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[1.] András DEMETER, [2.]Dávid SARLÓS, [3.]Julianna SKUTAI, [4.] Imre TIRCZKA, [5.]Gábor ÓNODI, [6.]Szilárd CZÓBEL

ECONOMIC VALUATION OF BLACK LOCUST AND TREE OF HEAVEN

[1,6.]Szent István University, MKK, Department of Landscape Ecology, H–2100 Gödöllő, HUNGARY
[2–5.] Szent István Egyetem, MKK, Natureand LandscapeInstitute, H–2100 Gödöllő, HUNGARY

Abstract: The spreading of invasive species causes serious economic and environmental problems nowadays. The recognition of these negative effects, understanding, and protection against them are based on estimates, assessing the size of the damage. Black locust (Robinia pseudoacacia L.) and tree of heaven (Ailanthus altissima Mill.) are widespread and extremely dangerous woody–stemmed plant species in Hungary. In our research we analyzed economic potential and cost of repel of the above mentioned species and items of these. During the data collection we sent thematically compiled questionnaire to the relevant state institutions (national park directorates and state forest companies). In addition, other publicly available background information was collected and telephone interviews were carried out as complement of data. Questionnaires concerned items of income and expense (15 items) in aspect of the analyzed species for the 2009–2013 period. A significant number of incoming data came from national park directorates, but vast majority of the state forest companies did not give information despite of multiple requests. During evaluation of data, we found that costs of black locust reduction were so high (sometimes hundreds of millions of HUF) that those could not be compensated by revenue from the sale. However, in the case of the state forest companies, incomes were several times bigger than costs in each year. Judgment of tree of heaven was negative in all areas. They could not be sold, so no revenue was derived from their presence, but reduction was very expensive.
Keywords: bioeconomic study, invasive plant, black locust, tree of heaven

1. INTRODUCTION

Nature conservation is getting more and more emphatic nowadays, and so the problems related to invasive species.The European Union council of ministers is currently working on a list that is about invasive species to exclude or repel.

Abroad have been quite a few studies have dealt with the economic implications of invasive species issues.

The study of PIMENTEL et al (2005) was based on economic analyzes related to invasive species on the US territory. They found that the non–native, aggressively spreading species caused significant environmental damage and losses, which amounted to nearly $ 120 billion a year.

Another research was also carried out in the territory of the United States (DITOMASO 2000), which had the subject of pasture–infectious invasive plant species. DiTomaso estimated the field weed related annual losses of $ 2 billion in the States.

Another group presented a quantitative bio–economic framework model, which they can use to carry out a comprehensive risk assessment of invasive species, and methods of protection against them in relation to the environment (Leung et al., 2002).

Similar researches can help to uncover and understand the ecological and economic consequences of the spread of these species. In our country does not currently have a comprehensive data that would lead to the conclusion about the spread and injury cash value of invasive species (HARASZTHY 2013). There wasn't a similar research in this topic in Hungary.

Black locust and tree of heaven are common invasive species in Hungary. The former got a lot of media attention in last year and now – as a result of the acacia coalition' action – it is declared Hungaricum (http1). This was due to its expansion and its forest– and apiary–related economic benefits. However its expansion is unwanted in many areas, and prevention consumes significant amounts of money.

Today, black locust has the largest area of tree species in Hungary. Reforestation of the country – starting in 1949 – gave a big boost to its expansion. Its 1–2 % area ratio went up to more than 22 % in just 100 years. The national success of black locust are due to its resilience and good usability. It is an excellent plantation species, which is easy to install and be grown. It grows so fast it becomes mature in 30–35 years, therefore it can be sold relatively soon. Through its vegetative recurring capability it requires minimal care and financial investment. (BARTHA et al. 2006).

In addition, it can tolerate chewing damage of wild animals relatively well, so its install can be more succesfull than other tree species (REMÉNYFY 2014).

The black locust wood is valuable, because it is hard and durable. It can be used for many things like pillar, parquet production or supporting structures, but is is also suitable for chipboard– and fiberboard production. Due to its density and high calorific value it is perfect for firewood too (BARTHA et al. 2006).

Its expanded root–system can absorb also weak–structured soils, and it can live on poor, drier areas. Because of this characteristics, black locust is suitable for re–cultivating raw soils, and for reforesting landfills and waste dumps (BARTHA et al. 2006).

Its presence is important for not just the forestry but also for another industry. Due to its excellent honey quality and great area, this species gives the base of the national honey production. Half of the sold honey is acacia (BARTHA et al. 2006).

According to Attila Borovics – director of Forest Research Institute of National Agricultural Research and Innovation Centre – the total value of the hungarian black locust stocks is approximately Ft 500 billion (VEREB 2014).

Black locust can be grown on more than 100 types of habitat in Hungary, which illustrates well the ability to find its life conditions widely. Its sprouting ability, strong vegetative reproduction and 50 years viable seed bank make it almost unable to be eradicated from those places where it already was settled once. Currently it has stock on more than 380 thousands hectares, but in addition it has presence in also other places like in smaller forestations, tree groups, and beside of roads and railways. This means it can get to almost anywhere or has already gotten (BARTHA et al. 2006).

According to Landscape Ecological Vegetation Database & Map of Hungary today 200 000 hectares semi–natural vegetation is infected, and from this, 33 000 hectares is damaged by black locust. In addition, it is spreading in the 60 % of our specially valuable oak–steppe (SZMORAD & TÍMÁR 2014).

It occupies more and more places also in our Central Mountains, since its original habitat extends up to the height of 1500 m above sea level. So the seeds of black locust already got to the significant part of the country. Phisical soil disturbance – like agricultural machine use – can bring them up to the soil surface, transport the seeds, or – as direct or indirect ground–fires – can destruct their hard husk, which helps them germinate.

Black locust largly transforms its habitat, thus reducing species diversity of the area. With its powerful evaporation and nitrogen enrichment effect, it can displace less tolerant plant species with the connected animal species from their original habitat (BARTHA et al. 2006).

Tree of heaven is a similarly agressive species, that appears mostly on opened, disturbed soil surfaces, and its continuous expansion can be observed in our country.From the presence of this species – unlike to black locust – no profit is realized, because its wood are not useful, generally classified as worthless.

Ailanthus altissima (Mill.) spreads mostly from populated areas along the roads in Hungary. It can settle more easily on disturbed soil surfaces thus endangering also valuable plant communities (e.g. on sand of Kiskunság, on Torna–karst, or on Szársomlyó) (UDVARDY 2004).On those areas where tree of heaven appears and proliferates, the original vegetation deteriorates and transforms. This occurs first because of dissolvent allelopathic compounds of the roots, later increasing shield effect, than the big amount of fallen and degraded leaves causes nitrogen enrichment in the soil. Nitrofil, disturbance–tolerant, shade–loving plant species appear mostly in those populations (UDVARDY 2004).

So tree of heaven is subject to negative conservation perceptions, as it can displace our valuable plant species, damage our natural– and semi–natural plant communities, and can decrease biodiversity.

Due to its nature and strong sprouting ability it is one of our hardest to eradicate in Hungary.Fast–absorb herbicide injection to the vascular tissues is proved to be a good solution.In order to increase the efficiency and for the protection of other species, must close the wounds of the treated plants when using strong chemicals.

Planting of native tree species to the place of exterminated Ailanthus stock can be a good solution in longer term, as the closed plant–stock already can prevent the re–strenghtening of tree of heaven (UDVARDY 2004).

Due to actuality of the previously discussed negative effects, we thought it useful to choose a research topic that deals with the mentioned species.

Our goals were, collecting and evaluating data from what we can conclude Hungarian territorial distribution, economic benefits, area size, economic value, suppression costs – where it is needed – and elements of the latter, related to black locust and tree of heaven. In addition, we planned to do national economic benefit and suppression cost estimate of the studied species.

2. MATERIALS AND METHODS – Datacollection

We wanted to get the necessary data from mostly national park directorates and state forest companies counting on their objective attitude and accurate documentation. Although a significant portion of the forest land is owned by private forest owners, is was not possible to ask them due to their big number and in default of their contact.

We needed information from what we could conclude economic value, spread, judgment and suppression cost of this two invasive species. Accordingly, we compiled an Excel–based questionnaire, including different sources of income and expenses itemized

regarding the last 5 years. Data of several years may give a better overview of the processes direction and extent of the changes. The questionnaires were sent via email as an attachment to the 10 national park services, and the 22 state forest companies. Finally we did not get considerable feedback, and appropriate amounts of information for over several months either. Because of this, we sent a simplified questionnaire to the competents, hoping they will fill it out with more pleasure.

As a result of the second request, we got more response, and our dataset expanded.

The need for expansion of datasets with regional values became clear with the received data.

With these informations we can calculate economic benefits and suppression costs of the studied species per hectare. Therefore we tried to get these regional informations– aboutthe relevant species – from the helpful national park directorates and state forest companies via email for first, and then by phone.

Beside correspondence, data found on internet were also collected. National park directorates

For national park directorates mostly utilization of tender sources – especially Environment and Energy Operational Programme–, and for state forest companies mainly regional and species ratio data could be found on their webpages.

3. DATA PROCESSING

Received and collected data were stored and processed in Microsoft Excel, and the two species were always treated separately.

First we summerized reactions of national park directorates and state forest companies to our request separately. These reactions were classified to these simplified categories:

- table filled ot;
- given textual information;
- or did not provide data.

The number of responses to the above mentioned categories was compared to the number of addressees receiving their % of the distribution. It was done in respect of national park directorates and state forest companies separately. The gotten values of % were also represented on diagram.

To show the results, we used also bar charts, and data – like incomes and costs – wereshown mostly with the related periods. Calculating the incomes and costs per unit area seemed to be useful, but with the exception of National Park Directorate of Hortobágy, we did not get the sent questionnaire–related values about any region.

However we got informations of eradicational costs – what were financed by Environment and Energy Operational Programme tender sources – from several national park directorates. With these data, we could calculate costs – unlikely the incomes – perarea unit.

Related to the spreading area of black locust we received almost no data. In case of the tree of heaven we got no data at all.

The earlier mentioned data were to be found exclusively on the web page of the state forest companies.

4. RESULTS

As you can see, at the diagrams, most of the National Park Directorates replied. Moreover they provided us with useful information. On the other hand, most of the state forest companies did not react to our request. Our first, more detailed chart, unfortunatelly in despite of the helpful answers, was filled out by none of them totally. That is why the usable data was uncomplete. Out of the responding national park directorates, the National Park Directorate of Kiskunság was outstanding, where from a significant amount of useful data arrived. A diagram was made out of this data, which shows us the extermination of the invasive species located at national park directorates, financed by the tender sources, and the destribution of cost (figure 2), in a period of 5 years.

The directorate spent most of the money on the eradication of Black Locust (figure 2).

In the Environment and Energy Operational Programme, the chemical eradication of the species is made by Ft 456,3 million in the period of 2010–2015, with the affected area of 346,45 hectares. According to the report – made by the national park direcotrate –, the amount of money is 42 % of the total source of the Environment and Energy Operational Programme. Looking at the costs, at the second place is milkweed, followed by our other studied species the tree of heaven. Latter is eradicated by Environment and Energy Operational Programme and Public Works Programme by the expense of Ft 142,1 million from the area of 249,48 hectares in 2009–2015. According to the earlier mentioned riport this amount takes 13% of the total source provided by the Environment and Energy Operational Programme. The other eradicated species, in decreasing order of the cost: desert false indigo, green ash and box elder, silver berry and European goldenrod.

Therefore, the National Park Directorate requested support for the suppression of 8 invasive plant species, being the most dangerous the black locust, milkweed and tree of heaven, according to the costs.

Looking at the incomes, the state forest companies were in much better financial status. With 4 times bigger values compared to the national park directorates (figure 3) However the expenses of the latter were almost 3 times bigger than the state forest companies. This result is not so surprising, since the state forest companies usually have closed forest stocks, where it is harder for

invasive species to get in and get stronger. However, the black locust is installed on many areas, and instead of its expensive eradication it is lumbered in age of mature, what gives the state forest companies great financial advantage. Opposed to this, the national park directorates manage less with this species. They cannot wait the black locust to get mature giving them bigger profit, because it can endanger the protected areas and ecological systems.

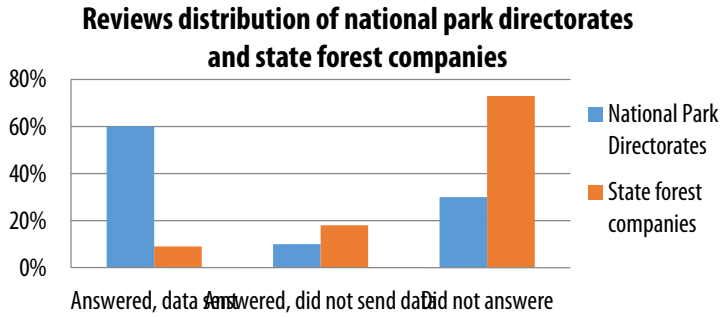

Figure 1. Reviews distribution of national park directorates and state forest companies

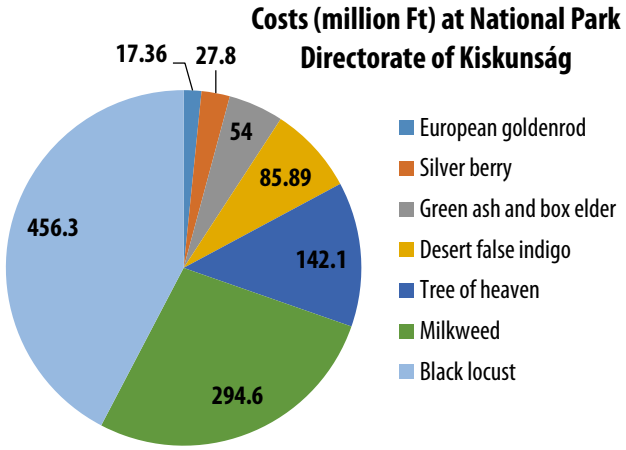

Figure 2. Distribution of eradicationed plant species and costs in Kiskunsági National Park Directorate (2009–2013)

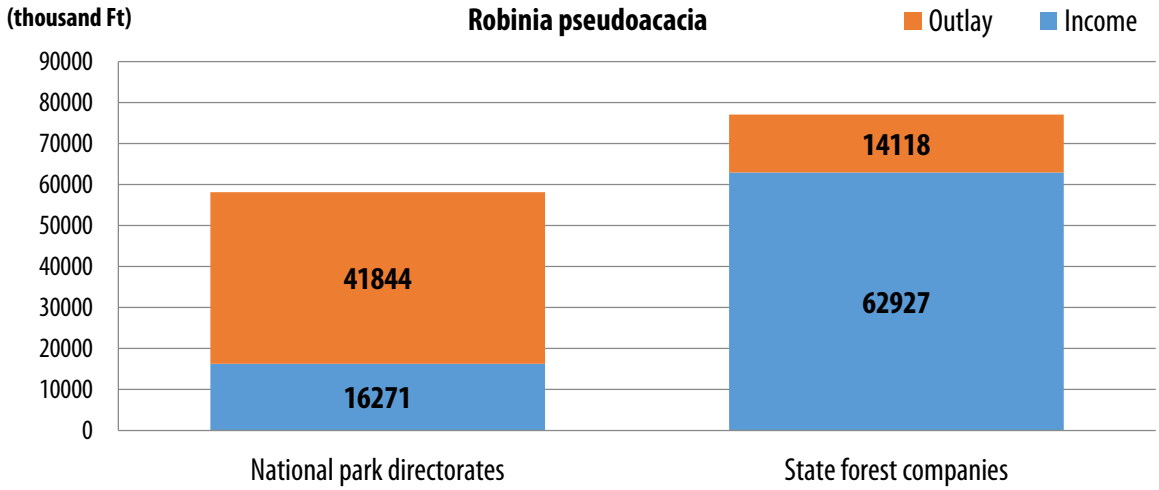

Figure 3. Overall black locust related average income and outlay in the national park directorates and state forest companies between 2009 and 2013

That is why instead of the greatly refundable lumbering they have to do the more complex and expensive supression.

The main difference comes basically from that how wanted the species is, and how it can be kept under control on the area. It is not included on the earlier shown diagram, but needs to be noticed that the National Park Directorate of Kiskunság spent Ft 450 million on the supression of black locust on its own in the last 5 years.

Because of insufficient data, the value of income/outlay could be added by regional data only in case of National Park Directorate of Hortobágy so incomes/hectares could be calculated only from this. As conclusion of the received informations we got Ft 840 081income per hectares.

There was insufficient data providied by the other national park directorates and state forest companies to calculate this value. Only National Park Directorate of Körös–Maros alone mentioned that their income did not exceed Ft 1,5 million per hectares.

The outlay per hectares and eradication costs could be calculated from more type of data. The chart – filled out by the National Park Directorate of Hortobágy–, and costs of suppression – came from Natonal Park Directorates of Kiskunság and Bükk – and regional data were available for this calculation.

As summarization of the data we calculated Ft 1 215 480 outlay per hectares, that more than exceeds the income per hectares mentioned in the previous thread.

According to the answers, tree of heaven was negatively judged on every area. Its large–scale spreading causes problems on almost every area.

The state forest companies – partly because of the quality of its wood – cannot sell it, but its eradication means plus expanses during the cleaning work.

The appearance in opened plant association and aggressive spreading of this species cause bigger and bigger damages at national park directorates. According to the received data, the suppression of this species is the most expensive at National Park Directorate of Kiskunság, as they spent more than Ft 140 million for this reason. Their expenses per hectares – as regards this species – were approximately Ft 569 584.

DISCUSSION

Our data collection was based on questionnaire survey sent to the HungarianNational Park directorates and state forest companies (a total of 32 institutions). Three months elapsed between the detailed and simplified questionnaire were sent. However, more than half of the surveyed institutions did not answer in any form. The small number of and incomplete questionnaires provided a few appreciable and well comparable data for the black locust. We received even less information about tree of heaven.

For this reason, we tried to get more information on websites of the relevant institutions, but most of them had not transparent, systematic data.

Therefore, comparison and evaluate of the values proved to be difficult.

The received and collected data were usually summarized in the form of charts and diagrams.

Due to the complexity of these data, we could come only to partial conclusion, and usually could not compare them.

The results seem to prove that suppression of black locust costs a huge sum of money on those areas where it is unwanted (e.g. the National Park Directorate of Kiskunság spent more than Ft 450 million just for suppression of this species in the studied period. At the areas treated by national park directorate's outlay is usually bigger than income. As a contrast, at state forest companies income is more significant. Tree of heaven is negatively judged on each areas, its suppression costs Ft 100 million.

Spontaneous emergence and expansion of the studied species can be expected. To avoid this and for planning and ending of a potent intervention estimated data on regional level would be needed. Transparent budget elicitation of state forest companies and national park directorates would also be important in unified and comprehensible form to support further researches.

Our research can be a base of a national–scale, realistic data–based, reliable cost estimate for suppression of invasive species, which already exists in many countries. In the future similar, complex researches can help to explore and understand negative – nature conservational – and for some species positive – financial – effects of invasive species. During the collection of data we were warned of other, dangerously spreading plant species. Those invasive species mentioned in the report of Environment and Energy Operational Programme sent by National Park Directorate of Kiskunság are the remarkable ones, since their suppression cost millions. Continuing of similar researches on a larger scale with in regards of the previously mentioned species would also be useful.

Acknowledgement

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