, the whole steep slope was covered by tree of heaven densely. Unfortunately, they really multiplied the problem, and made it almost impossible to treat, because of the steep slope and the density. This was a turning point for them to think about chemical treatment, and looking for new solutions, the result of which would be a future workshop.

Pic 35. Dense shoot-forest of tree of heaven in Podyjí NP, Czech Republic

Red oak (Quercus rubra):

The species causes problems in Biebrza NP. Conservationists have used two practices against the species, however non of them seems to be effective.

Practice A: remove of the bark at 1 m height.

Practice B: cutting the tree at 1 m height.

Considering the death of the certain individual it both practice seems effective, however both practices resulted in strong shooting from the roots, which basically multiplies the problem. Experts seems a little bit disappointed during my visit about this result. I mentioned them the use of chemicals, which made them very surprised, that in Hungary it is very general to use chemical treatment against IAS, but also made them think about the idea, that if they want to get rid of the species, they should use glyphosate.

Pic 36. Result of bark removal (Practice A) against red oak in Biebrza NP, Poland

Pic 37. Result of 1 m height cutting (Practice B) against red oak in Biebrza NP, Poland

Robinia pseudoacacia:

In Podyjí NP they struggle a lot with black locust (*Robinia pseudoacacia*). However, for me it seems like they have not found the optimal treatment against the species. They refuse to use chemicals so they have tried out different mechanical treatments.

One of the methods is to clear-cut the stock of the black locust, which is generally use elsewhere, too. It can be used only in homogeneous stocks, and you have to take in account that the treatment should be repeated for a couple of years because of the shooting process. Podyjí NP was successful with this technique at steep slopes, where the black locusts could not regenerate.

Pic 38. Clear-cutting of black locust in Podyjí NP, Czech Republic

Pic 39. Cutting black locust at 1 m height in Podyjí NP, Czech Republic

Another interesting practice is similar to the one I have mentioned at red oak. They cut the tree at 1 meter height. They use this practice against elder tree individuals in heterogeneous forest patches. Like in the case of red oak, it does not seem to be very effective because of shooting process.

Medvednica Nature Park also struggles continuously with black locust. Their fundamental problem is that they are not the owners of the forests. Black locust has a huge economical value, which makes forest managers prejudiced about it. They do not really want to get rid of it and help conservationist to eradicate the species from Medvednica. This resulted in controversial management practices. They clear-cut the black locust forest, but refuse to make the post-treatment in order to avoid shooting and help natural rejuvenation of oak and beech forests.

Pic 40. Shoot-forest of black locust in Medvednica, Croatia

Blackberry *(Rubus sp.)*

Though blackberry is native to Podyjí, the overgrow of it is not desirable, especially on heathlands. Couple of years of pointless struggle in order to get rid of the species from the sensitive heathland, conservationists decided to use a very drastic technique. They change the whole upper layer of the soil. For now it seems that they succeed in getting rid of *Rubus* sp., and the cleared patches are being colonized back from the unharmed habitats.

Pic 41. Heathland restoration in Podyjí NP, Czech Republic

Lupinus polyphyllus:

The garden lupine is about to be generally distributed, however, nowadays it causes problems at scattered localities. In Šumava NP, one of the biggest nature conservation issues is the spread of *Lupinus polyhyllus*. The administration tries to do its best to control the spread of the species together with volunteers, interns and workmen. Workmen clear bigger areas of infected habitats by motor-scythe, while students, volunteers treat those localities which could not be reached easily. Both of the practices

are very hard work. They do not forget about the post-treatment of habitats. They promote the areas for grazing.

Pic 42. Eradication of *Lupinus polyphyllus* by motor-scythe in Šumava NP, Czech Republic

Pic 43. Pile of dried *Lupinus polyphyllus* after pulled out by volunteers in Šumava NP, Czech Republic

Heracleum sp.:

As I mentioned before, some of the PA staffs I visited has some relevant information about the eradication of hogweeds. Conservationists of Biebrza NP, after the continuous failure of mechanical treatment (mulching) they eliminate the whole upper layer of the soil infected together with seeds and roots of the species. They could do this, because the infection was outside the PA. It seems the species have not returned yet.

Outside Šumava NP, NP staff members struggled for years to get rid of the species using a combination of mechanical and chemical treatment. When I was there, we found new specimens at the treated habitat.

Pic 44. *Heracleum* sp. at KNPD, Hungary

Hogweeds had appeared in Hungary as well. The KNPD is struggling with them at one locality outside the PA, and their story is very instructive.They found the species at a remote place surrounded by grasslands and a marshland. The grasslands were restored before by mixture of seeds originated from Germany, as the land-owner is German. The

first individuals might be on the grassland, but no one observed it, because it was grazed and mowed regularly. The first individuals were found surrounded by the marshland in 2013, when a heavy chemical treatment was applied. Since it was outside the PA, the ranger did not occur here regularly. They observed the species again in 2017 when it covered a quarter of a hectare area. They immediately started the mechanical treatment by mulching the whole area by forestry mulcher, which mixes the upper layer of the soil. The first flowering individuals appeared 8 days (!!!) after the treatment. They treated the plant by heavy chemicals, but about one month later, there were seedlings again. Now they continuously treat the area by mulcher, but when I was there, we found new plants.

Animal species

This part of my trips was not as successful as I expected. However, I realized, that the case of IAS animals is more problematic than the case of IAS plants.

The detection activities are basically the same as written above, however, it should seriously be taken into account that animals can move. So detection and mapping, monitoring activities might suffer from serious difficulties. In simple words, sometimes it is very hard to find the individuals of IAS animals. It should be put more effort in active searching, which is most of the time very difficult because of financial or other capacity problems.

These problems also occur considering the combat and eradication activities. Basically, I experienced only local attempts to get rid of one species, but these resulted only partial or temporary success. Anyway, the staff members of the PAs I visited were kind to tell their experiences on this issue.

In Hungary, during the past two years (2017-2018) all the national park directorates were involved into the “National Mapping of Decapoda Species”. The main goal of the Ministry of Agriculture with this project was the gain up-to-date information on native Decapoda species, since conservationist only have limited information on the recent distribution patterns of the three native species. However, it is well known, that more and more invasive Decapoda species occur in Hungary, and constrain the native ones. So basically,

the mapping should provide detailed information about the distribution patterns of native and IAS Decapodas. I was involved at my directorate in this activity, and also had the chance to see how others did this work at BNPD. There are only preliminary results, but it seems that the IAS Decapodas have a serious effect on the population of the native species. The eastern part of Hungary, where HNPD and BNPD located the most threatening species is spinycheek crayfish.

Beside the valuable new data on Decapodas, the method provides an extraordinary opportunity to collect data of fish communities. Naturally (and unfortunately) the fish communities are also affected by invasive species.

Pic 45. Pumkinseed *(Lepomis gibbosus*) from Sajó river, BNPD, Hungary

At Šumava NP, the mammal monitoring activities are designed to follow the protected species like *Lynx lynx* or wild cats. However, the paths are used by other animals as well, so the staff gained information about IAS animals due to the photo-traps. These

accidental data provide important information about the distribution patterns of such species like raccoon, raccoon dog, sika deer (*Cervus nippon*), American mink.

Pic 46. Field devices for mammal monitoring, Šumava NP, Czech Republic

The mammal species mentioned above accidentally occur basically in all of the visited PAs. They were introduced during the middle of the 20th Century either because of firm

production or hunting purposes. Nowadays, they are slowly spreading, reaching remote localities from their original introduction or captivity places and could appear anywhere in Europe. The problem they could cause strongly depends on the habitat they invade, and on the quick response the conservationists make.

Eradication activities were only implemented in two PAs. In Bierbza NP they had serious problems with the American mink at the nesting place of shorebirds. The conservationists used electric fences and different traps against the species. In Podyjí NP some of the small fish ponds were completely cleared from Prussian carp (*Carassius auratus gibelio*).

After the whole trip, for me it seems that regarding IAS animals one of the biggest source of the species is aquaristics. Unfortunately, it is a very common practice among people, that they let pets free when they get bored of into natural or semi-natural habitats. Accordingly, all PA I visited reported accidental occurrences of exotic fish, crayfish and sliders (*Trachemys* sp.) or other turtle species.

Also, the "classical" invasive fish species are present in every of the PA visited, like stone moroko (*Pseudorasbora parva*), different *Gobio* species, grass carp (*Ctenopharyngodon idella*) and bighead carps (*Hypophthalmichthys* sp.).

During the year of this study trips I had the opportunity to take part in two different conferences. The first was an information day organised by the Hungarian Ministry of Agriculture. The most interesting presentation was about how exotic insect species could reach remote localities. Basically, international trade is one of the strongest force behind the fast spreading of certain species. The presentation demonstrated some interesting, and sometimes funny situations about how different species can travel like stowaways. For example, a new species of mosquito reached Hungary via a huge load a car tires. The packages of the tires were not sealed watertight, so during the sea-transportation the rain stagnated in. These technotelmas provided enough water for the eggs and larvae to evolve. Another species reach Europe via the irrigation water stagnated in and around the lucky bamboos originated from Far-East.

Despite of the fact that many IAS animals are presented at the PAs I visited, it seems that somehow conservationists do not act against them actively. This is either because of lack of information about the species, or it cause only minor problems not serious ones, or do not have the right practice for eradicating, etc.

The staff members of Podyjí NP mentioned the Asian or harlequin ladybird (*Harmonia axyridis*) as one of the biggest problems within the PA. Previously, the species was known only from vineyards, but recently it occurs basically everywhere within the NP. It threatens the native ladybird communities, just similarly to the case in Hungary. The first detection of the species was about 15 years ago, and nowadays it is generally current, on the other hand, the populations of the native ladybirds decreased a lot. Unfortunately, neither the Czech colleagues or the Hungarian experts have any idea on how to eradicate or at least decrease the population of the invasive species. It is also worth to mentioned, that basically all the visited PAs do have the species.

Considering IAS animals only one quite complex measurement was shared with me. In Biebrza NP, one of the biggest problems considering IAS is the growing number of American mink (*Neovison vison*). The species was introduced from North-America in order to serve the fur industry, like at many places all around Europe. On the one hand, the American mink has a quite huge effect on the populations of the native small carnivors (the most important and threatened is the European mink - *Mustela lutreola*), and on the other hand the species is very successful in decreasing the number of waders within the NP. Basically, the mink distracts the birds in their everyday activities including feeding, roosting, overnight and of course nesting. Additionally, the mink easily spoil the nest either with eggs or younglings.

The experts of Biebrza NP realized the threat and it seems they tarted to act just in time. They mapped the most important wader nesting places and started to map the population and distribution of the American mink by using fur-traps and trace traps. After the assessment and evaluation they built electric fences around the most important wader feeding, roosting and nesting sites in order to keep out the minks, and also started to apply traps at places where both mink species occur. At places where only the american mink was detected they use killer-traps.

Pic 47. Traps for American minks, Biebrza NP, Poland

Laymen involvement

Non-expert people might not recognize the importance of the issue of IAS. In my opinion nature conservationists have a great responsibility to raise attention and awareness. The involvement of amateurs into active nature conservation would differ widely. Despite of the fact, that during my everyday work I am not responsible or marginally responsible for laymen involvement, because of personal reasons I put a greater emphasize on the topic during my visits.

Sum up my experiences at my Directorate and gained at the visited Hungarian NPs comparing to the experiences outside the Carpathian-basin, I had to realized, that Hungarian conservationist are far away from experts from abroad. For me it seems that the staff members I visited realized, that without the support and help of amateurs, students, tourist the combat against invasive species is only a dead-end. Naturally, awareness rising activities occur everywhere, but only others involve actively people into detection, mapping or eradication activities.

It was a little bit surprising that almost everywhere outside Hungary, monitoring (and detection) is not only implemented by the PA staff members, but amateur nature conservations, tourists, students, locals are also involved. Some of the organization have started campaigns to raise attention to the threat of IAS and get people involved into detection. Most of the time this is due to mobile application where people could send their data and picture into a database handled by nature conservation experts. In Hungary, only the FHNPD has something similar, but it is still under elaboration.

The only Hungarian good example was at FHNPD. Couple of years ago, the staff members on the Directorate working on the field started to use mobile applications in order to be able to collect data basically anywhere and anytime easily. The application itself is freeware, so anybody could have it on his/her smartphone. Experts realized, that this has a big opportunity for conservationist to involve anybody into data collection. After testing the application itself and proved to be very practical, they made different projects within the application. The different projects are available for different level of people (e.g. rangers only, botanist only, amateurs or dedicated for only particular monitoring programme, etc.). After a short and easy registration anybody could join to

the proper project and they can record data, including species name, localities, circumstances and pictures. Naturally, amateur data need strict validation before assessing into the database, but with pictures this time decreases. The registration and validation assure that no fake data has been upload. The supervisor mentioned that they gained a lot of important and interesting data from tourist regarding protected species and IAS, too.

During my visit I had the opportunity to try out the application which was really very easy to use, and also saw the validation process. After my report about this application, some of my colleagues were also very eager to know about this application, so they organized their own trip to see how it is going. Now HNPD is about to change fundamentally its data collection practices.

In Biebrza NP non-expert people are continuously involved into the work of the NP, including combat against IAS. They organize student camps during summertime, where children hear about the outstanding values of the PA and could be involved into nature conservation management. One of the regular programme points is the combat against Himalayan balsam. Children can easily understand the fact that the presence of certain species at some localities is not preferable, because they affect the natural values and sometimes suppress them back. So they are very happy to help in getting rid of the Himalayan balsam. Usually they work in small groups, and the groups compete with each other either in the cleared surface and the eradicated specimens of the species.

If the eradication practice is little bit harder, they choose another, more appropriate age group to help in the eradication. *Echinocystis lobata* causes serious problems within Biebrza NP. Most of the time it originates from settlements and it can reach remote localities along roads and watercourses. Numerous long sections of the Biebrza river's riverbank are infected by the species heavily. It can grow so dense stocks that even the reed could not survive beside this IAS. Combating against *Echinocystis lobata* is very troublesome, because it grows on the native species as a lianes, so even selective mechanical treatment is very hard to find. The best way is to pull the individuals out from the soul and off the specimen they grew on. It is a quite heavy works, so most of

the time interns and locals are involved. During my visit I had the opportunity to help Biebrza staff and interns in this combat.

Pic 48. Eradication of *Echinocystis lobata*, Biebrza NP, Poland

The Biebrza NP has one more very smart and very likeable initiative considering combating against IAS. They organizes a the "Biebrza Haymaking" (last year it was the *17th World Championships in Scything of Wet Meadows for Nature* in Szuszalewo). I think everybody among nature conservationists is aware of the fact that proper habitat management is a key factor in order to prevent the appearance of IAS and also a key factor in the eradication of the species, furthermore in the long-term maintenance. Unfortunately, there are special habitats which cannot be managed by any kind of machinery, the hard work should be done by handwork. The staff at Biebrza realized that they do not have the number is manpower so they decided to organize a competition, where the attendants compete for glory and recognition, while the habitat gets the proper management. The big event attracts conservationists, amateurs and professional scythers who help to maintain the meadows of Biebrza. HNPD is a regular

attendant to this event, however, unfortunately, I have never been one of the competitors.

As I mentioned before, one of the biggest problems in Šumava NP considering IAS is *Lupinus polyphyllus*. The eradication of the species is very problematic, because most of the time the stocks are at localities which could not be approached by machineries. Thus, the eradication of the species is realized mainly by interns and volunteers.

Another practice in Šumava NP that people can adopt small areas of infected habitats and they can either support the eradication with money or can clear the patches by their own. The Administration propagate these areas with their patron. After the first wave of eradication the long term management is often implemented with help of local animal husbandries.

2.3/2.4 - Potential gaps with objectives and expectations/ Difficulties, limits

Generally speaking, in my opinion my knowledge about IAS within Central- and Eastern-Europe improved a lot, there is no question about this. However, basically I have a little bit of lack about all of the PAs I visited. It is not a complaint, because all the staff members I met were amazing, however sometimes they did not show what they offered before, or did not have sufficient data and information about something that I needed from them.

In my opinion, the only gap that is quite annoying is the knowledge limit regarding IAS animals. I asked every PA staff I visited if they had anything to share regarding invasive animals, but the answers were quite unprofitable. The main points are described in details above, here I just want to emphasize that it seems that our global knowledge on IAS animals is getting bigger and bigger, it is still very limited. We are about to detect more and more species from different taxa, but effective practices regarding eradication can be found only occasionally. The presentations at the *3rd Croatian Symposium on Invasive Species* did confirms my feelings, because most of the presentations were about plants. The topic of the few presentations about animals was mainly about detection of new species, and not about investigating new methods of eradication practices.

I also still have some lack of information about the forecasting. I have not known anything useful about any of the species which might come in the near future to the Carpathian-basin or to Hortobágy National Park.

Other lack is about eradication practices, which is because one big difference between Hungary and other countries. Outside Hungary, conservation seldom use chemical treatment during the eradication measures or not at all, while in Hungary it is known as the best-practice method is most of the cases. For the truth, for me it is very controversial to use so much chemical within PAs, but it seems that that is the only effective and efficient way of combat. Experts not from Hungary said that they are aware of fact that only mechanical treatment is most of the time not enough in order to get rid of IAS, but they are still very afraid of using chemicals.

I also have to mention my limits. Sometimes it was very hard to focus on the topic. I had the opportunity so amazing places that sometimes I forgot about IAS and I just enjoy being at beautiful places where I have been never before. Also, our guides were so amazing, however sometimes missed the topic and show us the best part of the PAs, and not the one infected by IAS.

Also, I had to realized, that it is very hard to make notes, take pictures, ask relevant questions, during walking and enjoying the view.

I have to mention that the concept of the report also changed a lot during the whole trip depending what I heard. It also made the work a little bit difficult. Additionally, after changing the concept of the report during the later trips made me rethink the information I heard before, which was sometimes not so relevant or the notes did not include the relevant information considering the new concept. So maybe more controlled conversations and questions should have been done.

3 – Conclusions

Recently, one of the biggest issues of nature conservation worldwide is IAS, basically they affect negatively biodiversity in general and also the livelihoods of mankind. In order to prepare ourselves for the combat against them we have to find intervention point from the first possible appearance of a species to a complete eradication.

I think the major point is to share information and experience within the community of nature conservationists in order to learn from other's mistakes and prepare ourselves for new challenges. Conservationists have a huge responsibility in spreading the information among laymen from small children, students through amateurs, tourist to decision makers. One thing is very important in this process, we should find the best way of communication in order to reach them. I think, during my visits I saw some very good and smart idea to reach the different groups of people. I have already shared the basic ideas which I like the most (leaflets of CAEN, field activities at Biebrza NP and Šumava NP, data collection at FHNPD, etc.) with my colleagues. They have already used this information during organizing new programs or designing new information leaflets, also we started to elaborate a new way of data collection, which could be used by tourists, children or basically anybody else.

By the way, data collection. This is also very important to collect and assess as many data and information as we can. That is why I think is vital to involve anybody into data collection through a mobile application for example. The elaboration of the modified application and project in it is on with the help of experts from FHNPD and University of Debrecen.

Mapping and monitoring is also very important in the combat against IAS. I have seen a lot of good examples for partial or comprehensive mapping and monitoring practices (Medvednica, Biebrza, KNPD, FHNPD, BNPD), which will be applied during the elaboration of new mapping and monitoring schemes of HNPD for IAS. I am still in contact with experts of KNPD and BNPD in order to achieve this.

After all we should not forget about the terminal solution about IAS, the eradication. I had to realize that there are huge differences in eradication practices. This either

because of conceptual differences or within different circumstances the same species reacts differently so different eradication measures need to be done. I think this part of my study trip was one of the most instructive and most profitable for me and for the others as well. We shared with each other different practices at different places, think about ideas to test in the future together. I think these information will help my everyday work on IAS at my place invisibly.

I have also made friendships and new professional partnerships during the trips. The Biebrza NP kindly invited me for the next year to the hay making championship. On the other hand, together with the experts from Podyjí NP we are about to organize a workshop within the framework of EUROPARC Central- and Eastern Europe Section.

Additionally, I really have emphasize, that the whole study visit was not only about IAS. I had so many conversation with so many people hitting so many topics during these days, that I can hardly summarize (e.g. project proposal writing, ranger's work, recruitment of volunteers, designing visitor centers in the 21st Century, communication practices, etc). Hopefully, most of the information was deposited in my head.

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