



UNIVERSITETI I PRISHTINËS  
"HASAN PRISHTINA"  
FAKULTETI I SHKENCAVE MATEMATIKE NATYRORE

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FSHMN

Ref. nr. 334

Prishtinë, Dt. 02.02.2024

**KËRKESE**

**Për:** Këshillin Mësimor të Departamentit të Biologjisë

Këshillin e Studimeve të Doktoratës të FShMN-së

Këshillin e Fakultetit të Shkencave Matematike- Natyrore

**Lënda:** Kërkesë për formimin e komisionit për vlerësimin e dorëshkrimit të temës së doktoratës

Sipas Statutit të Universitetit të Prishtinës "Hasan Prishtina" dhe Rregullores ekzistuese për studime të doktoratës, i plotësoj kushtet për vlerësimin e dorëshkrimit, prandaj kërkoj nga organet e lartëpërmendura të FShMN-së të më mundësojnë formimin e komisionit për vlerësim të dorëshkrimit të temës së doktoratës me titull: "**BIMËT ALIENE INVAZIVE TË FLORËS VASKULARE NË RAJONIN LINDOR TË KOSOVËS**"

Kërkesës ia bashkangjes:

1. Kopjen e dorëshkrimit
2. Një punim shkencor nga lëmia e ngushtë
3. Pëlqimin e mentorit për dorëzimin e dorëshkrimit
4. Dëshmitë për pjesëmarrje në konferenca
5. Formularin F6

Prishtinë: 02.02.2024

**Kandidati:** Msc. Bujar Kadriaj

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Këshillin e Fakultetit të Shkencave Matematike- Natyrore

**Lënda:** Pëlqim nga Mentori për dorëzimin e dorëshkrimit të temës së doktoratës me titull: "BIMËT ALIENE INVAZIVE TË FLORËS VASKULARE NË RAJONIN LINDOR TË KOSOVËS" për kandidatin Msc. Bujar Kadriaj.

**Mendim:**

Dorëshkrimi i temës së doktoratës i kandidatit Msc. Bujar Kadriaj, përmban rezultate për bimët aliene invazive të florës vaskulare në Rajonin Lindor të Kosovës. Këto rezultate janë të një rëndësie tejet të veçantë për vendin tonë duke marrur për bazë se bimët aliene invazive aktualisht paraqesin një problematikë të rëndësishme në nivel global. Shqetësim të veçantë janë për habitatet të cilat ato pushtojnë dhe për biodiversitetin vendas. Rezultatet e fituara nga ky hulumtim janë paraqitur dhe përpunuar në mënyrë të duhur nga ana e kandidatit. Nga këto rezultate të fituara janë realizuar dy konferenca shkencore ndërkombëtare nga ana e kandidatit dhe një punim shkencor të cilat janë paraqitur si më poshtë:

Pjesë të punimit të botuara në formë kumtese:

- 11<sup>th</sup> International Conference of Ecosystems; June 4-6, 2021, Chicago, Illinois, USA (online).
- International Conference on New Achievements in Science, Technology and Arts" – ICNA-STA, 4-5 May 2023, Prishtina, Kosovo.

Pjesë të punimit të botuara në formë punimi shkencor:

- Kadriaj, B., Berisha, N., Krasniqi, E., & Millaku, F. (2023). Invasive alien plant species (IAPS) in the eastern region of Kosovo: a preliminary list. *Ecologia Balkanica*, Vol. 15, Issue 2.

Bazuar në rëndësinë që ka ky hulumtim, punën dhe përkushtimin e kandidatit në fjalë, në cilësinë e mentorit të tij mendoj se ky hulumtim i plotëson kriteret e punimit të doktoratës. Prandaj, sipas Rregullores për studime të doktoratës në Universitetin e Prishtinës “Hasan Prishtina”, ky punim i plotëson kriteret që të procedohet më tutje.

Prishtinë:

01.02.2024

Mentori:

Prof. Dr. Elez Krasniqi



## UNIVERSITETI I PRISHTINËS "HASAN PRISHTINA"

F6- Paraqitja e punimit të doktoratës

PARAQITJA E PUNIMIT TË DOKTORATËS <sup>1</sup>	
TË DHËNAT E PËRGJITHSHME	
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Emërtimi i studimit:	Biologji e organizmave dhe Ekologji
Udhëheqësi i studimit:	Universiteti i Prishtinës "Hasan Prishtina"
TË DHËNAT PËR PUNIMIN E DOKTORATËS	
Titulli në gjuhën shqipe	Bimët aliene invazive të florës vaskulare në Rajonin Lindor të Kosovës
Titulli në gjuhën angleze	The invasive alien plants of the vascular flora in the Eastern Region of Kosovo
Fusha e hulumtimit	Botanikë
DEKLARATA E MENTORIT/BASHKËMENTORIT	
<p>Dorëshkrimi i temës së doktoratës i kandidatit Msc. Bujar Kadriaj, përmban rezultate për bimët aliene invazive të florës vaskulare në Rajonin Lindor të Kosovës. Këto rezultate janë të një rëndësie tejet të veçantë për vendin tonë duke marrur për bazë se bimët aliene invazive aktualisht paraqesin një problematikë të rëndësishme në nivel global. Shqetësim të veçantë janë për habitatet të cilat ato pushtojnë dhe për biodiversitetin vendas. Rezultatet e fituara nga ky hulumtim janë paraqitur dhe përpunuar në mënyrë të duhur nga ana e kandidatit. Nga këto rezultate të fituara janë realizuar dy konferenca shkencore ndërkombëtare nga ana e kandidatit dhe një punim shkencor të cilat janë paraqitur si më poshtë:</p> <p>Pjesë të punimit të botuara në formë kumtese:</p> <ul style="list-style-type: none"> <li>- 11<sup>th</sup> International Conference of Ecosystems; June 4-6, 2021, Chicago, Illinois, USA (online).</li> <li>- International Conference on New Achievements in Science, Technology and Arts" – ICNA-STA, 4-5 May 2023, Prishtina, Kosovo.</li> </ul> <p>Pjesë të punimit të botuara në formë punimi shkencor:</p> <ul style="list-style-type: none"> <li>- Kadriaj, B., Berisha, N., Krasniqi, E., &amp; Millaku, F. (2023). Invasive alien plant species (IAPS) in the eastern region of Kosovo: a preliminary list. <i>Ecologia Balkanica</i>, Vol. 15, Issue 2.</li> </ul> <p>Bazuar në rëndësinë që ka ky hulumtim, punën dhe përkushtimin e kandidatit në fjalë, në cilësinë e mentorit të tij mendoj se ky hulumtim i plotëson kriteret e punimit të doktoratës. Prandaj, sipas Rregullores për studime të doktoratës në Universitetin e Prishtinës "Hasan Prishtina", ky punim i plotëson kriteret që të procedohet më tutje.</p>	
Vendi, data dhe nënshkrimi	


<sup>1</sup> Lutei që ta plotësoni formularin dhe ta dërgoni të nënshkruar me postë elektronike.

UNIVERSITETI I PRISHTINËS "HASAN PRISHTINA"

F6- Paraqitja e punimit të doktoratës

Në Prishtinë, 01 02 2024

Nënshkrimi \_\_\_\_\_

  
Prof. Dr. Elez Krasniqi

Nënshkrimi \_\_\_\_\_

(Emri e mbiemri i bashkëmentorit)

UNIVERSITETI I PRISHTINËS "HASAN PRISHTINA"  
FAKULTETI I SHKENCËVE MATEMATIKE-NATYRORE  
PRISHTINË

Pranuar me: <u>02.02.2024</u>			
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FAKULTETI I SHKENCAVE MATEMATIKE- NATYRORE  
DEPARTAMENTI I BIOLOGJISË



Msc. Bujar M. Kadriaj

**BIMËT ALIENE INVAZIVE TË FLORËS  
VASKULARE NË RAJONIN LINDOR TË  
KOSOVËS**

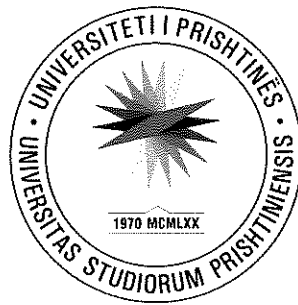
UNIVERSITETI I PRISHTINËS "HASAN PRISHTINA"  
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PRISHTINË

Planuar me: 02.02.2024			
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PUNIMI I DOKTORATËS

Prishtinë, 2024

UNIVERSITY OF PRISHTINA "HASAN PRISHTINA"  
FACULTY OF MATHEMATICAL AND NATURAL SCIENCES  
DEPARTMENT OF BIOLOGY



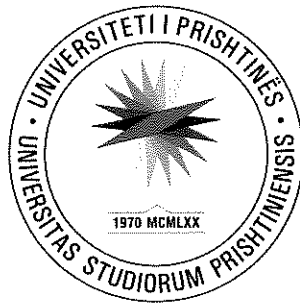
Msc. Bujar M. Kadriaj

**THE INVASIVE ALIEN PLANTS OF THE  
VASCULAR FLORA IN THE EASTERN  
REGION OF KOSOVO**

DOCTORAL THESIS

Prishtina, 2024

UNIVERSITETI I PRISHTINËS "HASAN PRISHTINA"  
FAKULTETI I SHKENCAVE MATEMATIKE- NATYRORE  
DEPARTAMENTI I BIOLOGJISË



Msc. Bujar M. Kadriaj

**BIMËT ALIENE INVAZIVE TË FLORËS  
VASKULARE NË RAJONIN LINDOR TË  
KOSOVËS**

PUNIMI I DOKTORATËS

Mentor: Prof. Dr. Elez Krasniqi

Prishtinë, 2024



## REZYME

Shqetësimet e ngritura në nivel global mbi invazionin biologjik, kanë bërë që edhe ne të fillojmë me hulumtime të kësaj dukurie në vendin tonë. Një nga faktorët kryesorë të ndryshimeve dhe kërcënimeve në biodiversitet dhe ekosistem janë taksonet aliene invazive. Shkalla e lartë e globalizimit ka bërë që të lehtësohet përhapja e këtyre taksoneve në mbarë botën. Disa prej tyre janë më pak e disa më shumë shqetësuese. Në kuadër të pushtuesëve biologjik hyjnë virusët, bakteriet, kërpudhat, bimët dhe shtazët. Bimët zënë një vend të rëndësishëm në invazionin biologjik. Shumë taksone bimore janë përhapur në rajone të ndryshme në nivel global në mënyra të qëllimshme (qëllime dekorative, mjekësore, bujqësore etj.) dhe aksidentale, por që kontrollimi i disa prej tyre pastaj është sfidë menaxhimi dhe paraqet një problematikë aktuale në biologjinë e konzervimit, ekologji, mbrojtje të mjedisit, bujqësi, etj.

Rezultatet e hulumtimit tonë tregojnë se edhe Kosova po ballafaqohet me invazionin biologjik nga bimët aliene invazive të florës vaskulare njëjtë sikurse vendet e rajonit dhe me gjerë në nivel global. Hulumtimi i bimëve aliene invazive është realizuar në Rajonin Lindor të Kosovës apo siç njihet si Rrafshi i Kosovës. Në këtë rajon janë konstatuar gjithsejt 21 lloje bimore aliene invazive, shumica prej tyre janë me origjinë nga kontinenti i Amerikës Veriore (12 lloje ose 57.14%), ndjekur nga Azia (5 lloje ose 23.81%). Më të ndikuara nga llojet aliene invazive ishin zonat rreth vendbanimeve (habitatet përgjatë rrugëve dhe rrjedhave ujore). Meqenëse ky grup i bimëve deri më tani nuk ka qenë i hulumtuar në mënyrë të drejtpërdrejt dhe ekzistojnë shumë pak të dhëna rreth tyre, ky studim paraqet kontribut në këtë problem të rëndësishëm për biodiversitetin vendas dhe tërheq vëmendjen e autoriteteve qeveritare përgjegjëse për ruajtjen e natyrës.

**Fjalët kyçe:** Rajoni Lindor i Kosovës, invazioni biologjik, bimët aliene invazive, biodiversiteti

## **RESUME**

Concerns raised at the global level about biological invasion have led us to start studying this phenomenon in our country. One of the main factors of changes and threats in biodiversity and ecosystems are invasive alien taxa. The high degree of globalization has facilitated the spread of these taxa around the world. Some of them are less and some more disturbing. Biological invaders include viruses, bacteria, fungi, plants and animals. Plants play an important role in biological invasion. Many plant taxa have spread in different regions globally in intentional (decorative, medicinal, agricultural, etc.) and accidental ways, but the control of some of them is then a management challenge and presents a current problem in conservation biology, ecology, environmental protection, agriculture, etc.

The results of our research show that Kosovo is also facing the biological invasion by invasive alien plants of the vascular flora, the same as the countries of the region and more widely at the global level. The research of invasive alien plants was carried out in the Eastern Region of Kosovo or as it is known as the Kosovo Plain. A total of 21 alien invasive plant species have been found in this region, most of them originating from the North American continent (12 species or 57.14%), followed by Asia (5 species or 23.81%). Most affected by invasive alien species were the areas around settlements (habitats along roads and waterways). Since this group of plants has so far not been directly studied and there are very few data about them, this study represents a contribution to this important problem for local biodiversity and draws the attention of government authorities responsible for nature conservation.

**Key words:** Eastern region of Kosovo, biological invasion, invasive alien plants, biodiversity

## ECOLOGIA BALKANICA

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*Invasive alien plant species (IAPS) in the eastern region of Kosovo:  
a preliminary list**Bujar Kadriaj, Naim Berisha, Elez Krasniqi\*, Fadil Millaku*University of Prishtina "Hasan Prishtina", Faculty of Mathematics and Natural Sciences,  
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**Abstract.** This paper presents a preliminary checklist of the invasive alien plant species (IAPS) in eastern Kosovo. This list was compiled based on a literature review and field surveys in the period between 2020-2022. The list includes 20 plant taxa with information on taxonomic affiliation (Family), life form, native range and type of habitat(s) they invaded. Most species belong to Asteraceae family, followed by Fabaceae and Balsaminaceae. Therophytes are the predominant life form. There are two genera, each with two species: *Erigeron* L. (*Erigeron annuus* (L.) Desf., *Erigeron canadensis* L.) and *Impatiens* Riv. ex L. (*Impatiens balfourii* Hook.f. and *Impatiens glandulifera* Royle), while others are represented by only one species. The majority of IAPS in the eastern region of Kosovo are from North, Central and South America (65%), followed by Asia (30%) and with only one species from Africa (5%). The habitats most heavily colonized by IAPS are the areas along roads, waste places, riverbanks and cultivated areas.

**Key words:** alien flora, biological invasions, plant invasions, biodiversity, Balkans.

**Introduction**

Kosovo is located in the western part of the Balkan Peninsula, in SE Europe. Due to its small territory (10,908 km<sup>2</sup>), it is quite rich in phyto-diversity, counting between 2800-3000 taxa of vascular flora (Millaku et al., 2017). The researched region is located on the eastern side of Kosovo with an area of 6,262.54 km<sup>2</sup> or 57.4% of its territory. In the geographical literature it is also known as the "Kosovo Plain" (Çavolli, 1997), which includes not only the flat parts, but also the hilly-mountainous parts (Bytyqi, 2017).

Biodiversity, food security, health, or economic growth of an ecosystem are threatened by invasive species, i.e., non-native plants, animals, or microorganisms (Lawler et al., 2006; Pyšek et al., 2020). Invasive species pose a major threat to biodiversity worldwide, affecting many habitats (Laface et al., 2020; Gutiérrez, 2017). It is widely

predicted that climate change will greatly exacerbate the threat of invasive species (Shabani et al., 2020). Globalization will inevitably lead to intentional or unintentional introduction of organisms into new environments through increased trade, transit, travel, and tourism (Gallardo & Aldridge, 2013; Dueñas et al., 2021; Kovács-Hostyánszki et al., 2022).

Invasive alien plant species (IAPS) occur in both terrestrial and aquatic habitats and may include herbs, shrubs, creepers, and/or trees (Spampinato et al., 2022). IAPS are capable of invading nearly every ecosystem on Earth and, because of their efficient use of resources (especially nutrients, water, light, oxygen, and habitat for other organisms), they can consume excessive amount of available natural resources, including a greater ability to capture light, resulting in higher rates of photosynthesis, faster

growth, and greater fruiting (Early et al., 2016; Peiris et al., 2021). As a result, they can threaten the community structure, functionality, and productivity of natural ecosystems (Vilà et al., 2011; Pyšek et al., 2012).

IAPS affect local species, communities, and ecosystems in a variety of ways (Weber, 2003; Pyšek et al., 2004; Richardson & Pyšek, 2006). They reduce the distinctiveness of biological communities at different spatial scales by reducing the species richness and abundance of native biota and their local biodiversity (Winter et al., 2009; Šilc, 2015). For example, in terrestrial environments, monospecific stands of invasive plants such as Himalayan balsam (*Impatiens glandulifera* Royle) can significantly limit understory by inhibiting seed germination, seedling establishment, and plant growth and development. IAPS also affect the biological, chemical, and physical properties of the soil (Gooden et al., 2009; Wickramathilake et al., 2013). According to Meyerson and Reaser (2002), invasive alien species have significant negative economic impacts on government, industrial, and private sectors. In many countries, the agriculture, forestry, fisheries, aquaculture, health, and conservation sectors are most affected (Caruso, 2022; Jiménez et al., 2022).

Although there are abundant data for Kosovo concerning the flora and, to some extent, plant communities (Rexhepi, 1994; Tomović et al., 2014; Millaku et al., 2013, 2017), the data concerning IAPS are entirely deficient. The study of this pressing issue in Kosovo is a relatively new topic. Until now, one publication is available (Krasniqi et al., 2011), which reports the status of three IAPS for Kosovo: *Amorpha fruticosa* L., *Reynoutria japonica* Houtt. and *Helianthus tuberosus* L., and a short country report (Maxhuni & Ibrahim, 2016) which tabulates three other IAPS (*Ambrosia artemisiifolia* L., *Datura stramonium* L. and *Robinia pseudoacacia* L.) but provides no further information about any original survey data. In addition, the publication has been cited and referred to in numerous reports of government environmental agencies and occasionally in environmental reports of various non-governmental organizations in Kosovo (Anonymous, 2013, 2014, 2015, 2017). There were occasional scientific publications where, among others, Kosovo was also mentioned (Adamowski, 2009), or even mentioned in the context of Kosovo and Serbia, quite often without

corresponding relevant specific details (Lazarević et al., 2012). As can be seen from the above data, attempts have been made to identify IAPS in Kosovo, but without a direct approach to their study and without a verified species list for these taxa in Kosovo.

Considering the importance of these taxa at local and global levels, more intensive field expeditions have been carried out, especially in the last two years, specifically targeting this group of plants. Based on this situation, the present study represents the first direct attempt to identify these plant taxa in Kosovo, more specifically in its eastern region, and to point out some taxa that are considered dangerous for the native flora.

### Materials and Methods

The research area of IAPS has been the eastern region of the country (Fig. 1). Since the territory of Kosovo is divided into two main geographical areas (the eastern and the western region), then we initially decided to study IAPS only in the eastern part. In order to establish a reliable list of IAPS in the eastern region of Kosovo, we first relied on a critical analysis of the existing data about these taxa in our country (Krasniqi et al., 2011; Maxhuni & Ibrahim, 2016), in the lists of neighboring countries as well as those further away in the Balkan Peninsula (Matevski et al., 2001; Petrova & Vladimirov, 2002; Petrova, 2004; Boršić et al., 2008; Arianoutsou et al., 2010; Stešević & Petrović, 2010; Lazarević et al., 2012; Petrova et al., 2013; Barina et al., 2014; Nikolić et al., 2014; Shehu et al., 2014; Maslo, 2016; Stojanović & Jovanović, 2018; Panjković et al., 2021; Zhuri & Imeri, 2022), while a large number of field surveys were done.

Our research so far has been based in different habitats in the eastern region of Kosovo. These field surveys focused mainly on habitats near settlements, vegetation along roads and railways, vegetation near rivers and riverbanks, and degraded habitats near settlements and mountains. The field surveys have been conducted in the period between 2020-2022. The useful data from literature sources, in addition to the general data collected from local floras, were especially publications dealing with ruderal flora (Prodanović et al., 2008; 2017; Mehmeti et al., 2009) and vegetation (Pajazitaj, 2009; Tabašević et al., 2021), vegetation and flora of meadows (Hundozi,

1982; 1983; Krasniqi et al., 2020), vegetation of hilly-mountainous areas (Krasniqi, 1966; 1972; Rexhepi, 1974; 1976; 1983; Krasniqi et al., 1981; Pajazitaj, 2012), and to some extent publications dealing with macrophytes along rivers (Bytyçi et al., 2022). Using the data obtained from the field surveys and the literature reviewed, we have provided information on taxonomic family affiliations, life forms, native origin and type of habitat(s) for each IAPS in the eastern region of Kosovo.

The taxonomic nomenclature of the plants follows the EuroMed Checklist (Euro+Med, 2006+). Life forms were assigned according to the

system of Raunkier (Raunkier, 1934) designated with the following abbreviations: P - Phanerophytes, Ch - Chamaephytes, H - Hemicryptophytes, T - Therophytes and G - Geophytes.

The determination of the native origin of the IAPS included in this list was based on available data from the international collaborative program Plants of the World Online (POWO, 2022). For each IAPS, the continent of origin is indicated with the appropriate abbreviation, with more specific information added in parentheses. The following abbreviations were used: AS = Asia, AM = America and AF = Africa.

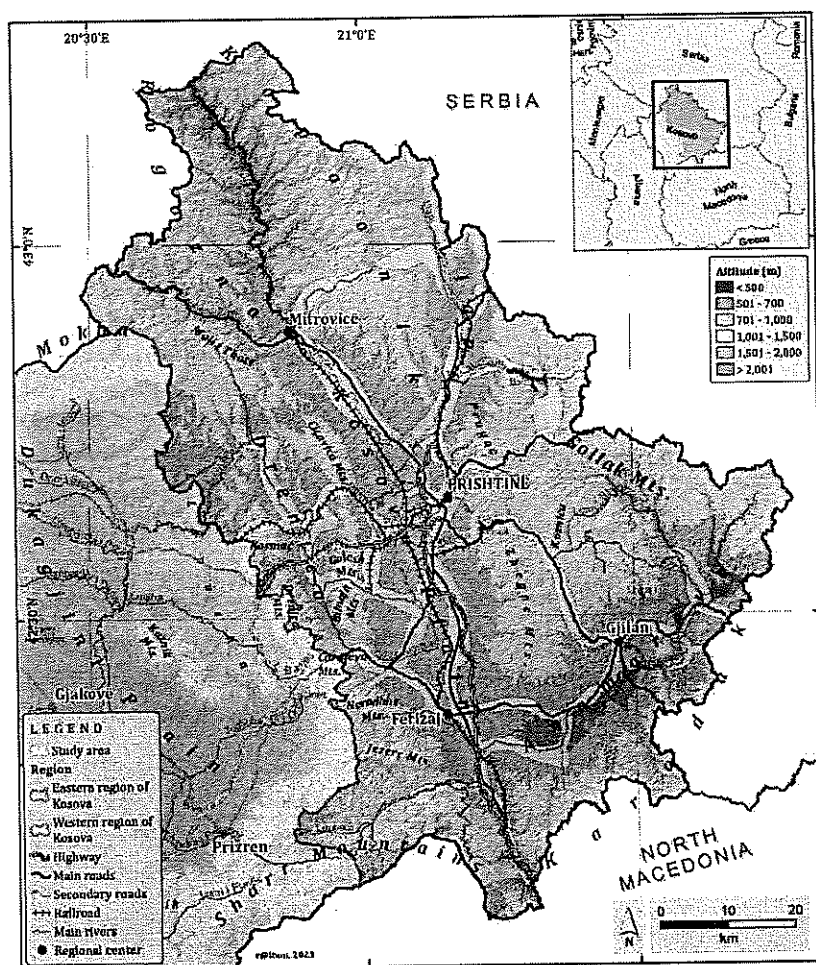


Fig. 1. Map of the study area of IAPS in the eastern region of Kosovo.

## Results and Discussion

The preliminary checklist of IAPS in the eastern region of Kosovo includes a total of 20 species (Table 1). It is important to emphasize that all these species belong to the Angiosperm group and there are no representatives of other plant groups. The current list contains informa-

tion on the proven occurrence of 20 IAPS. These species belong to 10 plant families. Of these, the Asteraceae family is the most species-rich with 9 species, followed by the Fabaceae and Balsaminaceae families with 2 plant species each, while the other families have only one species each (Fig. 2).



**Table 1.** List of invasive alien plant species (IAPS) in the eastern region of Kosovo.

**Note:** Explanation of abbreviations used: P - Phanerophytes, Ch - Chamaephytes, H - Hemicytrophytes, T - Therophytes and G - Geophytes. AS - Asia, AM - America, AF - Africa.

Taxa	Family	Life form	Native range	Habitat type
<i>Abutilon theophrasti</i> Medik.	Malvaceae	T	AS (Central Asia to China)	Along roads
<i>Acer negundo</i> L.	Sapindaceae	P	AM (Canada to Honduras)	Along roads, in the parks
<i>Ailanthus altissima</i> (Mill.) Swingle.	Simaroubaceae	P	AS (China)	Along roads, in the parks
<i>Amaranthus retroflexus</i> L.	Amaranthaceae	T	AM (Mexico)	Cultivated soils, along roads, waste places, etc.
<i>Ambrosia artemisiifolia</i> L.	Asteraceae	T	AM (Subarctic America to U.S.A)	Railways, along roads
<i>Amorpha fruticosa</i> L.	Fabaceae	P	AM (U.S.A. to N. Mexico)	Along roads, waste places
<i>Bidens frondosa</i> L.	Asteraceae	T	AM (Canada to U.S.A)	River banks
<i>Datura stramonium</i> L.	Solanaceae	T	AM (Texas to Central America, Caribbean)	Along roads, cultivated soils, waste places, etc.
<i>Erigeron canadensis</i> L.	Asteraceae	T	AM (New world)	Along roads, wasteland, railways, etc.
<i>Erigeron annuus</i> (L.) Desf.	Asteraceae	T	AM (Canada to U.S.A., Nicaragua to Panama)	Along roads, wasteland, etc.
<i>Galinsoga parviflora</i> Cav.	Asteraceae	T	AM (Mexico to Tropical America)	Cultivated soils, waste places, etc.
<i>Helianthus tuberosus</i> L.	Asteraceae	G	AM (Central & E. Canada to U.S.A)	River banks, along roads, waste places
<i>Impatiens balfourii</i> Hook.f.	Balsaminaceae	T	AS (N. Pakistan to W. Himalaya)	Stream banks
<i>Impatiens glandulifera</i> Royle	Balsaminaceae	T	AS (NE. Pakistan to Nepal)	River banks
<i>Reynoutria × bohemica</i> Chrtek & Chrtková	Polygonaceae	G	AS (Russian Far East to China and Temp. E. Asia)	Along roads, waste places, river banks, cultivated soils
<i>Robinia pseudoacacia</i> L.	Fabaceae	P	AM (E. Central & E. U.S.A)	Along roads, river banks, waste places, etc., while has it also penetrated the oak and beech forests
<i>Senecio inaequidens</i> DC.	Asteraceae	Ch	AF (Southern Africa)	Along roads, waste places
<i>Solidago gigantea</i> Aiton.	Asteraceae	H	AM (Canada to NE. Mexico)	River banks, along roads
<i>Sorghum halepense</i> (L.) Pers.	Poaceae	G	AS (Macaronesia to Central Asia and Indo-China)	Along roads, cultivated soils
<i>Xanthium spinosum</i> L.	Asteraceae	T	AM (Central & E. Canada to Mexico, Peru to S. South America)	Along roads, waste places

The total number of IAPS reported here for eastern region of Kosovo is much lower than in most countries of the region, since only one region of Kosovo has been researched and this is only a preliminary list. But here we must take into account the fact that Kosovo is a very small country compared to some countries in the region and has no access to the sea, so we can assume that this is the reason for the lower number of IAPS. In Albania, for example, 37 IAPS are reported (Barina et al., 2014; Shehu et al., 2014; Zhuri &

Imeri, 2022), in Serbia 51 (Lazarević et al., 2012; Stojanović & Jovanović, 2018), in Croatia 64 (Boršić et al., 2008; Nikolić et al., 2014), in Bosnia and Herzegovina 50 (Maslo, 2016), in North Macedonia 44 (Matevski et al., 2001), in Montenegro 50 (Stešević & Petrović, 2010), in Bulgaria 61 (Petrova & Vladimirov, 2002; Petrova, 2004; Petrova et al., 2013), and in Greece 50 (Arianoutsou et al., 2010). In total, the occurrence of 170 IAPS taxa is estimated in the Balkan Peninsula (Panjković et al., 2021).

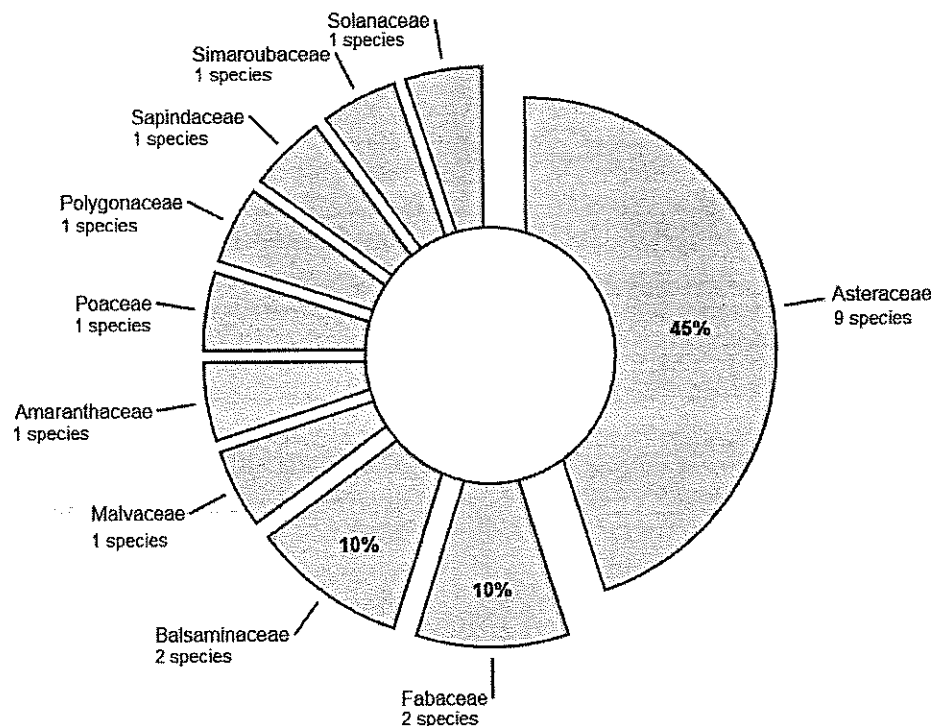


Fig. 2. Plant families with the total number of IAPS recorded in the eastern region of Kosovo.

Regarding to the plant genera, *Erigeron* L. and *Impatiens* Riv. ex L., they have two species each, while other genera are represented by only one species. In Kosovo, there are no native representatives of the Simaroubaceae family, except for *Ailanthus altissima* (Mill.) Swingle, which is invasive alien. In addition, from the family Balsaminaceae, three species are known in Kosovo, two of which are invasive alien, while the third species: *Impatiens noli-tangere* L. is considered a native species in Europe (POWO, 2022), with temperate Eurasia as native distribution range.

The analysis of the spectrum of life forms showed the predominance of Therophytes (Fig. 3),

represented by 11 species (55%). The second group was formed by Phanaerophytes, represented by 4 species (20%), followed by Geophytes with 3 species (15%), while Hemicryptophytes and Chamaephytes with only 1 taxon each (5% each). The higher representation of therophytes was already expected, since the biology of this group (annual plants) is known to complete their life cycle quickly, to be able to produce many seeds that are easy to disperse, and therefore to be very efficient plants for dispersal - invasive properties (Boršić et al., 2008).

From the results on the geographical origin of IAPS (Fig. 4), most of them in the eastern region of



Kosovo originate from America (65%). The 13 species from this continent originate mostly from the North America, with fewer species also from Central and South America. Asia forms the second group with 6 species (30%), while Africa is

represented by only one species (5%). On the other hand, there are publications that report on the spread of plants from America to the region of SE Europe has accelerated in the last decades (Panjković et al., 2021).

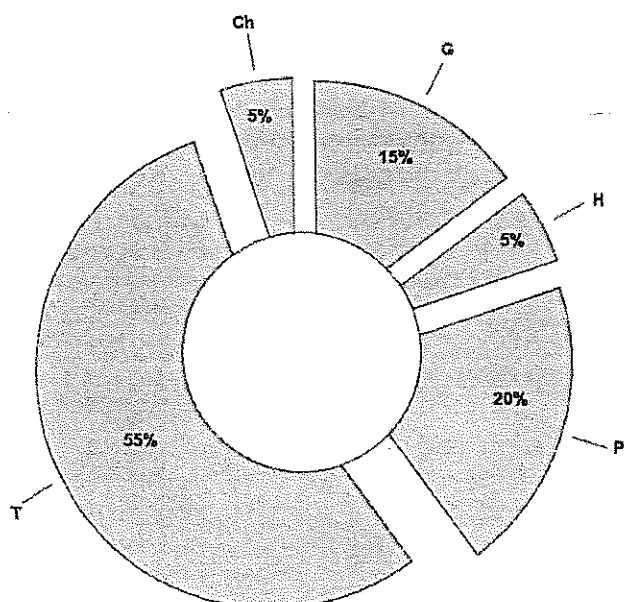


Fig. 3. Life-form spectrum of invasive alien plant species (IAPS) in the eastern region of Kosovo.

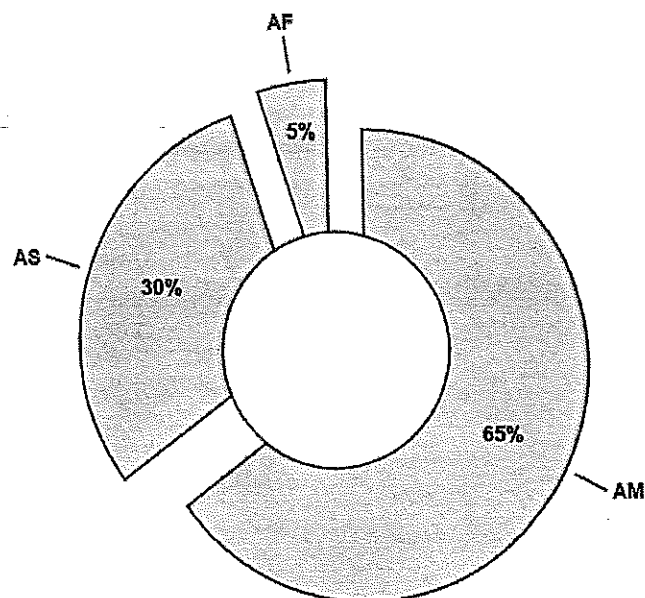


Fig. 4. Area of origin of invasive alien plant species (IAPS) in the eastern region of Kosovo.

To understand the mechanisms of invasion and to develop efficient predictive models and decision-support systems for management actions, it is essential to understand the geographic and temporal patterns of invasive species movement (Masters & Sheley, 2001), and additionally, to recognize the preferences of individual invasive alien species for habitat types (Carranza et al., 2011). Such patterns, if accurately described and quantified, can provide insight into the factors that contribute to invasions (Richardson et al., 2000; Kolar & Lodge, 2001). They also serve as the basis for predictive models that are critical to developing workable solutions, both for reducing invasion rates and their impacts as well as for reclaiming invaded landscapes.

Among the habitats where IAPS occur in the eastern region of Kosovo, anthropogenic habitats (areas along roads, waste places, cultivated areas) and riverbanks are the most affected by IAPS. A similar pattern has been reported from other studies too (Chytrý et al., 2008; Guarino et al., 2021). However, it is worth mentioning that their

invasion goes beyond these habitats, as the case with *Robinia pseudoacacia* L. which has penetrated in oak and beech forests.

In general, invasive alien plants can be said to be conspicuous for rare characteristics in conquered habitats. They employ various ecological strategies that increase their success rate in invading new habitats through permanent competition and interactions with native plant communities. Some of their main characteristics are: phenotypic plasticity, high dispersal ability, rapid reproduction and growth, the ability to efficiently reproduce vegetatively, the large number of seeds produced, long-lived seeds, etc. (Kunwar & Acharya, 2013).

### Conclusions

This paper presents original data on the occurrence of 20 invasive alien plant species in the eastern region of Kosovo. Most of the taxa included in the list originate from the North American continent. The family with the highest number of taxa is the Asteraceae family, while

the therophyte life form has the highest proportion. The habitats with the highest proportion of IAPS were anthropogenic habitats and river habitats.

In order to present the distribution map of IAPS in eastern region of Kosovo, many more expeditions will have to be undertaken. Nevertheless, we decided to publish preliminary results, since in the wider Balkan region, only Kosovo lacks data concerning IAPS. By doing so, we hope to make a contribution to this important problem for biodiversity and to draw the attention of governmental authorities responsible for nature conservation and environmental protection to this pressing issue. Although we have compiled this list with a valuable amount of data for this plant category, our work on the overview/knowledge gain of the IAPS is still on-going.

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052 PRELIMINARY DATA ON SOME INVASIVE ALIEN SPECIES OF VASCULAR FLORA IN THE EASTERN REGION OF KOSOVO

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**ABSTRACT**

The Eastern Region of Kosovo lies on the eastern part of the Republic of Kosovo, while it is also known as the "Kosovo Plain" and includes the plain and hilly-mountainous parts of this area. So far, floristic and phytosociological research has been conducted in Kosovo. Within the vascular flora a number of plant species are alien plant taxa and invasive aliens which grow in different habitats. There is almost no research on invasive alien plant species in Kosovo. The research is based on information from the last decade, part of the doctoral thesis, while focusing on invasive alien taxa for the fact that they have an impact on the environment and biodiversity. Invasive alien species are distinguished: *Amorpha fruticosa* L., *Helianthus tuberosus* L. and *Reynoutria japonica* Houtt. Knowledge of these plant taxa is important for the fact that these taxa spread outside their natural habitats, threatening native biological diversity (indigenous). As a result of their high ability to adapt to different environmental conditions and high reproductive ability, these species cause major economic disturbances and losses in the environments where they penetrate. Given their impact on the environment and especially on biodiversity, as well as the high degree of adaptation to environmental conditions, the recognition of these taxa is important. Knowledge of these species helps to take adequate measures for a better management of them.

**Key words:** flora, vegetation, alien, invasive, Eastern Region of Kosovo, Kosovo.





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# CERTIFICATE OF PRESENTATION

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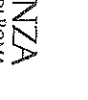
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## **Invasive alien plant species (IAPS) in the eastern region of Kosovo: a preliminary list**

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### **Abstract**

This paper presents a preliminary checklist of invasive alien plant species (IAPS) in the eastern region of Kosovo. This list was compiled based on a literature review and numerous field surveys. The list includes 20 plant taxa with information on taxonomic affiliation (Family), life form, native range and type of habitat(s) they invaded. Most species belong to Asteraceae family, followed by Fabaceae and Balsaminaceae. Therophytes are the predominant life form. There are two genera, each with two species: *Erigeron* L. (*Erigeron annuus* (L.) Desf., *Erigeron canadensis* L.) and *Impatiens* Riv. ex L. (*Impatiens balfourii* Hook.f. and *Impatiens glandulifera* Royle), while others are represented by only one species. The majority of IAPS in the eastern region of Kosovo are from America (65%), followed by Asia (30%) and with only one species from Africa (5%). The habitats most heavily colonized by IAPS are the areas along roads, waste places, riverbanks and cultivated areas.

*Key words: alien flora, biological invasions, plant invasions, biodiversity, Balkans*