



## **4<sup>th</sup> ESENIAS Workshop: International Workshop on IAS in Agricultural and Non-Agricultural Areas in ESENIAS Region**

**16-17 December 2013**

**Çanakkale, Turkey**

Co-organizers:

Çanakkale Onsekiz Mart University, Turkey

East and South European Network for Invasive Alien Species (ESENIAS)

Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences

Under the Patronage of:

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## **WORKSHOP OVERVIEW**

Threat of invasive alien species (IAS) to ecosystems and socioeconomic activities has been increasing in agricultural and non-agricultural ecosystems. The European Commission has published a proposal for a Regulation on the prevention and management of the introduction and spread of invasive alien species (9.9.2013, COM (2013) 620 final), which is not only a concern of EU countries but also of neighboring countries that are members of ESENIAS. New Animal and Plant health regulations concerning issues related to IAS are proposed this year. CBD 2020 Strategy also requires that invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated and measures are in place to manage pathways to prevent their introduction and establishment by 2020 (Target 9). In addition, ESENIAS prepared a work plan in the last workshop. All these issues are planned on being discussed in the workshop.



# PROGRAM



## 15 December 2013

17:00-19:00 Registration  
20:00 Welcome cocktail

## 16 December 2013

08:30-09:30 Registration  
09:30-10:30 Opening ceremony

Opening lecture

**Moderator Ahmet ULUDAĞ**

*An invasive species commonly known as native: The Olive Fruit Fly (*Bactrocera oleae* (Rossi)) (Diptera: Tephritidae) (Hanife GENÇ)*

COFFEE BREAK (With poster viewing)

11:00-12:00 Scientific session I: IAS as pest in agriculture  
**Moderators: Danijela STEŠEVIĆ and Mehmet DEMİRÇİ**  
\* *Tuta absoluta* Povolny (Lepidoptera: Gelechiidae), the exotic invasive pest in Turkey (Sevcan ÖZTEMİZ)  
\* *Adult population development of Tomato Leafminer (Tuta absoluta* Meyrick, 1917, Lepidoptera: Gelechiidae) in Çanakkale Province (Burak POLAT, Ali ÖZPINAR, Ali Kürsat ŞAHİN)  
\* *An invasive species in Çanakkale, Turkey: Jasmine Moth (Palpita unionalis* Hübner, Lepidoptera: Pyralidae) (Çiğdem ŞAHİN, Hanife GENÇ)  
\* *Ten economically important alien plant pest species in Turkish agriculture (Ali Kürsat ŞAHİN, Esengül ERDEM, Ali ÖZPINAR, Burak POLAT)*

12:00-13:00 Scientific session II (Situations of IAS)  
**Moderators: Tihomir STEFANOV and Necmi AKSOY**  
\* *Danube River as an invasive alien species corridor: alien bivalve molluscs, decapods and fish, Bulgaria case study (Teodora TRICHKOVA, Zdravko HUBENOV, Lyubomir KENDEROV, Vesela EVTIMOVA, Ivan BOTEV)*  
\* *Invasive alien plant species in Montenegro (Danijela STEŠEVIĆ, Nedeljko LATINOVIĆ, Danka CAKOVIĆ)*  
\* *Invasive alien plants in Croatia as a threat to biodiversity of South-eastern Europe (Božena MITIĆ)*  
\* *Invasive alien species of vascular plants in Bulgaria (Vladimir VLADIMIROV)*

LUNCH

14:15-15:15 Scientific session III (IAS impact on non-agricultural areas)  
**Moderators: Argyro ZENETOS and Hüseyin ÖNEN**  
\* *The current status of invasive fish species in Turkish freshwaters and potential impacts of the invasions (F. Güler EKMEKÇİ, Ş. Gülsün KIRANKAYA Baran YOĞURTÇUOĞLU, Lale GENÇOĞLU, F. Kübra ERBAY)*  
\* *Range expansion of translocated Aegean endemic species *Oxyaemacheilus bureschi* (Pisces: Nemacheilidae) in the Iskar River, Danube River basin, Bulgaria (Tihomir STEFANOV, Eliza UZUNOVA, Lyubomir KENDEROV, Teodora TRICHKOVA)*  
\* *Considerations on the potential conflicts between some invasive American aquatic turtles and native *Emys orbicularis* - analysis of the feeding behaviour (Nikolay NATCHEV, Yurii KORNILEV, Georgi POPGEORGIEV, Nikolay TZANKOV)*  
\* *Neophytes in protected areas. Case study: the Danube Delta Biosphere Reserve (Paulina ANASTASIU, Gavril NEGREAN, Daniela SMARANDACHE, Sanda LITESCU, Corina BASNOU)*

COFFEE BREAK (With poster viewing)

15:45-16:45 Scientific session IV (Invasive Alien Plants)

**Moderators: Vladimir VLADIMIROV and Tansel SERİM**

\* *A new threat in cotton fields in the West Mediterranean Region of Turkey: Ipomea spp.* (Ayşe İŞİK, İlhan ÜREMİŞ, Ahmet ULUDAĞ, Kayahan UZUN)

\* *The list of exotic ornamental plants potentially invasive in Turkey* (Necmi AKSOY)

\* *Agricultural ecosystems as a pathway for invasive plant species* (Milica RAT, Bojana BOKIĆ, Boris RADAK, Goran ANACKOV, Milica RADANOVIC, Slobodan BOJCIC, Pal BOZA)

\* *Invasion status of Common Ragweed (Ambrosia artemisiifolia L.) in Turkey* (Hüseyin ÖNEN, Hikmet GÜNALI, Selçuk ÖZCAN)

16:45-17:45 Roundtable (Work plan of ESENIAS and CBD 2020 Strategy)

**Moderators: Milica RAT and Teodora TRICHKOVA**

17:45-19:15 Roundtable (New EU Regulation on IAS)

**Moderator: Ahmet ULUDAĞ**

20:00 GALA DINNER

**17 December 2013**

09:00-09:45 Scientific session V (Aquatic environments)

**Moderators: Sajmir BEQIRAJ and Gülsün KIRANKAYA**

\* *Marine non indigenous species in South-eastern Europe* (Argyro ZENETOS, Paraskevi KARACHLE)

\* *Predicting potential invasive species in Bulgaria using GIS – key study on aquatic turtles* (Nikolay TZANKOV, Georgi POPGEORGIEV, Yurii KORNILEV, Nikolay NATCHEV)

\* *Trophic level and niche width of introduced Prussian carp (Carassius gibelio) and native fish species in a Turkish river* (Sükran YALÇIN ÖZDİLEK, Roger I. JONES)

09:45-10:30 Roundtable (Changes on EU Plant Health Directive)

**Moderator: Ahmet ULUDAĞ**

COFFEE BREAK (With poster viewing)

11:00-12:00 Scientific session VI (IAS in Agriculture)

**Moderators: Paulina ANASTASIU and Ayşe İŞİK**

\* *Biological control of red rot of sugarcane disease by using Trichoderma harzianum in vitro condition* (Subramanian GOMALTHINAYAGAM, G. REKHA)

\* *Efficacy of different herbicides on Parthenium weed and associated weeds in maize crop in Swabi district* (Haroon KHAN, Khan Bahadar MARWAT, Muhammad Azim KHAN)

\* *Effect of normal and elevated CO<sub>2</sub> levels on the growth of some invasive weeds in Turkey* (Khawar JABRAN, M. Nedim DOĞAN, Özkan EREN)

\* *The nightmare: genetically modified organisms as alien species* (Meliha Merve HIZ, Cüneyt AKI)

\* *The role of antioxidants in the Orobanche – cultivated plants interaction and broomrape invasion* (Okan ACAR, Sefer DEMİRBAŞ)

12:00-13.30 Closing followed by lunch

14:00 Field trip

## POSTERS

1. An Awareness Project: The Impact of Invasive and Exotic Species on Nature-Damage on Nature (Semra PARİN, Ahmet Dursun YALÇIN, Ali Asker IŞIKAY, Hilal AYVAZLAR, Pınar KILIÇ, Fatma ÖZGÜR)
2. Invasive plant species in Çanakkale-Turkey (Ersin KARABACAK)
3. A field trip to Musaköy for observation of broomrape infestation (S. DEMİRBAŞ, O. ACAR, B. ŞEN, H.N. GÖRKEM)
4. Invasive weeds in the Black Sea region of Turkey (Doğan IŞIK, Kübra GÖZÜKARA, Gülhanım TÜRKMEN, Zeynep KARNAS, Salih BİNGÖL, Adem AKÇA, Hüsrev MENNAN)
5. Seeds as a pathway: Speculation on *Leptophyla fusca* spreading in Turkey (Emre E. MUSLU, Ahmet ULUDAĞ)
6. Weedy sunflower as invasive weed species (Markola SAULIC, Darko STOJICEVIC, Ana MATKOVIC, Dragana BOZIC, Sava VRBNICANIN)
7. Allelochemical explanation of *Heracleum sosnovskyi* invasiveness (Ligita BALEŽENTIENĖ)
8. Invasive potential of *Bromus* spp. on wheat fields in Turkey (Süleyman TÜRKSEVEN, Mehmet DEMİRCİ, Tansel SERİM)
9. Expansion status of two invasive vines: Bur-cucumber and Mile-a-minute, in Turkey (Hüseyin ÖNEN, Cumali ÖZASLAN, Hikmet GÜNAL, Nihat AKYOL, Uğur ÇALDIRAN)
10. Situation of invasive alien species in EPPA A2 list in Turkey (Zübeyde Filiz ARSLAN, Ahmet ULUDAĞ)
11. *Pontogammarus robustoides* G. O. Sars, 1894 – New potentially invasive amphipod species to the Bulgarian inland waters (Lyubomir KENDEROV, Teodora TRICHKOVA, Yanka VIDINOVA, Svetoslav CHESHMEDJIEV)
12. Distribution of the invasive Blue Crab *Callinectes sapidus* Rathbun, 1896 along the Albanian coast (Ermira MILORI, Alba ZHORI, Irma AGOLLI, Sajmir BEQIRAJ)
13. Lake Ohrid tributaries: Natural and potential pathways for invasive alien species introductions (Sasho TRAJANOVSKI, Biljana BUDZAKOSKA, Lyubomir KENDEROV, Konstantin ZDRAVESKI, Ivan BOTEV, Teodora TRICHKOVA)
14. Native and non-native fish species in the tributaries and outflow of ancient Lake Ohrid (Teodora TRICHKOVA, Trajce TALEVSKI, Ivan BOTEV, Lyubomir KENDEROV, Sasho TRAJANOVSKI)
15. Distribution of *Gambusia* (Mosquitofish) in Turkey and its potential impact on aquatic ecosystems (F. Kübra ERBAY, Baran YOĞURTÇUOĞLU, Ş. Gülsün KIRANKAYA, Lale GENÇOĞLU, F. Güler EKMEKÇİ)
16. Rapid expansion in distribution area of a marine fish, sand smelt, in inland waters of Turkey (Lale GENÇOĞLU, Ş. Gülsün KIRANKAYA, F. Güler EKMEKÇİ, Baran YOĞURTÇUOĞLU)
17. A review of pest status of alien insects in Bulgaria (Rumen TOMOV)
18. A new approach to control the Colorado potato beetle *Leptinotarsa decemlineata* (Say) (Coleoptera: Chrysomelidae): Botanicals (Esengül ERDEM)
19. The potential use of entomopathogenic nematodes against tomato leaf miner *Tuta absoluta* (Lep: Gelechiidae) (Çiğdem GÖZEL, Uğur GÖZEL)



# ABSTRACTS



## **An Alien Species Commonly Known As Native: The Olive Fruit Fly (*Bactrocera oleae* (Rossi)) (Diptera: Tephritidae)**

Hanife GENÇ

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The olive fruit fly, *Bactrocera oleae* (Rossi) (Diptera: Tephritidae), is an important pest of olive orchards. Distribution of the olive fruit fly is limited to olive growing regions. It is commonly known as restricted to the Mediterranean basin however; recently it is reported throughout the Mediterranean basin, South and Central Africa, Canary Islands, Central America, California, The Near and Middle East. There are also reports showing the presence of the olive fruit fly in China, in Asia. Because of the abundance and intensive olive cultivation, traditionally, the olive fruit fly is believed and known as indigenous in the Mediterranean basin. However, some researchers reported that it probably originated in the sub-Saharan Africa region, where wild native olive varieties are primarily found, and where there are more biological control agents that most likely expanded into the Middle East and southern Europe. The olive fly is monophagous on cultivated and wild olive (*Olea europaea*) fruits. Adult females deposit their eggs inside the fruits. The newly hatched larvae feed upon and grow in the mesocarp of the fruit by tunneling. Bacteria and fungi may be introduced to the infested fruits and cause further rotting. Economic damages are caused by the female oviposition stings on the fruits which destroy the value of the table fruits and decrease the quality of the olive oil by increasing acidity. In the Mediterranean basin, the olive fruit fly is responsible for losses of almost 100% of table cultivars and 70-80% of oil value in epidemic years. It has been estimated that economic losses are around \$800 million/year. Various aspects of the olive fly laboratory rearing, biology, ecology and management have been studied for many years. Today, taxonomy, relationships among the species and widespread of the pests are being improved based on molecular approaches. In this study, the geographic origin of the olive fruit fly is discussed based on molecular analyses.

**Keywords:** *Olea europaea*, Olive, *Bactrocera oleae*, Olive fruit fly, invasive species.

## ***Tuta absoluta* Povolny (Lepidoptera: Gelechiidae), the exotic pest in Turkey**

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The tomato leaf miner, *Tuta absoluta* Povolny (Lepidoptera: Gelechiidae) is an alien pest of tomato and other Solanaceae crops. It is native to South-America and at present is distributed in Europe, North Africa and Asia. *T. absoluta* was first detected in the Aegean and Marmara Regions of Turkey in 2009, but now almost all the Regions of Turkey are infested. Infestation by *T. absoluta* could reduce yield and fruit quality, causing up to 100% yield losses in both greenhouse and open-field tomato production if no control measures are applied. *T. absoluta* is a very challenging pest to control because of having 10-12 generations per year and resistance to many insecticides. Therefore, a combination of all available control measures is required to control the pest. A review of efficient management strategies for control of *T. absoluta* in invaded areas is presented

**Key words:** *Tuta absoluta*, exotic, invasive, management, Turkey.

## Adult population development of Tomato leaf miner (*Tuta absoluta* Meyrick, 1917, Lepidoptera: Gelechiidae) in Çanakkale province

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Tomato leaf miner (*Tuta absoluta* Meyrick, 1917, Lepidoptera: Gelechiidae) was first recorded in Peru in 1917. Its first record in Turkey was in tomato fields of İzmir – Urla in 2009, and the pest reached a considerable population density till the end of the same year. The farmers were alarmed against this pest because of its rapid dispersal in the whole country. The pest caused severe yield losses on tomato, which has an important place in economy of Çanakkale and the control practices for the pest became unavoidable. Since the knowledge about population development is important for the successful control, two tomato fields in Central district (Batakovası and Dardanos) and one in Biga district were selected for investigations in 2012 and 2013. Pheromone traps containing tetradecadienyl acetate were used for the monitoring of flight of the pest. The pheromone traps were installed on 0.5 m high poles in the fields before the plantation of tomato seedlings and the numbers of adults in the traps were recorded twice per week. The population development of the tomato leaf miner was evaluated by relating the adult numbers with climatic data. First catches were recorded on 27.03.2012 and 08.03.2013 respectively and the flight continued till the end of December. Six flight activity periods were observed during the survey - at the end of April, at the beginning of June and in the middle of July, August, September and October with a total of 6 flights. First flight was recorded on weeds and other flights were recorded on tomato plantation in Çanakkale.

**Key words:** *Tuta absoluta*, tomato leaf miner, Çanakkale, tomato.

## An Alien Species in Çanakkale, Turkey: Jasmine Moth (*Palpita unionalis* Hübner, Lepidoptera: Pyralidae)

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Jasmine moth was first reported in 1961, in Israel as *Glyphodes unionalis* Hübner (Lepidoptera: Pyralidae). Later, the pest was renamed as *Palpita unionalis* Hübner. The pest is distributed in Italy, Greece, Swedish, Poland, Portuguese, Egypt, Iran, USA and Japan. In Turkey, *Palpita unionalis* was first recorded in 1969 in the Aegean region. In 1999 it was detected in the city of Bursa of Marmara province. In Çanakkale, the pest was first detected in 2008 after investigation of complaints by olive producers in the Ayvacık district. During a survey conducted in the period 2009-2011 the pest was detected in the central, Intepe and Bozcaada districts, as well as the towns of Kumkale and Dardanos. The first larvae of the pest were detected on the 30<sup>th</sup> of July in Bozcaada in 2009. Different instars of the pest were reared on natural host plants and artificial diets in the laboratory where all biological parameters of the pest were determined. The hosts of the pest are olive (*Olea europaea*), jasmine (*Jasminum* sp.), *Phillyrea* sp., privet (*Ligustrum* sp.) and *Fraxinus* sp.. The pest causes important economical losses in the olive orchards by feeding on shoots of saplings and younger trees. The pest also may decrease the quality of the product by feeding on all phenological stages of the olives.

**Key words:** Jasmine moth, *Palpita unionalis*, olive, alien species.

## Ten economically important alien plant pest species in Turkish agriculture

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In this study ten economically important alien plant pest species introduced in Turkey from different geographical regions are presented. Information about their first record and present distribution both worldwide and in Turkey, will be given. The current situation regarding these pests will be discussed in the context of plant protection. These species are as follows: Tomato Leafminer, *Tuta absoluta* (Lepidoptera: Gelechiidae); Colorado Potato Beetle, *Leptinotarsa decemlineata* (Coleoptera: Chrysomelidae); Bayberry Whitefly, *Parabemisia myricae* (Hemiptera: Aleyrodidae); Citrus Leafminer, *Phyllocnistis citrella* (Lepidoptera: Gracillariidae); Serpentine Leafminer, *Liriomyza trifolii* (Diptera: Agromyzidae) Western Flower Thrips, *Frankliniella occidentalis* (Thysanoptera: Thripidae); Pink Bollworm, *Pectinophora gossypiella* (Lepidoptera: Gelechiidae); Grapevine Phylloxera, *Viteus vitifoliae* (Hemiptera: Phylloxeridae), Horse Chestnut Leaf Miner, *Cameraria ohridella* (Lepidoptera: Gracillariidae); and Khapra beetle, *Trogoderma granarium* (Coleoptera: Dermestidae).

**Key words:** Alien, pest species, first report, first location, plant protection.

## The Danube River as an invasive alien species corridor: Alien bivalve molluscs, decapods and fish, Bulgaria case study

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The Danube River is the second longest in Europe. It is navigable, and 87% of the total river lengths serve as an international waterway. Heavily modified navigational waterways are suitable recipient areas for invasive alien species. Among the four principal aquatic invasion corridors in Europe, the Southern corridor links the Black Sea basin with the North Sea basin via the Danube–Main–Rhine Canal. This complex waterway facilitates an intensive dispersal of previously geographically isolated species in both northwest and south-east directions throughout the Danube River basin. In most of the cases of introduction and establishment of aquatic alien species through the Danube River, negative impact was reported, such as changes in biodiversity and communities, alterations of the food webs and ecosystem services. In the Bulgarian section of the Danube River, 3 alien bivalve mollusc species, one decapod species and 12 fish species have been recorded so far. Most of these species have established stable and abundant populations. Two field surveys were carried out in September 2012 and September 2013 to monitor the occurrence and abundance of the aquatic alien species. A total of 15 sites were sampled in the Danube River section from Vrav (840 rkm) to Ryahovo (466 rkm). A total of 9 mussel species were recorded, of them 6 species were native and 3 alien (*Dreissena bugensis*, *Corbicula fluminea*, *Anodonta woodiana*). Most frequently found and most abundant among all species was *C. fluminea*. It was found at all sites, but most abundant at substrates dominated by coarse sand and gravel. The second most abundant species was *A. woodiana*, which preferably occurred at substrates dominated by mud. A total of 28 fish species were recorded, of them 5 alien species (*Carassius gibelio*, *Hypophthalmichthys molitrix*, *Pseudorasbora parva*, *Syngnathus abaster*, *Lepomis gibbosus*). Among them, most frequently found were *P. parva*, *S. abaster* and *L. gibbosus*, and most abundant was *C. gibelio*, followed by *S. abaster*. The results were compared with previous studies and analyzed in terms of changes in alien species populations and potential impact on native aquatic communities.

The study was supported within the frames of the East and South European Network for Invasive Alien Species (ESENIAS) and the International Association for Danube Research (IAD).

**Key words:** Aquatic invasive alien species, pathways of introduction, abundance, the Danube River, Bulgaria.

## Invasive alien plant species in Montenegro

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Unlike some worldwide regions where invasive ecology is well developed, in Montenegro the interest for this a rather new field in ecology, that study a human mediate transfer of organisms to areas outside their natural dispersal range and the consequences of such transfer, appeared in the last 10 years. According to up to date research, 51 species of alien flora are considered as invasive. The most common invasive alien species (IAS) in the non-agricultural land are: *Ailanthus altissima*, *Aster squamatus*, *Artemisia verlotiorum*, *Bidens subalternans*, *Conyza albida*, *Conyza canadensis*, *Datura stramonium*, *Erigeron annuus* s.l., *Euphorbia maculata*, *Helianthus tuberosus*, *Oenothera* spp., *Reynoutria japonica*, *Robinia pseudacacia*, *Sorghum halepense*, and *Xanthium strumarium* subsp. *italicum*, while in the agricultural land are: *Amaranthus retroflexus*, *A. hybridus*, *Erigeron annuus* s.l., *Galinsoga parviflora*, *Portulaca oleracea*, *Sorghum halepense*, etc. In the last 2 years special attention was paid to the ragweed (*Ambrosia artemisifolia*). Although in many regions, the species is known as one of the most noxious agricultural weeds, in Montenegro it mainly inhabits roadside vegetation, very rarely agricultural land. In respect to the legislation about IAS, on 14<sup>th</sup> March 2013, the Government of Montenegro on the proposal from the Environmental Protection Agency adopted a Regulation on the National list of indicators in environmental protection. According to this regulation, the alien and invasive species are an indicator (B05) of pressure on DPSIR (Driving forces - Pressures - State-Impact-Response) model. Therefore, in the coming period their annual dynamics will be systematically monitored and summary data will be published each 10 years (Official Gazette No 29/2013).

**Key words:** IAS, Montenegro.

## Invasive alien plants in Croatia as a threat to biodiversity of South-eastern Europe

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During the analysis of alien and invasive flora of Europe, as a threat to biodiversity, data for Croatia were missing. Therefore, we prepared a preliminary list of invasive alien plants in Croatia, which resulted with 60 taxa, for which distributional patterns and range size for the state area (57,000 km<sup>2</sup>) were analysed. They were detected on 49% of the state territory, averaging five taxa per 35 km<sup>2</sup>. At least one invasive alien species is reported in almost 50% of the area of Croatia. The greatest number of invasive plants (> 30 per grid cell) was recorded in the major urban centres located at the intersection of main continental transport corridors and seaports. The number of invasive plants is increasing in the south-east direction and reflects a positive correlation with the temperature and negative with the altitude. The invasive plants occurred in a relatively wide altitude range, but mostly up to 1100 m a.s.l. The most endangered areas are in the Mediterranean region, especially on the islands. The number of invasive plants increased with habitat diversity and almost 75% of all sites with invasive plants are located within a few habitats with direct anthropogenic influence. The most invaded habitats are the agricultural areas, artificial surfaces, and affected forests. These results should provide a reliable regional and global basis for strategic planning regarding the invasive alien plant management.

**Key words:** Croatia, invasive alien plants, threat to biodiversity, distribution patterns, range size.

## Invasive alien species of vascular plants in Bulgaria

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The current list of invasive and potentially invasive alien vascular plants in Bulgaria comprises 60 species. The selection of the taxa is not a result of strict criteria-based approach but it is based on the available literature data and field observations taking into account the current distribution and abundance of the species, the trends in distribution and abundance, recorded invasiveness of the taxa in other parts of Europe with similar climatic conditions, and impacts registered on the Bulgarian territory. The 'top ten' species are: *Acer negundo*, *Ailanthus altissima*, *Ambrosia artemisiifolia*, *Amorpha fruticosa*, *Bidens frondosus*, *Elodea nuttallii*, *Fallopia ×bohemica*, *Opuntia humifusa*, *Paspalum distichum* and *Robinia pseudoacacia*. The taxonomic structure, biological type, origin and type of introduction of the species will be discussed. Several cases based on different distribution patterns and impacts will be presented with particular emphasis on the invasive alien plants in agricultural ecosystems.

Recently a book '*Invasive alien species of vascular plants*' has been published and will be presented during the workshop. It provides information about the invasive and potentially invasive plants in Bulgaria, including concise description of the morphological, biological and ecological characteristics of the taxa and their origin, as well as colour photographs and a distribution map for each taxon.

**Key words:** Bulgarian flora, invasive alien plants, invasive plants in agricultural ecosystems, worst invasive alien plants.

## The current status of invasive fish species in Turkish freshwaters and potential impacts of the invasions

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Among the Mediterranean countries, Turkey has the richest freshwater fish fauna. Turkey is located in the intersection of different zoogeographic regions and Anatolia is highly rich in terms of biodiversity. Freshwater fish fauna of Turkey consists of more than 350 species and about one-third of these species are endemics. Many freshwater fish species from different families are listed as Critically Endangered (CR) and Endangered (EN) by the IUCN. During the last century, changes in the hydrological regime due to human activities such as dam construction, drainage and irrigation have resulted in habitat degradation, fragmentation and loss in many freshwater environments in Turkey and the habitat of many fish species has been altered severely. In addition to these effects, overfishing, pollution and introduction of exotic species into the freshwater environments have also threatened the freshwater fish biodiversity. However, the extinction of two endemic species, *Pseudophoxinus handlirschi* and *Alburnus akili*, following the introduction of a translocated fish species, is an example of the fact that non-native fish species are one of the most important threats for the freshwater fish diversity in Turkey. More than 30 species were introduced into the freshwater systems during the last few decades in Turkey. Many exotic fish species are able to survive and establish sustainable populations in the new habitats, especially in the absence of their predators. The invasive species are more successful in terms of competition for habitat and niche, so they can rapidly expand their distribution area and invade new environments. In this study, we aimed to present the adverse effects of non-native and translocated fish species on the native ichthyofauna of Turkey.

**Key words:** Biodiversity, invasive freshwater fish species, endemic freshwater fish species, Turkey.

## Range expansion of translocated Aegean endemic species *Oxynoemacheilus bureschi* (Pisces: Nemacheilidae) in the Iskar River, Danube River basin, Bulgaria

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The Struma loach *Oxynoemacheilus bureschi* is endemic for the Aegean Sea basin. The recent distribution of the species in Bulgaria is investigated and compared with our previous studies as well as with published data in the ichthyological literature. A tendency for expansion of the species range out of its native area in the rivers Struma and Mesta, part of the Aegean Sea watershed has been established. The species was found in Palakaria River, a small tributary in the upper reaches of the Iskar River, Danube River basin, in the 1980s and recently spread upstream and downstream in the same catchment. In 2011 it was recorded for the first time in the middle-lower reaches of the Iskar River, in the section from Reselts to Glava, of comparatively high abundance. A coexistence with the other species of the same family – *Barbatula barbatula* is reported. The way of colonization of the Struma loach is not yet known, most likely it was a result of human-assisted introductions. Potential negative consequences for native species are discussed.

**Key words:** Nemacheilidae, *Oxynoemacheilus bureschi*, Bulgaria, distribution, range expansion.

## Considerations on the potential conflicts between some invasive American aquatic turtles and native *Emys orbicularis* - analysis of the feeding behaviour

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The invasion and the impact of non-native turtles on the local species in Europe has been a subject of several studies during the last decades. Unfortunately, until now this problem in Bulgaria has not been a focus of the scientific community and publications on the topic are scarce. The main goal of our study is to fill this gap because of the major conservation implications and the high conservation status of the European pond turtle (*Emys orbicularis*). The comparison of feeding behaviours and performance are important tools to estimate the threat of potentially invading turtle species that could be competitors to the local species. We consider the invasion of the North American species *Trachemys scripta elegans* as the most direct and already existing threat. The Red-eared slider is an extremely popular pet in Bulgaria. The hatchlings and the young animals are attractive and easy to take care of, but the large adult animals are often released in the wild, as noted in the scientific literature. *T. s. elegans* is an agile omnivorous aquatic turtle that manages to survive cold winters; it is relatively aggressive and in the wild it competes with the local species (specifically with *E. orbicularis*) for food and basking spots. We analysed and compared the feeding behaviour of *E. orbicularis* and *T. s. elegans* to assess the impact of the invasion on the local populations. Additionally, we present the feeding mechanisms and the feeding behaviours in other turtle species which are readily available in the pet markets and because of their ecological plasticity are potential competitors to the European pond turtle in Bulgaria.

**Key words:** Biological invasions, feeding patterns, prey capture, pond turtles, kinosternids.

## **Neophytes in protected areas. Case study: the Danube Delta Biosphere Reserve**

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The Danube Delta is a relatively young territory, formed about 10,000 years ago. It has quadruple status: Biosphere Reserve, Ramsar site (wetland of international importance), UNESCO World Heritage site, Natura 2000 site. Water and human activities are the most important factors influencing the flora of this area, including the penetration and spread of alien plants. The main goal of our research in this area was to inventory the alien plants in the Danube Delta Biosphere Reserve, and to identify those species which are invasive and potentially invasive in the natural and semi-natural ecosystems in order to propose measures for their prevention and mitigation. An inventory of these plants, conducted between 2009 and 2012 and based on bibliography and field research, comprises over 160 taxa. About half of them originated from America and less than a quarter of them from Asia. A relatively high number of species (42 taxa) have unknown status in the Danube Delta; they were reported only from one or two localities and we did not record them during our extensive field work. In this category we also included some taxa of *Xanthium* without a very clear taxonomy. Other 59 taxa are casual, usually ornamental plants escaped from cultivation; however among them there are some species which are known as invasive in other areas of Romania, as well as in Europe. We can mention here: *Asclepias syriaca*, *Helianthus tuberosus*, *Parthenocissus inserta*, *Rudbeckia laciniata* and *Solidago gigantea*. There are 26 naturalised species, two of them are established here over one hundred years ago (*Calibrachoa parviflora*, *Heliotropium curassavicum*). 36 invasive species were identified. Many of them were recorded in natural or semi-natural places. One of the newest invasive plants in the Danube Delta is *Ambrosia artemisiifolia*, which was found in Sulina town, and also on the saltmarshes in Sacalin Island, which is a strictly protected area. In order to prevent and mitigate the spread of plants recognised as invasive, we propose the implementation of some measures such as providing relevant information to local communities and raising awareness about the damages caused by the alien species, ensuring permanent monitoring of the main entrances into the Danube Delta (e.g. harbours), the prohibition of deposits of vegetal waste, and promoting further research on alien plant species in this protected area.

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**Key words:** Alien plants, Danube Delta, invasive, neophytes.

### **A new threat in cotton fields in the West Mediterranean Region of Turkey: *Ipomoea* spp.**

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The genus *Ipomoea* L. is found all over the world. It comprises about 500 species, and this makes it the largest genus in family Convolvulaceae. Three species of *Ipomoea* have been recorded in the Flora of Turkey: *I. stolonifera*, *I. sagittata* and *I. purpurea*; they are alien to Turkey. *I. stolonifera* and *I. sagittata* were established in natural areas with high water table. *I. purpurea* is an ornamental plant but there are records about its escape to the natural and agricultural habitats. Another *Ipomoea* species is spread in the cotton fields in the western Mediterranean part of Turkey. The species has very short history, as short as a few years, and its identification has not yet been verified although it is assumed as *Ipomoea lacunosa*, another alien species to Turkey. Identification, distribution and containment studies are immediate research works for these species.

**Keywords:** *Ipomoea lacunosa*, *I. stolonifera*, *I. sagittata*, *I. purpurea*, cotton, alien.

## The list of exotic ornamental plants potentially invasive in Turkey

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Recently, there have been many herbaceous and woody exotic ornamental plant taxa increasingly used in reforestations and landscape design in Turkey. It became urgent to prevent using the invasive alien ornamental plants, especially by landscape designers and gardeners. If the 171 alien and 71 cultivated taxa are included, the number of exotic taxa occurring in the Flora of Turkey rises to 242. Some of the exotic plant taxa that are used for ornamental purposes became invasive, they are devastating natural forest ecosystems, urban parks and the natural biological diversity. The species have been sorted according to invasive behaviour (from higher to lower). The most aggressive species have been sorted by their morphology (herbaceous, woody habitat, etc.). These species with the invasion scale (0. No list, 1. Low invasive, 2. Invasive, 3. Highly invasive, 4. Extremely invasive) are also included in the phytogeographical regions of Turkey. The checklist of alien and exotic ornamental plants considered as potentially invasive in Turkey will be used by planting and landscape designers, nurseries, gardeners and foresters. In addition, it will help in the prevention of further planting of alien plant taxa already introduced or new introduction of new alien ornamentals not yet introduced to Turkey. The list is the first tool that Turkey has in order to prepare the invasive plants' code of conduct for nurseries and landscapes.

**Key words:** Exotic, ornamental plants, invasive alien plants, Code of conduct, Turkey.

## Agricultural ecosystems as a pathway for invasive alien plant species

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Invasive alien plant species (IAPS) are one of the biggest threats to biodiversity in several last and suppose to be during next few decades. All their activities (introduction, dispersal, spreading) are directly and indirectly connected with human activities. Some of these impacts are hardly to be perceived at the time and are not measurable. Nowadays, the core of the projects dealing with IASP is monitoring with relevant prevention measurements. The preliminary list of IAPS for the pannonian part of Serbia is created in 2011 and since then several times is updated. List consists from biological and ecological data. Distribution data aren't present but data on habitats were included. Further investigations were conducted in the field, were data about 10 „the most invasive“ IAPS were collected. Data includes GPS coordinates for each populations (consider from few to many individuals) and habitats details. Based on these, prediction of the areal spread was defined and evaluation of habitats infected by them. Prediction of areal spread as a method were considered with circumspection because of unknown of a large number of unpredictable variables. Because of that data on habitats present a far more important informations. By them, we can indirectly, with existing data about the preferred habitats, their interconnections and present IAPS distribution predict their spread. The agricultural ecosystems find out to be center of the habitats network. For the most of the IAPS they are either the initial (input) or transient (transport) habitats. Since pannonian part of Serbia is mainly (cc.75%) agricultural area this is the main pathway for the invasive plants spread. Lack of adequate protection, especially the border region of agricultural ecosystems with roads and ruderal habitats, these irrigated and fertile soils are ideal for easy adaptations of invasive plants. Later inappropriate caution during the processing of fields, yield transport and residual plant material additionally contribute to the spread of invasive plants.

**Key words:** Invasive alien plants, Serbia, GPS, pathway, agriculture.

## Invasion status of Common Ragweed (*Ambrosia artemisiifolia* L.) in Turkey\*

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Turkey with its special location, various climates and landscapes is suitable for the expansion of invasive plant species. However, negative economic and ecological effects of invasive plants such as Common ragweed (*Ambrosia artemisiifolia*) have not seriously been taken into account by scientists and government officials. Since the first report of the plant in Turkey (1998), no one has studied common ragweed. We aimed to demonstrate the present invasion status of the plant in Turkey. The research area of the initial survey was from Sinop to Hopa-Georgia border, which was approximately 650 km long. The survey was conducted in September and November 2012. The frequency of occurrence and density of ragweed increased gradually from west to the east in the surveyed area. The weed was first encountered in the Samsun province. The ragweed was rarely observed between Samsun and Trabzon provinces. But, the weed extensively populated the area between Rize and Georgia border. Common ragweed was found in highly perturbed habitats such as roadsides and waste areas in the region. The observations indicated that common ragweed has already settled in the East Black Sea region of Turkey, and has been probably introduced from one of our northern neighbors (Georgia). It is also speculated that the ragweed expansion in Turkey was probably associated with the construction of the Black Sea Highway, since the highway construction cleared the land from all native plants and created suitable conditions for the invasion of the weed.

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**Key words:** Common ragweed, *Ambrosia artemisiifolia*, Turkey, invasion, distribution.

## Marine non indigenous species in South-Eastern Europe

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Information on Marine Non-Indigenous Species (NIS) in ESENIAS sea area coverage, is available mostly at country level, with few exceptions at a finer geographic coverage such as Sea areas. Here we present updated information regarding the state and trends of introduction of NIS for all ESENIAS countries. Pathways of introduction at sub-regional Sea level for all Seas surrounding ESENIAS countries are identified, and the trends of introduction among major taxonomic groups are investigated. According to our results there is an increasing trend in the number of introductions in the study area, with Turkey being the country with the highest number of recorded alien species, followed by Italy, Greece, and Ukraine. The major pathway of introduction is shipping, followed by progressive immigration via the Suez Canal and aquaculture. Shipping is the main vector of NIS introduction in the Black Sea, and its significance declines south-westwards to the Aegean, to the Ionian and the Adriatic Sea. Penetration via the Suez Canal (Lessepsian migration) as a pathway displays the opposite trend to shipping, with the highest rates in the Aegean Sea, and lowest in the Black Sea.

**Key words:** Biological invasions, East Europe, pathways, aquaculture, Suez Canal, shipping.

## Predicting potential invasive species in Bulgaria using GIS – key study on aquatic turtles

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The European continent bears an extremely poorly represented aquatic turtle fauna, especially compared to hotspots of turtle diversity such as the SE North American and East Asian regions, mainly caused by specific paleoclimatic oscillations during the Pleistocene. The long term isolation of European species made them more negatively susceptible to competitive interactions with non-native species. The present study introduces a forecasting system for determining the potential species and respective areas in Bulgaria prone to the establishment of invasive, non-native aquatic turtles by assessing their ability to adapt to local conditions, specifically climate and habitats. The core of this system is based on predictive GIS models of the potential distribution of a number of species occurring in similar geographical conditions that potentially or in practice could get established in the European Union and in particular in Bulgaria. Two approaches were combined. In the first type as a model species was chosen the European pond turtle (*Emys orbicularis*) because of the wide distribution of this species: most of Europe, as well as northwest Africa and western Asia. The present day spatial model of the real distribution of this species was extrapolated to a worldwide scale. From the regions covered by this model a set of potentially invasive species was extracted. The second type uses the reverse approach, in which the geographic range of 13 potentially invasive species popular in the pet trade were extrapolated and those falling within the area of interest were selected. Such approaches are applicable both to a small and large scale areas. The full list could be further reduced by considering additional various specific environmental parameters and habitat requirement of the species. To successfully accomplish conservation goals after determining the list of the invasive species a set of species specific measures have to be implemented, including stricter border control, importing bans, improved tracking of specimens in commercial networks, control of already sold or possessed specimens in a centralized database.

**Key words:** Non-native, spatial models, European Union, chelonian, invasion.

## Trophic level and niche width of introduced Prussian carp (*Carassius gibelio*) and native fish species in a Turkish river

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Carbon and nitrogen stable isotope analyses were made to determine the trophic position and dietary niche width of the invasive species *Carassius gibelio* to help assess the potential impact of this species on the native fish fauna in the Karamenderes River, northwest Turkey. The trophic level of *C. gibelio* was  $2.43 \pm 0.5$ ,  $2.04 \pm 0.4$  and  $3.35 \pm 0.5$  estimated by three different methods. Filamentous algae were the most important diet component according to the stable isotope mixing models. Filamentous algae and detritus were also considerable percentages of the gut contents. The niche width of this invasive species was larger than those of the native species. The isotopic niche of *C. gibelio* overlapped with that of *Barbus oligolepis* with a significance of 0.903. In terms of isotopic composition, the *C. gibelio* population shared 60% with *B. oligolepis*, 33.3% with *Squalis cii* and 25% with *Alburnus chalcoides*. Our results indicate that the high dietary plasticity of *C. gibelio* and its extensive niche overlap with the native fish species make it a strong competitor and a threat to the native fish fauna.

**Keywords:** Feeding ecology, Prussian carp, niche width, trophic level, Turkey.

## Efficacy of different herbicides on parthenium weed and associated weeds in maize crop in Swabi district

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*Parthenium hysterophorus* L. is a weed of national significance in Pakistan. Although it infested many districts of Khyber Pakhtunkhwa province, most affected districts are Swabi, Mardan, and Charsadda. Due to its successful compliance to varying conditions and to the absence of its natural enemies, the parthenium weed has reinstated our valuable national flora and posed a strong threat to our biodiversity. The weed density ( $\text{m}^{-2}$ ) was significantly influenced by the application of various herbicides in the maize crop. The densities of *Amaranthus viridis*, *Convolvulus arvensis*, *Digitaria sanguinalis*, *Parthenium hysterophorus*, *Portulaca oleracea*, *Trianthema portulacastrum* and *Xanthium strumarium* were not considerably different during both years, whereas the year effect was significant for *Cynodon dactylon*, *Cyperus rotundus* and *Sorghum halepense*. The densities of *Cynodon dactylon*, *Cyperus rotundus* and *Digitaria sanguinalis* were higher in 2009 as compared to 2010. Less number of weeds was found in the Primextra Gold 720 SC (atrazine+S-metolachlor), hand weeding and Dual Gold 960 EC (S-metolachlor) treated plots. The year effect was also found imperative. The fresh weed biomass ( $\text{g m}^{-2}$ ) was reduced in the plots where Primextra Gold and Dual Gold were sprayed and in the hand weeding plots. The weed mortality (%) was significantly influenced by the application of different herbicides, whereas the year effect remained similar for the weed mortality. Higher weed mortality was observed in the plots where Primextra Gold was sprayed, followed by the hand weeding and Dual Gold which were at par with each other. The effects of different herbicides were significant on the maize plant height (cm). Long stature maize plants were recorded in the hand weeding and Primextra Gold treated plots, whereas short stature plants were found in the control plots. The numbers of grains  $\text{ear}^{-1}$  were significantly increased by the application of different herbicides and higher numbers of grains  $\text{ear}^{-1}$  were recorded in the Primextra Gold and hand weeded plots. Lower number of grains  $\text{ear}^{-1}$  was found in the control plots. Thousand grain weight was significantly changed by using different herbicides in the maize crop. Heavier grains were recorded in the plots where Primextra Gold was sprayed, followed by the hand weeded plots, whereas lighter grains were obtained in the control plots. The application of different herbicides significantly influenced the biological and grain yields of maize. The effect of year was found non-significant for both the grain and biological yields. Higher biological and grain yields were produced in the Primextra Gold sprayed plots and hand weeded plots. The control plots resulted in lower grain and biological yield. Higher harvest index was recorded in the plots where Primextra Gold was sprayed followed by the hand weeded plots. Lower harvest index was observed in the control plots. Herbicides, Primextra Gold 720 SC as pre-emergence application, can provide best control of parthenium weed and associated weeds in the maize crop.

**Key words:** Parthenium, Maize, atrazine, metolachlor.

## Effect of normal and elevated CO<sub>2</sub> levels on the growth of some invasive weeds in Turkey

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The climate changing, particularly the increasing CO<sub>2</sub> levels in the atmosphere can increase the proliferation of invasive weeds. The information regarding the response of invasive weeds to increasing CO<sub>2</sub> levels will be useful for the development of management plans for these species. We supposed that the increasing atmospheric CO<sub>2</sub> can improve growth of invasive weeds in Turkey. The effect of normal (400 ppm) and elevated (800 ppm) CO<sub>2</sub> levels was evaluated on the growth and dry matter accumulation of some important invasive weeds in Turkey. The tested invasive species included *Avena barbata*, *Bromus tectorum*, *Capsella bursa-pastoris*, *Poa bulbosa*, and *Carduus nutans*. These invasive weeds were grown under normal and elevated CO<sub>2</sub> in a controlled environment glasshouse and the data regarding the plant height, chlorophyll, fresh weight, dry weight and number of leaves per plant was recorded. The results indicated that *Carduus nutans* and *Poa bulbosa* were not affected by increased CO<sub>2</sub> levels in terms of plant height, chlorophyll, fresh weight, dry weight and number of leaves. *Capsella bursa-pastoris* was negatively affected by the increased CO<sub>2</sub> levels having lower height, fresh

and dry weight at higher CO<sub>2</sub>. *Avena barbat* and *Bromus tectorum* were positively influenced by the increased CO<sub>2</sub> level. A significant increase in the dry matter accumulation of both weeds was recorded when grown under the elevated CO<sub>2</sub> levels. In conclusion, the invasive species will respond variably to the changing climate. Hence, some invasive species will not be affected, some will have negative effects on their growth, while others will increase their growth in response to the changing climate.

**Keywords:** Invasive weeds, climate change, growth, dry matter.

## **The nightmare: genetically modified organisms as alien species**

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Genetically modified organisms (GMOs) are products of modern biotechnology that encapsulate any living organism containing a novel combination of genetic material other than the natural one. In fact, the logic of the process comes from horizontal gene transfer that naturally occurs between different species and results in alteration of the targeted genome. For example, *Agrobacterium sp.* is capable to transfer small part of its plasmid genome to plants, or lentiviruses can transfer their genes to animal cells. Many research groups aim to determine the function of the genes by mutation, recombination, adding or deleting genetic material. Nowadays, the recombinant DNA technology is widely used to produce desirable phenotype such as resistance to pests or herbicides as well as increased production capability or quality. The long term effects of the GMOs on human beings or the environment is not clear thus, public reaction is worrisome due to information pollution. The main question is whether GMOs are environmental threat or ecological risk to the universe? The debate comes from the fact that genetically modified organisms are seen as alien species that are capable to spread out and supplants native species. The hypothetical risk is if a transgene will be invasive and flow throughout species and cause new ecologically harmless phenotype or alter the current metabolic pathways and thus produce more toxic compounds? In fact, the logic of the GMO production is to obtain desirable phenotype for specific requirement such as for example the production of golden rice. Nobody can give certain provision about ecological risk yet the excessive herbicide or pesticide usage could be more harmless than GMO's. The aim of the paper is to evaluation of the current situation and requirements of the GMO safety products and their possible effects on the ecological environment as a alien species.

**Keywords:** Genetically modified organisms (GMO), alien species, ecological risk.

## **The role of antioxidants in the Orobanche – cultivated plants interaction and broomrape invasion**

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*Orobanche* spp. and *Phelipanche* spp. (Broomrapes) are obligate root parasites that are leafless and devoid of chlorophyll. Their growth and development is entirely dependent upon their host. Seed germination of these plants depends upon chemical signal molecules that are released from the host plants. Broomrape species significantly reduce the yield of many cultivated plants such as sun flower, tobacco, tomato, potato by infecting these plants. The occurrence of broomrape in many agricultural areas is increasing. Environmental stresses also reduce the yield of many cultivated plants. New crop cultivars resistant to biotic and abiotic stress factors are required to maintain the yields. Numerous studies show that the antioxidant capacity of plants correlates with resistance to environmental stresses. This capacity to tolerate stress is determined by enzymatic (SOD, POX, APX, CAT, GR etc) and non-enzymatic (ascorbate, tocopherol, glutathione etc) antioxidants. The results of our research indicate that some tomato varieties grown in Çanakkale, exposed to broomrape infection, exhibit differential antioxidant capacities. Similar results were observed in some sunflower, pepper and eggplant varieties. Additionally, an exposure to salt stress induced an increase in the resistance to the broomrape infection

in *Arabidopsis* stimulated by increased levels of antioxidant enzymes. In this review, recent research results on the interactions between the antioxidant enzymes and the broomrape infection were analyzed. We focused on the infestation of broomrape in agricultural areas based on antioxidant capacities of some agricultural plants.

**Key words:** Orobanche, Phelipanche, Broomrape, Antioxidants, Tomato, Sunflower, Eggplant, Arabidopsis.

### **An awareness project: The impact of invasive and exotic species on nature-damage on nature**

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A project on invasive alien species under the Comenius school partnership, an EU program, has been conducted by 5 partner countries, which are Estonia (coordinating country), Italy, Spain, Poland and Turkey. The aim of the project is to create awareness and convey information on invasive and exotic species to general public but particularly to students, teachers, and parents. The subject of exotic and invasive species and environmentally friendly outlook are important to all partner schools. The project will be concerned with geography, biology, English, environment, IT, health education, culture studies and ecotourism as well as invasive alien species. The project is initiated in 2013-2014 school season and will last two years. The main planned activities during the first year are to find out the historically earliest exotic species in the given area and to find out the most widely spread exotic species in the participating countries and how they affect the habitants of the local areas. In the second year, the following questions will be answered: „What are the positive and negative exotic species on the local natural and cultural environment?“, „Do the exotic species have any influence on the health and eating habits of the people in the area?“, „How tourism and moving of people have affected the spread of species?“

**Key words:** awareness, student, teacher, education, invasive alien species

### **Invasive plant species in Çanakkale**

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The present study provides first preliminary results on invasive plant species in Çanakkale. We evidenced the presence of 15 invasive vascular plant species, including 9 native and 6 naturalised. The invasive plants are mostly distributed around town centres and agricultural areas. Some of the native invasive plants have rhizomes and they mostly develop in large areas. Some exotic invasive plants, which are planted as ornamentals on touristic places, succeed in reproductive growth and successfully spread in nature. Currently, the exotic plants are not a threat, but some native invasive species such as yellow foxtail (*Setaria glauca*), horseweed (*Conyza canadensis*) and dog's tooth grass (*Cynodon dactylon*) cause big problems in agricultural areas. When planting exotic plants, they must be surrounded by barriers to prevent them from spreading in nature.

**Keywords:** Çanakkale, exotics, invasive plants, Turkey.

## A field trip to Musaköy for observation of broomrape infestation

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*Orobanche* and *Phelipanche* spp. (broomrapes) are obligate root parasite plants, completely devoid of leaves and chlorophyll. Their growth and development fully depends on its host. Solanaceae plants are infected with broomrapes. Some of these plants are tomato, pepper and eggplant. In Çanakkale, 550158 tons of tomatoes were produced in 2012 and 20 percent of this production was provided from nearby agricultural areas of Çanakkale. In 2012 pepper was produced 152994 tons in Çanakkale and 4 percent of this production was provided from nearby agricultural areas of Çanakkale. Eggplant production was 799285 tons in Turkey in 2012. All these plants are used as food all around the world.

During a field trip to Musaköy (40°19'55''K, 26°54'05''D), it was detected that tomato, pepper and eggplant plants had been heavily infected with broomrapes. This broomrape species was identified as *Phelipanche aegyptiaca* (Pers.) Pomel. According to the broomrape number per plant, the most severe infection was observed in the tomato plants. Low infection was found to in the pepper plants. It was noticed that the parasitic plant declined the growth of these crops despite the observed fruit development in these plants.

**Key words:** *Orobanche*, *Phelipanche*, Broomrape, Musaköy

## Invasive weeds in the Black Sea region of Turkey

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Weeds are constant component of agro-ecosystems and alternative control methods have been used to control them in different crops. However, many seeds and propagules of exotic species are introduced in new regions by accident and some of them may settle and become component of the natural flora. The growing international trade and movement of people increase the probability of introducing alien species into the environment including the risk that the species could become invasive and damage the native biodiversity. Invasive species have traits favoring establishment and spread into new locations. Invasive plant species are tolerant to extreme environmental conditions. New locations keep them away from herbivore and diseases. Genetic variation, competitive adaptations, aggressive reproductive strategies, and efficient dispersal methods allow them to explore new habitats and displace slower growing native plants including other weeds. In this study 10 invasive species in the Black Sea region of Turkey are listed. Those species are *Ambrosia artemisiifolia* L., *Persicaria perfoliata* (L.) H. Gross, *Sicyos angulatus* L., *Hedera helix* L., *Pteridium aquilinum* (L.) Kuhn, *Smilax rotundifolia* L., *Sambucus nigra* L., *Rubus* spp, *Urtica dioica* L., and *Artemisia vulgaris* L. Early detection of invasive alien plants and quick coordinated responses are needed to eradicate or contain the invasive plants before they become widespread and control becomes practically and/or financially difficult.

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**Key Words:** Invasive weeds, Turkey, Black Sea Region.

## Seeds as a pathway: Speculation on *Diplachne fusca* spreading in Turkey

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*Diplachne fusca* is an invasive alien species and a weed in the rice fields. It is invasive alien species in Europe and the Middle East with a large native range worldwide, which is controversial. Its introduction to Europe and spreading country to country is not clear similar to Turkey. Plant was seen for the first time in Trace part of Turkey in early 2000s. The primarily plant identification was wrong, and later it was identified correctly. Today, it can be found in almost all rice producing areas of Turkey, which are not documented well. Among the introduction pathways to Turkey, the most acceptable one is the entrance with rice seeds imported for consumption, which is either used as seed to propagate rice illegally or refined for consumption in a factory. In both cases seeds of *D. fusca* were spread and established in Trace and after that rapidly spread all over Turkey. Its spread in Turkey most likely happened through rice seed trade. Trace is the main rice producing area for consumption and propagation purposes. It is necessary to adopt legal measures for producing propagating materials and raw food material processing factories to prevent entries of new invasive alien species.

**Key Words:** Introduction, Spread, rice, unintentional pathway.

## Population variability of weedy sunflower as invasive species

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The weedy forms of sunflower (*Helianthus annuus* L.) are morphologically clearly different from the volunteers that arise from the segregation of hybrid-F1 varieties. The weedy sunflower populations are characterized by a high morphological diversity with plants combining in different proportions cultivated and wild traits, from typical F-2 plants to typical wild-like phenotypes. Those plants have adapted to different environment in undesired way, becoming harmful and invasive weeds. According to our surveys, the weedy sunflower composed the biggest population in southern Srem (around 1 000 ha of crop and non-crop fields) and southern Banat (around 7-8 000 ha of crop and non-crop fields) in Vojvodina Province (north part of Serbia).

We created an experimental design with three populations of weedy sunflower to assess its relative fitness as the most important factor which indicates its survival and spreading as an invasive weed species in the ecosystem. The following fitness parameters were evaluated: visual plant injury, plant height, fresh weight, leaf area, relative and total chlorophyll content, seed germination, yield and yield parameters. Based on the evaluated fitness of the recorded biotypes of weedy sunflowers and invasiveness, we wanted to propose a strategy for its control. Our findings revealed large populations and high variability of generative production which ranged from 3512-8900 seeds/plant, depending on the number of heads and the analyzed population. Seeds dispersed from the mother plant can be affected by a number of factors. If only 5% of the seeds germinate, it can be expected that about 170-440 seeds (originating from a single plant) will germinate the following year. It is not clear. Such a high number of weedy sunflowers can significantly affect the yield reduction and there is a great possibility of "escape" of genes from sunflower hybrids tolerant to herbicides which would only impede the suppression of this invasive weed species.

**Key words:** weedy sunflower, population variability, fitness

## Allelochemical explanation of *Heracleum sosnovskyi* invasiveness

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Among the reasons of species invasiveness success in new environment is its chemical interaction with the recipient community determined by the absence of tolerance of resident flora to new chemicals produced by the invader, in this particular case by *Heracleum sosnovskyi* Manden. The allelopathy is expected to be an important mechanism in the plant invasion and may encourage the development of general research models of invasive susceptibility in the ecosystems. *H. sosnovskyi* is native to the Caucasus region and is a dangerous invader which successfully spread worldwide, as well as has naturalized in Lithuanian habitats and plant communities. *H. sosnovskyi* exhibited high biochemical activity due to the accumulation of phenolics. The assessment of the total phenolics content (TPC) and biochemical impact of *H. sosnovskyi* on perennial ryegrass (monocots) and winter rapeseed (dicots) seed germination was done *ex situ*. The aqueous exudates of 2-year old *H. sosnovskyi* exhibited higher phytotoxicity than 1-year old plant exudates. The phytotoxic effects of *H. sosnovskyi* aqueous exudates on the germination depended on the extract concentration (0.02-0.2%), plant age (1-year, 2-year), plant parts (shoot: stem, leaf, blossom, seed, root) and growth stage (rosette-ripening). The phytotoxicity of *H. sosnovskyi* determined extract was most strong at flowering stage due to highest TPC (30.42 mg ml<sup>-1</sup>). All parts of *H. sosnovskyi* produced phenolics, which inhibited the acceptor-species seed germination. The exudates inhibited the seed germination. The level of inhibition was concentration depended. The phenolics content varied throughout the plant age (0.22-81.03 mg ml<sup>-1</sup>), growth stage (0.17-81.03 mg ml<sup>-1</sup>) and across different plant parts (2.97-92.61 mg ml<sup>-1</sup>) inhibiting the germination of acceptor plants. The results suggested that the invasive plant species may acquire spreading advantage in new territories through the use of their allelochemicals to inhibit germination. Nonetheless, the species evidence for allelopathic effects should not be restricted to analysis of the plant exudates in the lab, but should also include research in the natural environment.

**Keywords:** *Heracleum sosnovskyi*, phenolics, phytotoxicity, allelopathy, germination.

## Invasive potential of *Bromus* species in wheat fields in Turkey

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Wheat has been by far the most important field crop in Turkey in terms of land area planted (9 million ha) and amount of grain produced (20 million t). Weeds are considered as one of the most important factors limiting the wheat yields in all regions of Turkey. In the group of the problematic weeds: *Avena*, *Lolium*, *Sinapis*, *Phalaris*, *Alopecurus*, *Galium*, species can be ranked according to *their importance*. But, recent studies conducted in Turkey show that the density and frequency of *Bromus* species in wheat-growing fields have increased. In a survey that was carried out in 2009, *B. tectorum* and *B. japonicus* were detected in the wheat-growing fields. In addition to these *Bromus* species, three other *Bromus* species (*B. rubens*, *B. madritensis* and *B. rigida*) were observed in the wheat-growing fields during another survey two years later. According to the last survey done in 2011, the number of *Bromus* species in the wheat reached five. Among these *Bromus* species, *B. rubens* and *B. madritensis* are especially crucial because they are categorized as invasive species in many countries. In this study, the density and frequency of *Bromus* species detected during the surveys conducted by other researchers and our survey in the wheat-growing fields are compared and discussed.

**Key words:** *Bromus. tectorum*, *B. japonicus*, *B. rubens*, *B. madritensis*, *B. rigida*.

## Expansion status of two invasive vines: Bur-Cucumber and Mile-a-Minute, in Turkey\*

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Bur cucumber (*Sicyos angulatus* L.) and mile-a-minute (*Persicaria perfoliata* (L.) H. Gross) are annual invasive climbing vines. While the origin of bur cucumber is North America, mile-a-minute is originated from Eastern Asia. The earliest records on the weeds in Turkey were from 1984 for the mile-a-minute and from 1996 for the bur cucumber. Since then there has been almost no detailed studies conducted. Therefore, we aimed to study the distribution, biological and ecological aspects of the vines together with some other invasive species such as the common ragweed in Turkey. Within a TUBITAK funded project, the surveys on vines were initiated in 2013. The surveyed area was extended from Samsun to the Georgia border, which was approximately 600 km through the Black Sea Region of Turkey. Initial results revealed that both species are already found in a broad geographic range, and the vines have been established in the region. The species were first encountered in the Giresun province. They also extensively populated the Trabzon and Rize provinces. The plants were found in agricultural and nonagricultural habitats such as roadsides, riversides and wastelands, on the borders of forestlands, hazelnut and tea plantations, and in the vegetable grown areas of the region. Although the observed effects of the bur cucumber and mile-a-minute were often limited at the borders of forests, orchards and tea plantations. The climbing nature of the invasive vines, which reached the top of the native tree canopies (forest trees, hazelnut, chestnut, mulberry, tea, etc.), as well as the covering effect of the weeds (particularly the herbaceous plants on the ground) may prevent the use of light and inhibit the further growth of the covered plants. The above-mentioned effects of the vines may severely influence the native plant diversity and with the increase of the population of weeds in the future the economy of the region might be threatened. The human-generated disturbances have promoted the spread of the invasive plants in the region. The lack of concern for the management of invasive species in Turkey has also enhanced the expansion. Therefore following the assessment and monitoring of plants in Turkey, management activities to combat with the vines is needed. Otherwise, the established populations of vines most likely will further expand and spread dramatically and become persistent in the region.

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**Key words:** Invasion, Turkey, Invasive Plant, distribution, Bur cucumber, *Sicyos angulatus*, Mile-a-Minute, *Persicaria perfoliata*,

## Situation of invasive alien species in EPPO A2 list in Turkey

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EPPO (European and Mediterranean Plant Protection Organization) is an intergovernmental organization responsible for European cooperation in plant protection in the European and Mediterranean region. The organization works more specifically on invasive alien plants, in particular it analyses the risks presented by specific invasive alien plant species for the EPPO region and recommends measures to prevent their introduction and spread via international trade. EPPO has lists for phytosanitary purposes. The EPPO A1/A2 Lists are to recommend that organisms of serious phytosanitary concern should be regulated as quarantine pests by the EPPO member countries (A1 pests are absent from the EPPO region and A2 pests are locally present in the EPPO region). There is not any species in A1 list, while A2 list consists of 11 plant species. *Heracleum persicum*, *H. sosnowskyi*, *Ludwigia peploides* and *Polygonum perfoliatum*, which are in A2 list of EPPO and recorded in flora of Turkey, an eleven-volume book. *Solanum elaeagnifolium*, another species in EPPO A2 list

has been recorded in Turkey as well. *H. persicum* is an Irano-Turanian plant and native to Turkey. The others are alien species to Turkey. There has been no detailed distribution data so far about these species. Furthermore, existence of *Eichhornia crassipes*, *Baccharis halimifolia* and *Limnophila sessiliflora* in Turkey has been speculated because some forum sites in internet related to ornamental plants mention those plants seen in Turkey. There is a need to verify if these species have already naturalized or not.

**Key words:** *Heracleum persicum*, *Heracleum sosnowskyi*, *Ludwigia peploides*, *Polygonum perfoliatum*, *Solanum elaeagnifolium*, *Eichhornia crassipes*, *Baccharis halimifolia*, *Limnophila sessiliflora*.

### ***Pontogammarus robustoides* G. O. Sars, 1894 – New potentially invasive amphipod species to the Bulgarian inland waters**

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The amphipod species *Pontogammarus robustoides* G. O. Sars, 1894 (Amphipoda, Crustacea) is of Ponto-Caspian origin and in recent years has been reported as invasive alien species in several Central and West European countries. In Bulgaria, the species was reported from the Bulgarian sector of the Danube River and some Black Sea coastal lakes and rivers. This is the first report of the species for the fauna of the inland waters in Bulgaria. It was found for the first time in the Mochuritsa River, at the confluence with the Tundzha River (near Yambol Town, Aegean Sea basin) on 03.10.2006 (23 individuals). Subsequently the species was recorded again at the same locality: in 2009 (41 specimens) and in 2013 (100 specimens). Additionally, two native amphipod species, *Gammarus komareki* Schaferna 1922 and *G. arduus* G. S. Karaman 1975, were found to occur at closely located sites (Mochuritsa River at Vodenichane Village, 15 km upstream, and main stream of Tundzha River). In 2011 *P. robustoides* was recorded in high abundance in the littoral area of the Ovcharitsa Reservoir, which is affiliated to another river basin (Maritsa River, Aegean Sea basin). Because of the high potential of the species to spread in the inland river systems in Bulgaria and to become invasive, further studies of its distribution, vectors of introduction, biological traits and ecological requirements are urgently needed.

**Key words:** *Pontogammarus robustoides*, translocated species, Aegean Sea basin.

### **Distribution of the invasive Blue Crab *Callinectes sapidus* Rathbun, 1896 along the Albanian coast**

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Since its first record in 2006, the invasive blue crab *Callinectes sapidus* has been quickly and largely distributed along the Albanian coast. This study has been based on the information gathered in almost all coastal lagoon areas of Albania, such as Vilun, Kune, Vain, Patok, Rrushkull, Karavasta, Narta, Orikum and Butrint during 2009-2013. Besides direct observations and samples' collection in the studied areas, questionnaires have also been distributed to the local fishermen with the purpose of gathering information about the presence of the blue crab along the Albanian coast, its state in each surveyed area and assessment of its possible impact on other lagoon populations in the areas where it was present. In the lagoons of Patok, Narta and Orikum more detailed studies have been carried out on assessing the population structure of the blue crab and the stability of this species in the lagoons. The blue crab has resulted as already established in those three lagoons and it is expected to be established in several other lagoons and river mouths in the Albanian coast. The present study is ongoing

and aiming to assess the establishment of the blue crab in other coastal areas, its population structure and possible impacts on the biota in introduced areas.

**Keywords:** alien and invasive species, blue crab, Albanian coast.

### **Lake Ohrid tributaries: Natural and potential pathways for invasive alien species introductions**

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The role of the four tributaries (rivers Sateska, Koselska, Grasnica and Cerava), together with the only outflow (River Crn Drim) is rather considerable regarding the sustaining of the water balance of Lake Ohrid. Since the early 1970s, with the intensification of the industrial development in the watershed of the lake, until present times, the negative influence of the tributaries concerning the water quality and habitat destruction in the littoral of the lake has been identified. However, until recently, neither the tributaries, nor the outflow were considered as factors that can directly assist the introduction of alien and invasive species.

The goal of the research was to determine possible existence of alien or invasive macrozoobenthic species in the mentioned water flows, and the existence of potential vectors and conditions for their introduction. By applying the WISER method, samples from different sites throughout the water flows were collected, according to the following criteria: upper flow, middle flow and inflow in the lake; the different anthropogenic impact reflected in the changes in water quality and habitat changes.

A total of 54 taxa from 8 groups (Turbellaria, Oligochaeta, Hirudinea, Bivalvia, Gastropoda, Amphipoda, Isopoda and Insecta) were registered in a total of 19 localities from 7 water flows in the Macedonian part of the watershed of Lake Ohrid. The largest number is classified under the group of Insecta and it is characteristic for the upper flow of the Sateska River, where there were no visible disturbances of the habitats. Unlike the condition in the upper flow of the Sateska River (characterized by “very good” ecological status), the inflows and middle flows of the other rivers indicated disturbed trophic state of the water and “bad” or “very bad” ecological status (Cerava and Grasnica Rivers). Although macrozoobenthos alien species were not registered during the research, the natural location of the tributaries and increased frequency of anthropogenic activities in the watershed of the lake, as well as the existence of localities with “bad” ecological status and disturbed (destroyed) habitats indicated the need of continuous monitoring for the occurrence and introductions of potential invasive alien species in the watershed of Lake Ohrid.

**Key words:** Lake Ohrid watershed, macrozoobenthos, ecological status, alien species.

### **Native and non-native fish species in the tributaries and outflow of ancient Lake Ohrid**

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The ancient Lake Ohrid, located in Macedonia and Albania, represents one of the most significant hotspots of endemic biodiversity on the Balkan Peninsula. It is known that the aquatic and isolated ecosystems with globally

significant biodiversity are most vulnerable to different impacts, such as climate change, habitat change, introduction of invasive alien species and pollution. While the ichthyofauna in the lake has been extensively studied, little is known about the current state of the ichthyofauna in the tributaries and its outflow, the Crn Drim River. In order to study the fish species diversity in the Lake Ohrid catchment in relation to occurrence of non-native species and the influence of some environmental factors, in May 2013, we sampled different sections of 6 tributaries as well as the Crn Drim River.

A total of 15 fish species were recorded. Of them, 12 species are endemic to the Lake Ohrid and Crn Drim River catchments. Two of the species, *Pseudorasbora parva* and *Carassius gibelio*, are alien to the ichthyofauna of Macedonia. Most frequently found were *Pachychilon pictum* and *Squalius squalus*, which also had the highest relative abundance in the lower and middle sections of the rivers. They were followed by *Alburnus scoranza*, which was abundant in the lower sections of the rivers, and by *Barbus rebeli* and *Phoxinus lumaireul*. The alien *P. parva* was found in two tributaries and the Crn Drim River, while *C. gibelio* in 2 tributaries, both in comparatively low abundance. The relation of the fish species distribution and abundance with the physicochemical and substrate characteristics are analyzed. The identified threats, such as the occurrence of non-native species, although in low number and abundance, water pollution and some hydromorphological changes in the river courses indicate the need of urgent measures for the protection of the endemic ichthyofauna in the Lake Ohrid catchment.

**Key words:** Endemic fish species, non-native species, threats, Lake Ohrid catchment.

## Distribution of *Gambusia* (Mosquitofish) in Turkey and its potential impact on aquatic ecosystems

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The mosquitofish, *Gambusia sp.*, is one of the most widespread freshwater fish genera all over the world. Although it is native to America, the distribution area of *Gambusia sp.* has rapidly expanded since it has been intensively used for mosquito control. This species was introduced into the inland waters of Anatolia in the 1930s and has invaded almost all freshwater ecosystems in Turkey. The mosquitofish is highly tolerant to poor water quality, especially high turbidity, extreme ranges of temperature and salinity and low dissolved oxygen conditions. Today, the mosquitofish is considered as one of ‘The World’s Worst Invasive Species’ ([http://www.issg.org/worst100\\_species.html](http://www.issg.org/worst100_species.html)) due to its wider ecological and physiological tolerance in harsh environments, and to its negative ecological impact. The mosquitofish has a wide food preference; it can adversely affect phytoplankton, zooplankton, other invertebrate, fish, and amphibian populations, as well as mosquito larvae. Therefore, the small viviparous fish, *Gambusia sp.*, can disrupt the entire ecosystem function. The invasive characteristics of the mosquito fish are strongly related to its reproductive success due to high fecundity, multiple-spawning in a breeding season, live-bearing, short duration of both gestation and pre-adult periods, and sperm storing ability of females. The invasive mosquitofish is known to prefer similar habitats and even has similar niche with *Aphanius* species. Therefore, the presence of this introduced species should be regarded as a serious threat to populations of *Aphanius* due to its invasive characteristics and even direct predation on the fries and eggs. Our aim is to determine the relationship between *Gambusia sp.* and *Aphanius sp.* and to present a conservation strategy for *Aphanius*. In this study, we present the distribution of mosquitofish in Turkey and its possible effects on the endemic and endangered *Aphanius* species.

**Key words:** Mosquitofish, biodiversity, Anatolia, invasive species.

## Rapid expansion in distribution area of a marine fish, the sand smelt, in inland waters of Turkey

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The sand smelt (*Atherina boyeri*, Risso 1810) is known as a marine-estuarine species having a wide distribution area covering coasts of northern Atlantic Ocean, Mediterranean Sea, Black Sea and Caspian Sea. This euryhaline species is also known to live in lower parts of rivers, estuaries and coastal lakes. This species was recorded from all coasts of the seas surrounding Anatolia, also from lagoons and lakes having connection with the seas. After the first record of the sand smelt in inland waters from lake Sapanca in mid 1940s, the sand smelt was reported from İznik lake, which has not a direct connection to the sea. During the last decade there were new records from different natural lakes and reservoirs of Anatolia such as the reservoirs on Kızılırmak, Sakarya, Aksu and Orontes rivers. The sand smelt established successful populations in many inland waters of Turkey which are isolated and have no connection with sea. In Turkey, the distribution of this species in the inland waters has been expanding conspicuously during the last decade by illegal introductions and becoming popular for fishers due to the economic value. The common feature of these sand smelt populations in confined to freshwater, are successful breeding and filling vacant pelagic niches and becoming dominant fish. The ecological impacts of sand smelt such as predation on zooplankton, competition with endemic fish species and fishes having economical value should be considered. Due to life history traits such as short life cycle, early maturation, and prolonged reproduction period, this species has a great potential of being an invasive species in the inland waters of Turkey.

**Key words:** *Atherina boyeri*, freshwater systems, Anatolia.

## A review of pest status of alien insects in Bulgaria

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Bulgarian biodiversity and economy are threatened by the introduction of alien insects because of increasing transport and the global warming. The alien terrestrial insects recorded so far in Bulgaria account to 294 species and 52 of them have been detected during the last 13 years. The highest number belongs to Hemiptera (96) and Coleoptera (87), followed by Lepidoptera (34), Hymenoptera (23), Phthiraptera (16), Diptera (15), Thysanoptera (8), Orthoptera (6), Blattodea (3), Psocoptera (3), Zygentoma (1), Siphonaptera (1), and Dermaptera (1). Most of them originate from Asia (94), followed by Americas (84), Africa (45), etc. The species with cosmopolitan distribution and considered as cryptogenic are 84. The trade with plant material and in particular ornamental plants is considered as a main pathway for the introduction of alien species.

In recent years, the following species have rapidly increased their population density and range of distribution in Bulgaria: *Cameraria ohridella* Deschka et Dimic, *Phthorimaea operculella* Zeller, *Harmonia axyridis* (Pallas), *Metcalfa pruinosa* Say, *Tuta absoluta* (Povolny), *Nezara viridula* (Linnaeus), *Pseudococcus calceolariae* (Maskell), *Aphis spiraeicola* Patch and *Acizzia jamatonica* (Kuwayama). Their pest status is discussed.

**Key words:** Alien insects, pest status, pathway, Bulgaria.

**A new approach to control the Colorado potato beetle *Leptinotarsa Decemlineata* (Say)  
(Coleoptera: Chrysomelidae): Botanicals**

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The Colorado potato beetle, *Leptinotarsa decemlineata* (Say) (Coleoptera: Chrysomelidae), is a global destructive pest of potato *Solanum tuberosum* L. (Solanaceae). The beetle's origin is supposed to be the highlands of Mexico. Its rapid spread to the other parts of the world began in 1874 from Atlantic coast by the Spanish settlers. Over the time it has spread to the other continents for several reasons, especially as a result of its high tolerance to the cold climates. The beetle has been detected for the first time in Turkey in 1963. Since then, there have been some outbreaks in the country. In this study, it is going to be discussed whether the botanical insecticides as a biological control method will be able to regain its real prestige or not. Also the invasion history and management attempts of this pest in Turkey will be described.

**Key words:** The Colorado Potato Beetle *Leptinotarsa decemlineata* (Say) (Coleoptera: Chrysomelidae), botanical insecticides, invasion, biological control.

**The potential use of entomopathogenic nematodes against tomato leaf miner *Tuta absoluta* (Lep: Gelechiidae)**

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*Tuta absoluta* Meyrick is native to Central America, widely distributed in South America and known as the most devastating tomato pest all over the world which can cause up to 100 % loss of production. The species was first recorded in 2009 in Turkey and showed a rapid spread, causing serious damages in almost all tomato fields. The extensively use of pesticides against *T. absoluta* was not effective enough and negatively affected it's native natural enemies. It is essential that an efficient method for control of the population of the pest to be developed in order the use of insecticides in tomato production areas to be reduced. Entomopathogenic nematodes can be used effectively to control soilborne pests and the use of entomopathogenic nematodes has been rapidly increased all over the world as well as in Turkey. In this study, an extensive survey has been conducted to identify EPNs in Turkey. In addition, the efficacy and the potential of entomopathogenic nematodes against *Tuta absoluta* in tomato fields in Turkey were investigated. In this respect, the success of native natural enemies against alien species in the biological control were discussed.

**Key words:** *Tuta absoluta*, entomopathogenic nematodes, biological control, tomato

