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Review

Alien Plant Invasion: Are They Strictly Nature's Enemy and How Can We Use Their Supremacy?

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Abstract: Invasion of plant species has been considered as one of the most dangerous force in biodiversity changes and alteration of soil properties. Due to their significant impacts on ecology and the economy, it is important to find an effective approaches to manage the invasive plants expansion and utilize them as beneficial biomass sources. This review focuses on the characterization of the negative and positive features of invasive plant species in general. Most studies targeted on invasive species removal and lacked an evaluation of their potentials in modern biotechnologies. Currently, there are studies aimed at their use in soil remediation, medicine, the chemical industry, the textile industry, and even gastronomy. Based on these reviews, we bring forward possible future development in this research field, which might serve as a theoretical premise for further researches.

Keywords: invasive species; prevention of invasiveness; eradication of invaders; potentials of invaders

1. Introduction

Soil is a complex, dynamic and vitable system that can be described as the living skin of the Earth. It is an important reservoir of biodiversity and contains approximately a quarter to a third of all organisms [1]. Soil biodiversity can include organisms ranging from microscopic bacteria and nematodes to mites, millipedes, earthworms, and other macroscopic organisms. Soil biology is a relatively young field of research, and ongoing monitoring of changes in soil biodiversity is rather complicated. Current global developments, such as anthropogenic threats to soil (e.g. through intensive agriculture, the impact of biological invasions, industrial activity, etc.) and climate change, represent a burden on the proper functioning of soil [2,3]. Soil degradation is a very serious environmental problem. Nowadays, almost 60% of the ecosystems worldwide are described to be degraded and exploited unsustainably [4,5]. The activity and diversity of native communities is significantly influenced by intensive agriculture. These activities are closely connected with the cultivation of monocultures, intensive tillage and fertilization, application of phytopharmaceuticals [6], drainage activities [7], or biological invasions [8]. In many parts of worlds ecosystems, biotopes are constantly gradually degraded to a large extent mainly due to agricultural and forestry activities, transport and tourist infrastructure. Acidification, salinization, chemical contamination, invasive species, climate change and the growing ecological footprint are other factors that have an adverse effect on ecosystems [9,10]. The impact of invasive plants on soil ecosystems and natural biota has received quite a lot of attention in the recent decades. Invasive species, including plant and animal ones, often have a significant impact on the structure of natural vegetation. Scientific studies suggest, that invasive plant species change soil abiotic and biotic properties, nutrient availability, organic carbon content [11], composition of soil microflora [12] and soil mesofauna [13]. Much attention is paid to the highly vulnerable and threatened world ecosystems, which include, for example peat bogs, heaths, coastal ecosystems, etc. Therefore, it is very important to find and use methods that are highly effective, reliable and sensitive to the early detection of adverse changes in ecosystems caused by anthropogenic influences.

The main goal of this complex review was (a) to define invasive and non-native plant species, (b) to show the efficiency of different eradication approaches, and (c) to highlight the potential of using invasive plants in future research.

2. Invasive and Non-Native Plant Species

One such fundamental, but criticized concept in invasion biology is that of "non-nativeness". Biologists see species dispersal as one of the key driving forces in evolution and indeed, there is no ecological rule or norm that says anything has to stay put, and very few taxa do so [14]. Many species can be considered non-native at some point in time. Non-native species of plants (or animals) are those species that do not have a natural area of distribution in natural ecosystems and have been introduced into the territory or have spread to natural system in which they similarly do not have a natural area of distribution [15]. Most naturalized non-native plant species appear to behave ecologically like resident species, and occur at low to middle frequencies [16,17]. There is an evidence that a small portion of non-native species can become locally dominant [8], with the ability to completely change the ecosystem composition and create monocultures. These species are generally referred to as "invasive" [18]. Interestingly, some ecologists focusing on invasive species define non-nativeness as mentioning only to those species that are dispersed by humans [19,20]. Furthermore, species that are able to expand their range naturally are occasionally also designated as non-native [21]. Invasive exotic plants are considered as one of the greatest threats to the conservation of native species, communities and ecosystems [22] and require detailed and quick attention in every parts of the world [23].

It is believed that plants invasion is one of the greatest effort for modification in the terrestrial ecosystems biodiversity and nutrient cycling [24,25]. In current research, the scientific community is concerned about the impact in underground soil chemistry and biology emerging due to invasion [26,27]. Climate change present an existential and life-threating commination to global food security, ecosystems, and public health. The work by Mao et al. [28] suggested that the issue of the spread of invasions and climate change is closely related. The most fragile biotopes are those with high number of endemic species. Invasive species are expected to have the greatest impact on the biodiversity of aquatic ecosystems, especially stagnant waters, while among terrestrial ecosystems, the biodiversity of Mediterranean ecosystems is under the greatest pressure [29].

Many researchers believe that there is a strong interaction between invaders and soil biota components. For example, some invasive species advantage from the localities where they interact with fewer soil enemies compared to their native ranges. Other exotic species experience new, but relatively strong mutualistic partners that increase their invasive success [30]. Such studies are important to understand the long-term impact of invasion on terrestrial native vegetation and other biological components as biology and soils are inseparable with each other. Currently, the number of invasive plant species and their rate of spread are increasing in many parts of the world. It is clear, that invasive plant and animal species have also spread on the ice-free Antarctic islands despite the Antarctica Treaty [31]. Invasive species also threaten very rare ecosystems, such as wetlands. Many of these species have been introduced into terrestrial and aquatic ecosystems accidentally (e.g., in water ballast, in soil, or as crop seed "contaminants"), but some have been intentionally introduced as ornamentals, food, or fiber products [32].

3. The Global Threat of the Plant Invaders Presence

Native plants can act as sink for air pollutants and contribute significantly to carbon sequestration [33,34]. Invasive species are amongst the most significant drivers of species extinction and ecosystem degradation, causing negative impacts on ecosystem services and human well-being

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[35]. Therefore, loss of native plant diversity through invasive plant pathogens may indirectly affect human health through perturbations in the environmental quality [36]. There are many cases over the world of devastating effects of invasive species on ecosystems and these dramatic invasions emphasize that invaders often parallel environmental changes that are taking place at the regional scale [32]. Exotic species (weeds, pests, parasites) significantly affect the agriculture and forest activities due to their economic productivity. Much research has focused on studying the impact of the spread of invasive species on natural biodiversity and ecosystem functions [37,38]. According to these studies, it is clear that invasive species cause a threat to natural biodiversity, ecosystem services, environmental quality and human health.

Exotic species significantly influence soil biota. They had a very strong impact on diversity and abundance of wild pollinator [39] and ants [40]. The study of Baranová et al. [41] showed significant changes in *Coleoptera* families and *Carabidae* groups, but not necessarily reduction in their diversity. Very important group of soil biota are soil nematodes. Due to their abundance, diversity, and trophic structure [42] are often used as useful bioindicators of soil conditions [43]. Significant changes in nematode diversity, community composition and trophic composition were also observed in several studies [13,44]. Soil microbial communities play important roles in soil nutrient cycling and supplying of essential plant nutrients [45]. Soil microbiota is highly sensitive to almost all physical and biochemical changes, as well as environmental conditions [46,47]. Therefore, microbial indices are successfully used as indicators of soil quality and health, because of large surface area, reactivity, distribution and generation time. Soil microorganisms facilitate a practically very quick reaction to any environmental changes mainly because they are closely related to the adjacent environment [48,49]. Some authors [50–52] showed that increasing invasion status resulted in altered soil properties, with an overall increase in nutrient supply and enzymatic activities. They also pointed the affection in the structure of the soil microbiota that are related to cycling of the nutrients. Those significant changes in soil abiotic and biotic composition caused by some exotic species lead to positive feedbacks between the plants and soil, which is very likely to help the invaders. Contrary, there are number of studies [9,47,53] that describe a drop in diversity, abundance and activity of microbial population in soil system. Interesting is, that the same invader might differently influence the studied ecosystems [54], depending on local conditions. So sometimes, it is quite difficult to reach the simple pattern of their individual impact. Therefore, investigation on the interaction between invasion status and ecological/environmental changes is high of importance. Biological invasions (both plant and animals) are efficient of interacting with other anthropogenic changes in the environment to alter biodiversity and ecosystem processes in invaded localities. For example, there is an proof from a various of ecosystems that nitrogen inputs benefit alien plant species [55,56]. Human alteration of the N cycle, however, has increased the rate of N fixation to such an extent that human-derived N now exceeds natural processes [57].

Despite global climate changes, there are a number of plant and animal species that have adapted relatively quickly to changes in temperature and the length of the growing season [58]. There are many assumptions and questions from ecologists, whether these climate changes could favor some non-native and invasive plant species. It is obvious, that the native habitats of invasive plant and animal species are warmer, and thus would be at a great advantage [32]. Compared to natural biota, these species would tolerate extreme temperatures better, should experience lower mortality and would be able to adapt to these changes more quickly. The study by Dukes and Mooney [59] shows that a wetter climate can cause a higher concentration of several invasive plant species, which will have a negative impact on native plant and animal species. Many research activities study the effects of global environmental change on biological invasions. These studies also focus on the influence of individual environmental factors on invasion success. Plant invasions significantly change the composition of vegetation and can directly or indirectly affect ecological functions and subsequently worsen land use or environmental changes. [60].

4. Challenges in Prevention, Eradication and Control

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Success in the management of invasive plant species requires active tries to prevent new introductions, quickly detection of nascent populations and persistent efforts to eradicate the most aggressive invaders [61]. To reach these objectives we first, however, need to know (a) what kind of species we should prevent from entering the country/locality/region, (b) what kind of new species we should look for and where, and (c) which of the detected species we should potentially control or eradicate [62]. There is a general assumption that changes in land use directly increase biological invasions. The study of Wang et al. [63] suggests that conversion of natural habitats need to be controlled and well managed to help mitigate future invasion risk. It is believed that proper field monitoring and relevant sampling techniques are necessary. In addition, one of the most important point is early detection of the presence of an invasive species. Last decades, land modification have been very extensive and in most ecosystem and regions irreversible Poor and inefficient use of the soil ecosystem, which negatively affects the ecological functions and soil health, is considered to be the primary cause of soil degradation in native ecosystems [46]. The ecosystems in general, might change in their structure, composition and function. Since the presence of invasive species is in almost every landscape and biotope, their rate of spreading depends on the structure and dynamics of the landscape [64]. Eliminating the spread of invasive plants is important after understanding land use and landscape management. Many studies indicate that a high diversity of invasive plants has been recorded in altered and degraded ecosystems (post-mining sites, ruderal and anthropogenic sites). It is also clear, that changes in the composition and structure of the landscape can significantly improve the settlement of invasive species [32]. The management of biological invasions is essential, not only to maintain biological diversity and the environment, but also to protect production sectors. Some data indicate that well managed areas (for example in nature parks, protected areas) are stable and do not easily undergo invasions [65]. Some other studies, focusing on forest ecosystems, indicate that invasive species pose a significant threat. These ecosystems are relatively vulnerable and their biodiversity is threatened [66].

Management of invasive alien species includes several option that are closely connected: (a) prevention of the new introduced species, (b) eradication following introduction, (c) containment or control of invaders and (d) adaptation [67]. In past, much attention has been paid on eradication and postinvasion control. Comparatively, little efforts have been committed to the prevention measures. Nowadays, biologist emphasize the importance of such preinvasion controls, treating invasive species as a form of “biological pollution” [67–69]. One of the very effective prevention way of invasive plat spreading is environmental education. Rising public awareness is very important in ecosystem prevention related to biodiversity loss and understanding the influence of humans on nature [70]. Biological invasions have a significant impact on various features of life on Earth, and therefore require approaches that will be quick and effective. Public education and public awareness are forcefully suggested for successful prevention, elimination and management of exotic species [71]. Successful management of invasive species is needed for public to be aware and engaged to prevent new introductions and support control interventions. The study of Cordeiro et al. [72] showed that focusing of public awareness and investing in these kind of projects pays off. These activities can focus on improving the planning of invasive alien plants management strategies. We should all focus on supporting capacity building and effective mutual communication between educators and scientists. These debates should be both formal and informal, with the aim of involving the whole of society in the recognition, prevention and management of invasive species in general. The positive effect on native biota represents eradication of invasive species. Compared to the control measurement, eradication is the preferred approach. A relatively large challenge in biological invasions requires control that reduces the presence of the invasive species or limits its further spread. This tool requires a huge investment of time, tools and money to keep the attacker at bay. Another approach against invasive species is eradication, which may need large short-term investments. Successful removal of unsuitable species might be achieved within several months or years and provides the best chance to restore native biodiversity [73]. If the eradication of invasive species is successful, there is often a favorable restoration of native species and natural ecosystems, but achieving this state requires a lot of effort, time and financial support. The ecological context of

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eradication is increasingly complex. Nowadays, it is common for invasive species, that are long-term established in the system and are affected by global changes, to cause enormous damage. Almost all countries of the world are trying to prepare action plans in the field of the environment, which also include the problematics of biological invasions. However, despite investing in standard tools for the eradication of non-native species, such as poisons, mechanical interventions, efficiency may not be achieved for the complete restoration of native ecosystems [74]. The elimination of invasive plant species is very difficult and requires systematic intervention over several years. Their effective elimination will only be possible when citizens take responsibilities and ensure the elimination of these invasive plants on their own property. In practice, the success of regulating the occurrence of invasive species is affected by proper management practices. These should be taken into account both ecological conditions of a specific location and biological properties of individual species [75]. Before the eradication, it is necessary to find out in advance some following fact: (a) natural conditions of a specific location, (b) spread of the species within the locality, i.e. surface extent of the territory, (c) abundance of the invaders, (d) their biological properties and ecological demands, (e) reproductive traits, (f) risks involved in their eradication, (g) financial burden and (h) detailed time and hierarchical sequence of eradication steps [75,76]. There are some important rules that are necessary to follow. Some authors [72,75] point that more attention in eradication should be paid on localities that are near aquatic ecosystems (especially in the upper sections, from where they tend do spread downstream). During the elimination of invasive species, it is also necessary to ensure very carefully handling the localities with seeding individuals in fertile stage. Invasive and non-native plant species must be removed in their initial stage occurrence at the site when their removal is most effective. The eradication approaches of these plant species are mainly determined by the methods of their reproduction, abundance, nature and location of the site, danger and size of the site, plant growth phase and other biological characteristics of the species. In species that are reproduced by also generative intervention, must be elimination carried out before or during the flowering of the species, essentially before the start of seed formation [77–79].

Generally, there are several approaches that are effectively (more or less) in invasive plants species eradication: (a) mechanical, (b) chemical, (c) both mechanical and chemical, (d) biological and (e) environmental [80–82]. All these methods have some advantages, but as well as limitations. Table 1 shows some examples of their individual advantages and limitations.

Table 1. Overview of the individual eradication approaches with their advantages and limits of use.

Approaches	Advantages	Limits	References
Mechanical (pulling, digging, hot steam application, plucking, grazing, plowing, cutting, mowing, mulching, foil placing, suffocation)	Practically very effective Preventing the formation of flowers, fruits and seeds Destruction of seed stock Least harmful to the environment	Small area application Very strenuous and laborious Plants often regenerate and are capable of new reproduction Not applicable in every type of ecosystems	[83–85]
Chemical (herbicides)	Large scale area application Affects the whole plant including root system	Very harmful to the environment Does not affect the soil supply of seeds Reduced effect if plants are heavily dusted Not applicable in every type of ecosystems	[83–86]
Combined (mechanical and chemical)	The most effective among listed Small and large scale application	Unrecorded	[73,85,87]

	Suitable for excessively tall and dense population		
Biological (natural invaders enemies – insects, mold, fungi)	Exploiting the potential of a natural enemy	Low efficiency The possibility of the damage, not the total elimination Insufficient research	[84,88–90]
Environmental (appropriate management of unmaintained and abandoned sites)	Well managed and maintained localities Prevention of the penetration of competitively stronger and fast-starters invaders	Appropriate use only with other effective methods	[75,86,91–93]

In practice, when removing invasive plant species, the most often used are only three of the five removal methods above: mechanical, chemical and combined. The most effective is considered the combination of mechanical and chemical approach. Mechanical (sometimes called physical) is mainly applied in case of rare or small-scale occurrence of the species on the site, or at occurrence of the species in watercourses, in water protection zones or in protected areas, where chemical or combined methods cannot be used [94]. Within this problematic, there is very interesting question that scientists have been discussing recently. Should invasive plant species be removed? This is a debate that is alive among experts, with opinions moving between two extremes. On the one hand, we can look at invasions as a natural phenomenon and not interfere, or on the other hand, we can take the view that invasive plants should be removed always and everywhere. Somewhere between these extremes is a practical approach weighing the energy put into their removal versus the result achieved [95]. Perhaps, even more interesting is the question of whether, even with the hypothetical involvement of all available resources for the removal of invasive plants, it is even possible to achieve their permanent eradication in the nature. Noticing the expanse of the spread of some invasive and non-native species in localities, some authors state that the most aggressive ones, despite any effort, will remain a permanent part of the nature [96,97]. There is a greater chance to influence whether and what other types of invasive plants will appear in the future. It is proved, that invasive species have caused many negative effects on native ecosystems, but several studies have indicated some of their positive characteristics [98,99]. In addition, invasive plants are opportunistic species and once they enter their non-native area, it is almost impossible to eradicate them completely. [100].

5. New Perspectives in Plant Invasion Research

The fact is that prolonged invasion of exotic plant species significantly alters the soil carbon and nutrient stock in terrestrial ecosystem [101]. This help invaders very effective prosperity in the region [102]. Apart of their ability to modify their local environment, they also have some advance physiological traits such as high specific leaf area [103,104], increased leaf nutrient content [105], rapid growth rate [106], higher litter decomposition rates [107] that in turn affect nutrient cycles. Contrary, there are many works that describe the opposite features of these characteristics, such as lower decomposition rates and nutrient release of litter [108]. Moreover, as mentioned before, the same plant invader might have various effect on the soil ecosystem, depending on local conditions [109]. There are also examples where invasive species were found to have contributed positively to economic, social and ecological services [99,110,111]. In some circumstances, the many positive characteristics and considerable adaptive potential of invasive plants need to be acknowledged. Because of the difficulty of the eradication approaches and the aggressively of the exotic plants to quickly colonize new ecosystems in large surface, the researchers open new questions in this problematic. Can invasive species be beneficial for wildlife? Should we be leaving invasive plants in our landscapes or eliminating them? Can we use them for our advantage? Therefore, the recent research in invasive species are also addressed to answer all these questions. Importantly, it must not be forgotten in these approaches – we absolutely do not want to preserve invasive species, but to a large extent try to eradicate them.

5.1. Phytoremediation Potential

Very serious worldwide concern is environmental degradation by contaminants. Remediation of degraded areas with heavy metals is a major global challenge. Despite the existence of a number of conventional physico-chemical approaches that can be used, these tools do not appear to be the most effective. The use of a relatively cheap "green" and sustainable technique of phytoremediation appears to be simple and unrivaled. Since the eradication of introduced invasive species in their non-native environment is very complicated, the possibility of their control appears to be very effective. This control includes the sustainable management through the method of their use in contaminant remediation, i.e. phytoremediation. Because invasive species can survive in harsh conditions and they represent huge threat for natural biodiversity, the knowledge about their ecology in polluted sites is highly important. The results of several authors [98,100,112,113] showed that invasive and non-native plants can be considered as potential phytoremediation candidates. They can easily be introduced even in severely degraded environments. Phytoremediation, as the most effective environmental restoration technology, offers sustainable management of invasive plants. Phytoremediation, which uses invasive plant species, is currently becoming more popular for its environmental friendliness and effectiveness in removing potentially toxic elements from soils [114]. On the other hand, however, this method requires large human and certain financial resources, performance can be seasonal, limits to several pollutants and creates secondary wastes after treatment [115]. Despite these negatives features, it is considered a very effective and potentially low-cost technology. Thus, there is a shift of awareness to the modification of invasive plant species into biosorbents for the decontamination of dangerous substances. There are several papers that describe the value of biochar production from invasive plants in such method [116–119]. All these authors define the negative effects of invasive plant species, their distribution, and show the high potential of biosorbents that are low-cost and biodegradable. Those substances from invasive plants have a number of functional groups that make them an ideal matter for the elimination of heavy metals, organic dyes and petroleum pollutants. The study of Nguyen et al. [112] shows lack of studies investigating these biosorbents for the treatment of many surface hazardous substances such as pharmaceutical drugs, pesticides and other organic materials. It is expected that future biotechnology research will also focus on invasive and non-native plants within these important aspects.

5.2. Natural Dyes

Natural dyes from exotic plant species may serve as reliable, nontoxic, replicable alternatives to synthetic ones [120]. This information is high of importance, because the textile-dying industry is considered to be the most environmentally polluting industry in the world [121]. Natural dyes might be easily extracted from every part of the plant like roots, leaves, fruits, seeds, or petals [122] and have many definite advantages (antibacterial activity, UV protective effects, biodegradability, etc.) [123]. Unfortunately, some limits of this technology lie in their low wash and light fastnessses and that they can only achieve limited hues, mainly yellow, reddish and brown. Therefore, more research are needed in order to keep the natural dyes vibrant, consistent and more colorfast between batches [124,125]. All these researches conclude that invasive plant species could be potentially used for worldwide sustainable environment in the creation of dyes for textile industries using simple methods.

5.3. Chemical and Pharmaceutical Potential

Some authors [126] suggest the use of invasive plant species as a source of potential substances used in pharmaceutical industry. Once available, these drugs might generate income, thus decreasing the global cost of eradication. These authors do not propose to use those invasive species in traditional medicines or phytoterapies, but it is essential to search for active substances with detailed pharmacological and toxicological studies. In addition, there are many European invasive plant species that in their native ecosystem are found to be useful in medicine for many symptoms, use in cosmetics and they also produce significant antimicrobial and antifungal compounds [127–130]. The chemistry of plants, in general, is very complicated and rely on the ability to synthetize allelopathic compounds. The significance of secondary metabolites for the invasive plant was unclear for a long time. Scientists now agree that they are important factors for survival plants, as they participate in the interaction of plants with animals, plants with each other, microorganisms and other components of the environment. Secondary metabolites serve to the plant primarily as a defense against, for example, herbivores. Defensive substances produced by plants are often very toxic. In addition, secondary metabolites also serve as a defense against insects and microorganisms. Exclusion defensive substances into the soil or air prevent the growth of other types of plants in their own immediate surroundings. We call this phenomenon allopathy [126,131,132]. The study of some authors [133,134] indicated that the high content of monoterpenes in essential oil in selected invasive plant species have an allelopatic effect and could be in practice used as biological/ecological herbicides. Recently, some scientists [135,136] reviewed the potential of exotic plants in bionanoparticles fabrication. They describe that natural compounds from invasive and non-native plant species act as decreasing and stabilizing agents for formation of bionanoparticles. The role of exotic species as major botanical sources to extract natural compounds such as piceatannol, resveratrol, and quadrangularin-A, flavonoids, and triterpenoids, which are connected tightly to the formation and application of bionanoparticles is very essential. It is expected, that bionanoparticles that are mediated from invasive plants, have revealed outstanding antibacterial, antifungal, anticancer, and antioxidant activities that could be useful in biomedical applications, therapeutic treatment and smart agriculture.

Chemical potential of many invasive plant species should be clearly developed, and even this group of species represents serious global problem, their benefits should be turned into a profitable and commercial resource. There are many studies showing biological activity of plant extracts, but so far not effective substances have been isolated that are actually used today. Therefore, the search for the active metabolites should be also the priority of the invasive plants research.

5.4. Interaction with Native Pollinators

Non-native and invasive plants interact with native species and largely influence, directly and indirectly, those species, as well as the ecological function of the whole ecosystems [137]. Very usable are mutualisms interactions with native pollinators and sometimes are these interactions necessary for the reproductive success of the invader. Despite the assumption that invasive plants have generally negative impacts in native pollinators, there is not a significant evidence to support this premise [22]. On the other hand, invasive plants are widely reported as potential cause of bee reduction [138,139], but their impact on bee population endures rather unclear and controversial. The study of Drossart et al. [140] suggests that common generalist bumble bees might not always suffer from plant invasions, depending on their behavioral plasticity and nutritional requirements. Several studies also showed higher abundance of bee population in transects and their visit rate and seed production of invasive plants [141,142]. Competition for pollination might be an primary factor in plant reproduction [143], but there is a need to pay attention to the effect of the growing number of invasive plant species on pollination of native species. The study of some authors [144] showed that invasive plants are able to help to sustain biological diversity by supplying a source of forage for pollinators in the urban and suburban ecosystems. This fact highlight the importance of assessment of both positive and negative roles of exotic plant species to improve biodiversity conservation.

5.5. To Eat or Not to Eat?

Turning invasive species into gourmet meals could blunt environmental and economic costs across the world. The idea of using invasive plant and animal species in gastronomy sector is not new. For example, consuming such weeds has been known previously for many purposes, including as a good food source given their ubiquity and abundance [145]. Human consumption of invaders is considered as a way control invasive species that can significantly affect their population. There are several initiatives, campaigns and web sites that suggest harvest strategies and recipes for common invasive plants of the region [146]. In the early twenty-first century, conservation biologist Joe Roman introduces the tem "Invasivorism", i.e. the use of invasive species in gastronomy as one of the tool to reduce their abundance [147]. A great advantage of this gastronomic use is also the increasing of public awareness of these non-native and invasive species and potentially help detect new populations. In addition, there is an evidence that human might reduce population size (when is low) of some invasive species by eating them. Programs based on elimination of invaders are effective to other approaches, such as mechanical removal of invasive plants, generating stronger combined effect [146,148,149]. At this point, it is very important to point out that it is necessary to pay great attention to the residues after using the invasive plants for such purposes. These residues must be boiled (or otherwise denatured) and only then thrown in the bin or composted to prevent further unwanted spread.

6. Conclusions

Plant invasions are an ever evolving process that is occurring on a large scale around the world today. According to the already mentioned information, it is very complicated to destroy them permanently in the country once they occur. And that is why a lot of attention is paid to their control and use of beneficial possibilities for humans. Our review suggest that the role of non-native and invasive plants in native communities needs to be reconsidered, and this should include their potential as sources of feed for native pollinators, in soil recovery, in medicine, in different kinds of industry and even in gastronomy. Efficient evaluation of the role of non-native and invasive plants in complex environment can contribute to the process of ecosystem restoration. For example, if exotic species support native populations as food sources, it is important to replace them rather than remove them. Future studies of the effects of non-native and invasive plants control and using on biodiversity and ecosystem services of different types of ecosystems are necessary.

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