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Iliia CHRISTOV  
Eric STRAUSS  
Abd-Alla GAD  
Isa CUREBAL

# Science, Ecology and Engineering Research in the Globalizing World

Managing Editor  
Recep EFE



Ecological and Engineering Researches in the Globalizing World

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## **Managing Editor**

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## **Preface**

This book, “Ecological and Engineering Researches in the Globalizing World” has 43 Chapters including ecological approaches in making urban land use decisions, landscape design to develop public awareness, sustainability principles and landscape planning, effects of global climate change, landscape planning in urban design competitions, wetlands under the pressure of urbanization, landscape ecological analysis of the modern delta of the Ural river, microbial interactions in phyllosphere and rhizosphere, history of Edremit/Van cultural landscape, concept of urban square in sustainable cities, sustainability of cultural heritage assets, visual landscape quality, the role of the regional scale cultural, ecological properties of wooden building materials, tobacco in the historical process, antiuro lithiatic activity of medicinal plants, green infrastructure plan in metropolitan cities, bio-fertilizers in organic agriculture, importance of fertilization programs in new production models, the role of ecotourism in the preservation and development of rural identity, some natural and exotic invasive plant species in turkey, modeling of urban sprawl using remote sensing data, ecological design in landscape architecture, vertical green systems, neighborhood effect in urban identity formation, greenways on railway route, structural equation modeling, evaluation of visual landscape quality, the contributions of green spaces to urban ecosystem, the effects of integrated urban water management on the quality of urban life, construction of rafting tourism strategic action plan, bronze age urban organization in mesopotami and green chemistry applications in textile industry.

Contributions in each chapter are prepared by experts in the respective fields and mirror the advancement in the approach. This book contains important future tasks of the particular fields and supplies extensive bibliographies at the end of each chapter, as well as tables and figures that illustrate the research findings. All these make this book highly useful and a must read for students, researchers and professionals in landscape architecture, ecology, environmental sciences and architecture.

We would like to express our gratitude to all contributors for bearing with us as the volume has taken time to come to fruition

We particularly wish to express our thanks to the team at Sofia St. Kliment Ohridski University, Publishing for preparing the book for publication.

The Editors



## Chapter 16

# Some Natural and Exotic Invasive Plant Species in Turkey

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### INTRODUCTION

Invasive and alien plant species are an important threat to natural habitats. These species, which can show a tendency to naturalization, have a devastating effect on the natural food chain. Invasive species usually have a different phenology than natural species. Leafing are earlier than wild plants and are cut off from activity later than usually. In short, vegetation times are longer. This is because of their high ecological tolerance. These invasive plants develop many strategies to survive. Their development is often rapid and they grow to maturity at early ages. Many of invasive plant species have the ability to reproduce vegetative because of stolon, rhizomes, and shoots rooted at the soil. These species tend to be mostly pollination by wind. Fruits are carried by winds, waters and birds to reach very wide spreading areas. Owing to this feature, colonies can be built in places far from natural habitats. The main problem occurs in global biodiversity. Biodiversity is a complex structure composed of a perfect blend of bacteria, fungi, plants and single-celled organisms. All the organisms that are constituent parts of biodiversity are living elements of ecosystems and these organisms enable the continuity of life on the planet. These naturalized species, with their invasive character, exterminate the wild plant species present in the region. They cannot just settle for certain species, but can destroy the whole organism community. Naturalized invasive species tend to alter the normal succession stages of the ecosystem in which they are located and are effective on the ecosystem in the long run.

Naturalized invasive plant species eliminate the wild species that exist in the region. They do not just to replace specific species. They can destroy the whole organism community. Naturalized invasive plant species tend to change the stages of succession in the ecosystem in which they are located and have an impact on the ecosystem in long term.

Today, there are many factors that threaten biodiversity. The most important of these are habitat losses, the disintegration of natural ecosystems by human ingenuity and the degradation of their dynamics. In addition, invasive species gain land due to wrong land use, over-utilization of plant sources, global warming and environmental pollution can be among other threats to biodiversity (Chevalier *et al.*, 1997; Işık *et al.*, 1997). For example, the disruption of habitats directly changes the structure of the ecosystem. This results in isolation and deterioration of habitats away from each

other. In habitats where fragmentation increases and structural dynamics are broken, plant and wildlife mobility is restricted (Collins, 2005).

Turkey is a unique country in terms of plant biodiversity because of its geographical location, geomorphological structure, micro-climate diversity and its combination with three different flora regions. Habitat fragmentation and loss of habitat are the leading factors that threaten biological diversity. Habitat fragmentation may occur naturally or anthropogenic origin (wrong land use, road construction, forestry activities, etc.). This factor, which threatens biodiversity, causes alien species to settle in natural habitats (Pysek & Richardson, 2010). In the globalized world, the globalization of travel and trade allows these non-natural species to find new areas of distribution in various parts of the world (Wagner *et al.*, 2017). These non-natural species create serious problems in various fields such as environmental, economic and human health in the new habitats they find. (Xu *et al.*, 2012). With 11,707 taxa in Turkey, there are also alien plant species that enter Turkey's flora in different ways such as introducing or naturalizing. It has been determined that there are 340 of alien plant species which are not included in the natural flora of Turkey (Uludağ *et al.*, 2017).

In this study, information about the origin, biological and ecological characteristics of some invasive alien plant species that are spread commonly in the Turkey has been compiled. Some of them naturally take place in the flora of Turkey. These plants are *Amaranthus retroflexus* L., *Ambrosia artemisiifolia* L., *Clematis vitalba* L., *Conyza Canadensis* (L.) Cronquist, *Echinochloa crus-galli* (L.) P. Beauv., *Microstegium vimineum* (Trin.) A.Camus, *Polygonum persicaria* L., *Sicyos angulatus* L., *Xanthium spinosum* L., *Tradescantia fluminensis* Vell., *Crassocephalum crepidioides* (Benth.) S.Moore, *Rhododendron ponticum* L., *Robinia pseudoacacia* L., and *Ailanthus altissima* (Mill.) Swingle.

***Amaranthus retroflexus* L.** is native to North America, but is widespread as an introduced species on most continents in a great number of habitats. Young plants usually emerge from the end of May to June. Growth can be very rapid. Flowers appear from June to October. The first fruits can be developed in July, although I observed plants that fructified in January. Senescence stage is from November to February. Phenological stages are slightly dephased for different latitudes (Costea *et al.*, 2001; Iamonica, 2010). It is often found in garden cultures, rich in nutrients, and sometimes in arid soils. He likes warmth. Common in subtropical areas. It may produce more than 1 million seeds under appropriate conditions. Seeds can remain in the soil for 10-40 years without germinating (Uygur *et al.*, 1986).

***Ambrosia artemisiifolia* L.** is an invasive alien plant in Europe. It grows to 20-90 cm, even 120 cm in height. It begins to emerge early in the spring and continues to emerge through the summer. Plants that emerge early in the spring have a longer vegetation period. They are higher, more ramified and produce more seeds (Galzina *et al.*, 2010). As an annual plant it reproduces by seed and has abundant seed production. One plant produces on average 1000-4000 seeds but that number can be significantly higher. Seed can remain viable in the soil for 35 years and even more (Ostojić *et al.*, 1992; Ostojić, 2005). Solitary, individual plants are more ramified and

generally pollinate more. Common ragweed plants react with high phenotypic plasticity to population density and competition from other plants (Brandes & Nitzsche, 2006).

***Clematis vitalba* L.:** is native to central and southern Europe. It is a invasive deciduous plant which spreads both vertically and horizontally. It can grow up to 7 times faster than ivy. Stems can grow several meters in a single season. One plant is capable of blanketing an area of 180 m<sup>2</sup>. Old Man's Beard is tolerant of cold, moderate shade, damp, wind, salt and most soil types. Damage from the species also enhances the colonization of native habitats by other invasive plants. It can reproduce by both seed and vegetative means. An estimated 17,000 viable seeds are produced per 0.5 m<sup>2</sup> in areas. Seed dispersal is by wind, water, people and animals. It often grows on roadsides, and the risk of seeds being transported on road vehicles from known infestations to new sites is high (URL-1, 2017).

***Conyza canadensis* (L.) Cronquist** is native to North America. Annual herb up to 150 cm, with patent hairs and with arranged flowers in small yellowish-white spherical flower heads. Flowering is from June to August. It propagates by seed, producing a high amount of seeds that are efficiently dispersed by the wind, rapidly enhancing their distribution area. A ruderal weed species, very frequent in disturbed areas: urban areas, roadsides, abandoned fields, common lands, ditches and unattended crop fields (removed soils and enriched in nutrients). It also appears in natural and semi-natural areas normally associated to disturbance events. It forms dense areas that prevent the growth of native vegetation. High costs in applying control methodologies, mainly in crop areas. It reduces productivity in crop fields (URL-2, 2017).

***Echinochloa crus-galli* (L.) P. Beauv.** is an annual introduced from Europe and India. An upright summer annual weed. Found in moist, disturbed sites, marshes, and wet turf areas. The stem is flat and erect with roots at its nodes. The leaves are linear with a broad round base narrowing at the tip. The seed head is windmill-shaped and the seeds are short with stiff awns. The flower head is reddish, purplish, pinkish or greenish. Panicle and seed head often purple, spikelets end in a bristle. Each plant can produce up to 40,000 seeds. Completes its development in 42-64 days (URL-3, 2017). This species is ranked 3rd among the world's worst weeds, and can consume 60-80% of available soil nitrogen in one growing season (Royer and Dickinson, 1999). Seeds can survive up to 12 years (Cliffor & Walter, 2005).

***Microstegium vimineum* (Trin.) A.Camus** is an annual grass from Asia. It germinates in spring and grows slowly until mid-summer ultimately reaching a height of 0.6–1.5 m. Reclining stems can grow to a length of up to 2 m. In unfavorable conditions, the plant can be as small as 10–20 cm in height but it is still capable of producing flowers and seed (Mehrhoff, 2000). *Microstegium vimineum* possesses characteristics typical of many invasive alien species: it grows quickly, fruits within a single season, produces abundant seed and readily invades habitats that have been disturbed by natural (Tu, 2000; Oswalt & Oswalt, 2007). It produces numerous seeds in autumn eds are dispersed by water, animals and through human activities on

clothing and vehicles. Seeds may remain viable in the soil for 5 years (Barden, 1987).

***Polygonum persicaria* L.** is native to Europe. It is annual herbs with coarse, erect or ascending stems that grow 30 to 91 cm tall. Stems are swollen at the nodes (Welsh, 1974). It reproduces entirely by seeds. It can produce up to 1,550 seeds in one season (Stevens 1932). Seeds can be dispersed by birds and mammals after being ingested (Ransom 1935). Most seeds germinate in spring. The optimum temperature for germination is 20°C (Bouwmeester & Karssen, 1992). It inhabit an extremely broad range of habitats, from moderate shade to full sun, flooded areas to dry areas, and fertile soils to nutrient-poor soils (DiTomaso & Healy, 2003; Heschel *et al.*, 2004). It grows best in soils with pH between 4.0 and 8.5. It can tolerate a slightly broader range of environmental conditions than curly top knotweed (Sultan *et al.*, 1998).

***Sicyos angulatus* L.** is native to North America. This plant is an annual vine, drying entirely in the coldest months of the year (Hilty, 2002-2006). *Sicyos angulatus* blooms from mid-August to mid-September (Cooperrider, 1995). Each fruit contains a single, large seed. Thus what appears to be a seed at dispersal is a single mature ovary with one seed inside. It is an annual plant that spreads mainly by reseeding itself. Seeds are produced in large numbers and the enclosing fruit is disseminated by animals, which may catch the prickly fruit in their fur (URL-4, 2017). Seeds germinate from May through September (Esbenshade and Curran, 1996). *Sicyos angulatus* is invasive in maize and soybean fields where its seeds are scattered by farm machinery (URL-4, 2017).

***Xanthium spinosum* L.** is native to North America. It is an annual herb originating from South America (Chile). It is widely distributed throughout the temperate regions in the World (URL-5, 2017). Bathurst burr is an erect, multi-branched annual herb, growing up to 1 m high. Flowers are creamy green and small, developing into straw-colored burrs, 1–1.5 cm long, with numerous yellow hooked spines. The burrs contain two seeds that can survive up to 3 years under field conditions (Anonymonus-6, 2017). Woodlands, pastures, fields, forest margins, coastal habitats and disturbed sites such as roadsides, ornamental landscapes, agricultural fields, and urban waste areas; also common along riparian areas. The cockleburs can grow in most environment and can tolerate many soil types (URL-5, 2017).

***Tradescantia fluminensis* Vell.** is an endemic South American species in its natural areas. Despite its natural environment, it is known as an invasive species outside its natural environment. (Standish *et al.*, 2001). *Tradescantia fluminensis* is a succulent, creeping and perennial plant of ground cover. The main body can reach 1.5 m in length and has a soft and brittle structure. Every nod on the body is capable of producing new bodies. Breeding of this invasive species is mostly done through stolons and tubers. (Maule *et al.*, 1995). *Tradescantia fluminensis* responds quickly to the presence of sufficient light and nitrogen (Maule *et al.*, 1995). In the edge habitat, the growth rate of this taxon reaches to 40-50 m (Standish *et al.*, 2004). In addition, well-drained soil is increasing the growth of this taxon (Smale & Gardner, 1999). *Tradescantia. fluminensis* has great negative effects on forest biodiversity,

with the possibility of spreading on the edges of forests and creeks outside its natural environment (Standish *et al.*, 2001). With the decline of the closure in these areas, there is an increase in population density and prevents new youth from coming. The dense populations that are formed cause homogenization of the natural environment and cause the species diversity to decrease (Standish, 2002).

***Crassocephalum crepidioides* (Benth.) S.Moore** is a plant species of African origin. *Crassocephalum crepidioides* are 30-120 cm long, erect, simple or branched annual herbaceous species. Flowering is between August and November, fruiting stage is between October and March (Davis *et al.*, 1988). Plant sprouts have optimal germination ability in 10-30 °C and 4-10 soil reaction (Nakamura & Hossain, 2009). *Crassocephalum crepidioides* species are usually able to multiply by seeding, and plant members can produce about 5000 seeds per m<sup>2</sup> (URL-7, 2018). Seed germination ability decreases during the next growing season. *Crassocephalum crepidioides* taxon is mainly distributed in moist habitats, especially in artificial land (Chen *et al.*, 2009).

***Rhododendron ponticum* L.** is a woody taxon that grows naturally in Turkey and Georgia and can reach 10 m height (Stevens, 1978). The leaves are evergreen, leathery, full-sided, wide obovate or elliptical. The purple-pink-colored clustered flowers are open in May. *Rhododendron ponticum* are used as ornamental plants outside the natural distribution area due to their showy flowers (Spain, England, Belgium, Holland etc.) (Cross, 1975). Outside the natural spreading area, *Rhododendron ponticum* is considered as an invasive species. In addition to producing millions of small seeds every year, *Rhododendron ponticum* species also has the ability to grow fast and produce strong sprouts. (Maguire *et al.*, 2008). This plant species belongs to the worst 100 invasive species in the world with the cause of the invasive character. (URL-8, 2018). Reforestation in areas covered with *Rhododendron ponticum* is extremely difficult (Harris *et al.*, 2009). However, an important benefit of this woody species in high mountain areas is the prevention of landslides on steep slopes and deforested places.

***Robinia pseudoacacia* L.** is native the eastern coast of North America. It is a deciduous species with a limited spread here. It was first brought to Europe in 1601 by J. Robin. It is a tree in 20-25 m length. There are drooping white inflorescences which reach a length of 10-20 cm. Fruit is 5-10 cm long, flat and contains 3-10 pieces of light-brown seeds (Chamberlain, 1970). It makes its best developments well-drained soil in river beds (Cierjacks *et al.*, 2013). There is a root system that descends deep ahead, then spreads around. At the tips of their roots, there is often Mycorrhiza, which consist of bacteria that fixing free nitrogen as seen in all Fabaceae family specimens (Rice *et al.*, 2004). Black locust annually produces nearly 12 kg seeds. Germination ability of this species seeds is low due to seed dormancy (Masaka & Yamada, 2009). On the other hand, *Robinia pseudoacacia* has a powerful root and stem sprout feature that easily increases the population level in areas with plenty of light (Swamy *et al.*, 2002). So, in order to remove this species from the naturalized areas, it is necessary to remove all of the plant from the habitat. Black locust is commonly used in urban areas for ornamental purposes and in forestation areas,

preventing soil erosion and honey production.

*Ailanthus altissima* (Mill.) Swingle is a deciduous woody species and native to China. It is called “Tree of heaven”. Perennial woody up to 20-25 m. The seed is flat, located in the middle of the wing (Cullen, 1967). It is a fast-growing, short-lived tree that can survive for 40-50 years. It grows with seed or strong root and stem sprouts. *Ailanthus altissima* is a sun-loving woody plant and find suitable habitat in forest areas and ruderal areas where there is generally intervention (Wickert *et al.*, 2017). *Ailanthus altissima* species begin seed production after 4-5 years and each female individual is able to produce about 350,000 seeds per year. (Bory & Clair-Maczulajty, 1980). In addition to this strong proliferative ability, there is an allelopathic effect of *Ailanthus altissima*. This feature limits the development of natural species in the areas where Tree of heaven colonize and causes them to move away from the own environment (Small *et al.*, 2010).

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