



SOCIO-ECONOMIC BENEFITS OF NATURA 2000

■

CASE STUDY ON THE ECOSYSTEM SERVICES PROVIDED BY BIAŁOWIEŻA FOREST (POLAND)

Output of the EC project

Financing Natura 2000: Cost estimate and benefits of Natura 2000

Contract No.: 070307/2007/484403/MAR/B2

Olimpia Pabian*, Bogdan Jaroszewicz**

* Polish Society for the Protection of Birds OTOP

** Geobotanical Station of University of Warsaw



Citation and disclaimer

This report should be quoted as follows: Pabian O., Jaroszewicz B. 2009. Assessing Socio-economic Benefits of Natura 2000 – a Case Study on the ecosystem service provided by Białowieża Forest. Output of the project Financing Natura 2000: Cost estimate and benefits of Natura 2000 (Contract No.: 070307/2007/484403/MAR/B2). 69pp.

TABLE OF CONTENTS

EXECUTIVE SUMMARY	4
1. INTRODUCTION	6
1.1. Description of Natura 2000 Site PLC 200004 ‘Białowieża Forest’	6
1.2. Why is the site of socio-economic importance?	9
2. SOCIO-ECONOMIC BENEFITS OF THE BIAŁOWIEŻA FOREST	10
2.1. Overview of site’s socio-economic benefits	10
2.2. Detailed valuation of different benefits	21
3. STATUS & FUTURE TRENDS OF DIFFERENT BENEFITS	61
4. KEY MESSAGES FOR THE FUTURE MANAGEMENT OF THE SITE	62
4.1. The most important benefits provided by Site	62
4.2. Benefits in danger	63
4.3. Ecosystems services with potential to increase their importance	63
4.4. Can identified benefits be sustainably managed and promoted? What are the trade-offs between them?	64
4.5. Possible implications in the wider context of Natura 2000 Network	65
4.6. Suggestions of future actions	65
4.7. Conclusions	66

EXECUTIVE SUMMARY

Natura 2000 Site PLC 200004 '*Puszcza Białowieska*' ('Białowieża Forest') consists of a relict of primeval forest which used to dominate this part of Europe. A large proportion of old trees and the presence of many fungi, dead wood dependent invertebrates, as well as the fact that the area has never been cleared gives the site an outstanding character. Most of the area is covered by mixed deciduous forests, with dominating oak-lime-hornbeam deciduous forest *Tilio-Carpinetum* – a natural habitat of Community interest.

The development of the region for close to 90 years has been supported by the Białowieża National Park. The nomination of the Białowieża Forest as a Natura 2000 site in 2004 was the next step in its evolution. While the site has always been important for nature conservation – designation has led to the prospects of better management around an ecosystems approach. Designation has also enabled the authorities to access funds for sustainable development and better nature conservation. Designation has brought new possibilities to the region and the Network needs promotion and better understanding by all stakeholders. Assessing the range of human benefits supported by the forest can help with this process.

Most of the ecosystem services (i.e. different goods and services provided by ecosystems, such as provisioning of biodiversity resources, regulation of water and climate, and mitigation of natural hazards) the site provides are in good status. Their importance in the future is likely to increase due to development of tourism as an alternative to timber extraction. The most controversial potential benefits provided by the site are the future possibilities for continued timber extraction. This benefit decreases the potential possibilities of future development of other services at the site. Therefore, in order to continue, timber extraction needs to be carried out on sustainable basis and take into consideration the maintenance of the other important benefits the site provides. Currently timber extraction is estimated to be worth **€6 million** per annum. This contrasts with a willingness to pay study on visitors to the forest, which estimated a value, which we assume to include all the recreational, amenity and existence type values, to be **€4 billion**.

Most of the ecosystem services identified in this study provide benefits for local communities. Tourism is clearly an important service already with **€100,000** paid in entrance fees annually, **€100,000** for hunting licences and **€150,000** for horse riding. Provisioning services are also important with the annual value of mushrooms and honey extracted estimated at **€180,000** and **€100,000** respectively. Some benefits that are much harder to value, particularly the sites regulatory services, have a much wider array of potential beneficiaries. Exploiting the benefits to local communities is important to garner support for the idea of Natura 2000 while demonstrating the broader benefits can still be important for site management.

Recognition and support of the Natura 2000 network by local communities will not be possible without more complex and resource intensive monetary valuation of ecosystem services in the future. To date many beneficiaries do not actually see any

connection between income generated by their enterprises and ecosystem services provided by a site.

All decisions considering commercial use of goods from the Natura 2000 site should take into account the broader array of services delivered by the site. Failing to do so may mean that some, like timber, are prioritised at the expense of more valuable ones. Understanding the range of services is fundamental to informing land and resource use choices at the site.

The most important action to undertake at the site as soon as possible is development and implementation of the site's management plan. This management plan should take into consideration the insights gained on the ecosystem services provided by the site (e.g. in the context of this case study) and the potential to develop sustainable income streams around them. This could help to identify solutions that would both benefit the site's conservation goals and take into consideration the broader socio-economic significance of the site.

1. INTRODUCTION

1.1. Description of Natura 2000 Site 'Białowieża Forest'



© Andrzej Keczyński

The 'Białowieża Forest' Natura 2000 site includes an overlapping Special Protection Area and Special Area of Conservation. The sites fully overlap and their total area is 62,997ha. Most of the land inside of the Natura 2000 Site limits belongs to the state (94.5 per cent) and is administered by Białowieża National Park (10517.27 ha) and State Forests Districts: Białowieża (12588 ha), Browsk (20385 ha), Hajnówka (196652 ha). The rest (5.5 per cent) of the site consists of lands owned by local communities and many private owners. 93.8 per cent of the area is covered by forest ecosystems with only 16 large clearings (6.2 per cent of total site area), including the largest one – Białowieża glade with the area of 13.8 km².



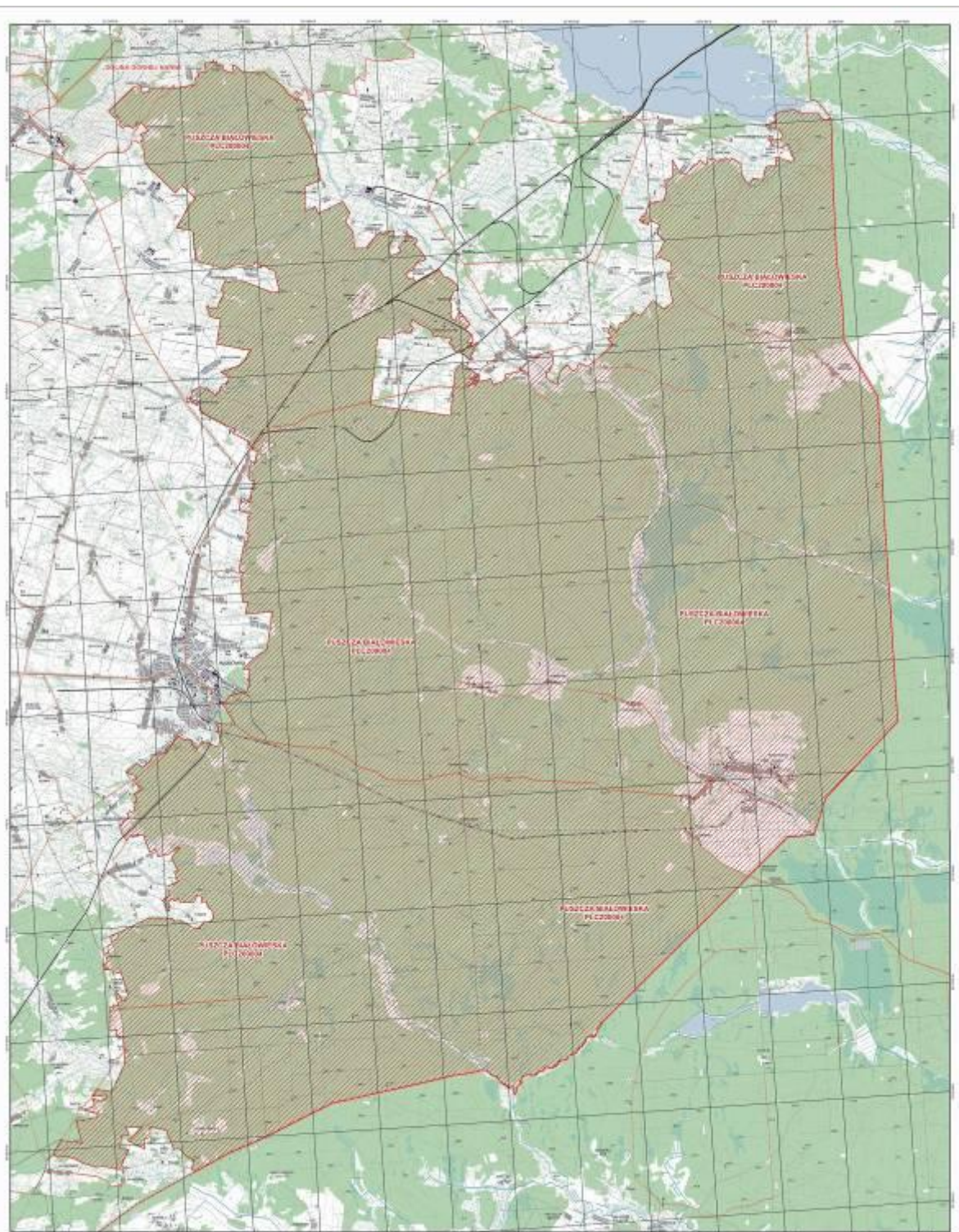
© Andrzej Keczyński

The Białowieża Forest is a relict of primeval forest which dominated this part of Europe in past. A large share of old trees, the presence of many dead wood dependent invertebrates and the fact that the area has never been cleared of the forest gives to site an outstanding character. Most of the area is covered by deciduous forest developed on fertile brown and podsol soils. A large share of the area is covered by natural habitats of community interest: east European oak-hornbeam-linden mixed deciduous forest *Tilio-Carpinetum*. River and stream valleys with organic soils are covered by ash-alder along stream forests *Cireceao-Alnetum*, and peatbogs are overgrown by subboreal spruce forests, subboreal birch bog forests, and pine bog forests. Xerothermic mixed and oak forests are characteristic for drier sandy soils. On their edges quite often develop xerothermic grasslands with rare and protected plant species.



The following species listed in Annex II to Habitat Directive have been given local priority in nature conservation: saproxylic beetles, European bison, scarce fritillary and birds typical for boreal forest ecosystem: white-backed woodpecker, three-toed woodpecker, and some owls. For these species, the most important issue is the maintenance (and in some fragments restoration) of natural forests, which should be the prevailing activity within the site's limits.

© Andrzej Keczyński



Source: natura2000.mos.gov.pl/natura2000

Map of the Białowieża Forest Natura 2000 site PLC 200004

1.2. Why is the site of socio-economic importance?

The aim of Natura 2000 network of protected areas is to stop the decline of Europe's biodiversity. They also **preserve natural resources essential to people's social and economic wellbeing** such as drinking water, fisheries and forests. Properly managed Natura 2000 sites are mostly multi-functional in nature, helping to promote diversity in often economically remote areas through direct and indirect spending. In addition, Natura 2000 sites **can be economic engines**. They frequently support jobs and livelihoods. Wildlife and nature oriented tourism, for example, is already an important and growing activity in the region. Tourist spending provides support to regional businesses, even those not directly involved in tourist service: shops, small bakeries, transport, mailing companies, health sector, and many others.

There are a few thousand jobs directly related to the protection of the environment (national parks, landscape parks, etc.) in Poland, with such employment expected to increase. The national park, with 110 employees, is one of the largest employers in the Białowieża community.

Natura 2000 sites provide the settings for healthy outdoor activities. The sites provide a public facility that plays an important role in a reduction of public health burdens through encouragement of physical activity and mental wellbeing. Protected areas also bring tremendous cultural, ecological, spiritual, and scientific benefits to society. Białowieża – a village inhabited by approximately 2,500 citizens, and with several festivals, concerts, ecological events each year, is a good example of that. Exploring protected areas offers not only the opportunity to understand nature but also for exercise and education.

Implementation in the Białowieża region of the Life+ project “Land of the bison” proved that Natura 2000 network has potential to attract more European funding to maximize the socio-economic benefits of the sites. Promoting protection of the European bison and Natura 2000 designations, encouraged partnerships between landowners and local communities, encouraging investment, and the number of visitors.

Development of the Białowieża region for close to 90 years has been strongly supported by the existence of the Białowieża National Park (founded in 1921). This encouraged local communities to develop its touristic potential based around the royal and tsars' former hunting grounds. In 1926 the National Park brought back bison – the species had been wiped out during First World War. The fame of the forest is tightly associated with this species and the process of its re-introduction and, together with The unmanaged nature of the forests are core reasons for the millions of people visiting the region. The Białowieża Forest is recognized worldwide becoming a Biosphere Reserve in 1997 (in 2005 expanded to cover the whole Białowieża Forest). In 1979 it was inscribed on the list of UNESCO World Heritage Sites (in 1992 expanded to adjacent part of Belarussian National Park ‘Belovezhskaya Pushcha’), in 1997 it was awarded by European Council Diploma for protected areas (reissued in 2002, suspended in 2007). In this context nomination of the Białowieża Forest to the Natura 2000 network in 2004 was natural and inevitable.

Designation has also brought added value to the Białowieża Forest site. For the first time the whole area has been covered by one protected area designation. It gives hope for improvement of the forest management and arrangement of protected areas management within the Białowieża area. There are 22 nature reserve type designations present in Białowieża Forest. Almost none have management plans. Establishment of Natura 2000 site provides a chance for a better management of the whole forest and establishes an ecosystem approach to its protection. For the first time it has a status strong enough to influence local spatial management plans, assuring that further infrastructure development respects nature.

Białowieża Forest as a 'living biological laboratory' attracts scientists from around the world which, in turn, supports local socio-economic development. The knowledge gathered by generations of scientists, about the uniqueness of this forest is a very important argument in applications, by local communities and institutions, for external funds or specialized economic resources (e.g. Life+). Natura 2000 has brought to the region new possibilities and deserves better promotion and understanding by all stakeholders

However, the idea of the Natura 2000 network, is not well recognized in Poland yet. Poland joined the EU in May 2004 but most citizens still associate this network with bans, limitations and barriers on economic development. There are not to many decision-makers who understand the advantages connected to the Natura 2000 program. The idea still needs to be promoted and any documents showing its benefits are of high importance in the process of public education. It is hoped that this case study can help to raise awareness on the variety of socio-economic benefits provided by the Natura 2000 Network and its sites.

2. SOCIO-ECONOMIC BENEFITS OF THE BIAŁOWIEŻA FOREST

2.1. Overview of site's socio-economic benefits

There is large number of services provided by Białowieża Forest:

Food

The most important forest goods collected in the Forest are: **mushrooms, berries, and game**. Most of them are collected by local inhabitants for their own needs. Some surplus is sold to food processing companies and local restaurants. This service has potential for further development. Agriculture has declined steeply in the area over the last 20 years. Traditional agricultural activities have been replaced by the maintenance of small fruit-vegetable gardens with eco-friendly products, important for local B&B owners. The only traditional agricultural activity is apiculture, which has developed local honey 'Lipiec Białowieski'.

Timber

One of the most important current benefits of the Białowieża Forest Natura 2000 site is **timber**. This benefit is not sustainable and currently brings high benefits to a narrow group of people. Timber is mostly sold outside the region.

Fuel

Firewood extraction plays an important role in benefits provided by the Forest. This benefit was highlighted, as the status of the Białowieża Forest changed, e.g. plans for extension of the Białowieża National Park to the entire Białowieża Forest takes into consideration the need to provide firewood to meet local needs (within sustainable limits).

Natural medicines

This benefit currently makes a small contribution to local income, but has huge potential. Currently only a few medium size companies use forest goods to produce herbal teas, juices, or dry forest fruits as a component of natural medicine.

Water provisioning and regulation

Water benefits are secured and in good condition. The importance of water provision may increase in the future if visitor numbers increase. In addition, forest cover and riparian vegetation regulate surface water run-off in the locality of the forest. This benefit may become more important with accelerating climate change. This benefit is connected to aquifer recharge.

Ecotourism & recreation

The best developed benefit within the boundary of the site. Successful development of tourism has a long local tradition and is based on the conservation of the Forest habitat, the presence of European bison and the existence of the Białowieża National Park. Tourism development in Białowieża started in 1921, when Polish government established “Nadlesnictwo Rezerwat” – the forerunner of the Białowieża National Park. Since then the Forest has been open to the public (previously entering of the forest was possible only with a permit from tsar’s administration). Some tourist infrastructure has been built: tourist trails, accommodation (initially owned by the national park but later also of private owners), guidebooks, Nature Museum, European bison reserve, training of guides, etc.

At the beginning of 1990s Polish NGOs and scientists started campaign for the national park, to cover the whole Białowieża Forest. Since then many initiatives and programs supporting local communities and their sustainable development has been launched.

To date however, tourism has been developing unevenly. Most investments and benefits accrue to Białowieża rather than adjacent areas. Only the Białowieża village community has direct contact with the area protected in the National Park. The chance for more equal distribution of benefits should be taken as the Park expands to the whole area of the Białowieża Forest. The process of national park development itself, generates benefits for all communities, as they are offered funds for development of education centres, tourism trails, and so on.

Education, art & research

Białowieża Forest is one of Europe’s biggest and most amazing natural laboratories. Scientists from around the world carry out scientific research. Białowieża village has become a strong and modern scientific centre with three scientific institutes: the Mammal Research Institute of the Polish Academy of Science, the Geobotanical Station of the University of Warsaw and Natural Forests Laboratory of the Forest

Research Institute. There are also two education centres. The national park runs a Museum and Bison Reserve with highly educated staff and a good level of nature education on offer.

Cultural & amenity values

Preserving natural forest landscapes is a very important benefit attracting thousands of visitors. This benefit is founded on the uniqueness of its natural landscapes, the diversity of plant species the undisturbed course of natural processes and the deterioration of forest landscapes in the rest of Europe.

Climate / climate change regulation

Carbon sequestration becomes more and more as time goes by and protecting the forest may have valuable carbon benefits. Forest ecosystems are characterized by very strong moderating effect on local climate: daily and annual temperature fluctuations are much smaller in the forest than in the open areas. Regulation of a microclimate is also, therefore, a very important benefit generated by the forest.

Air quality regulation

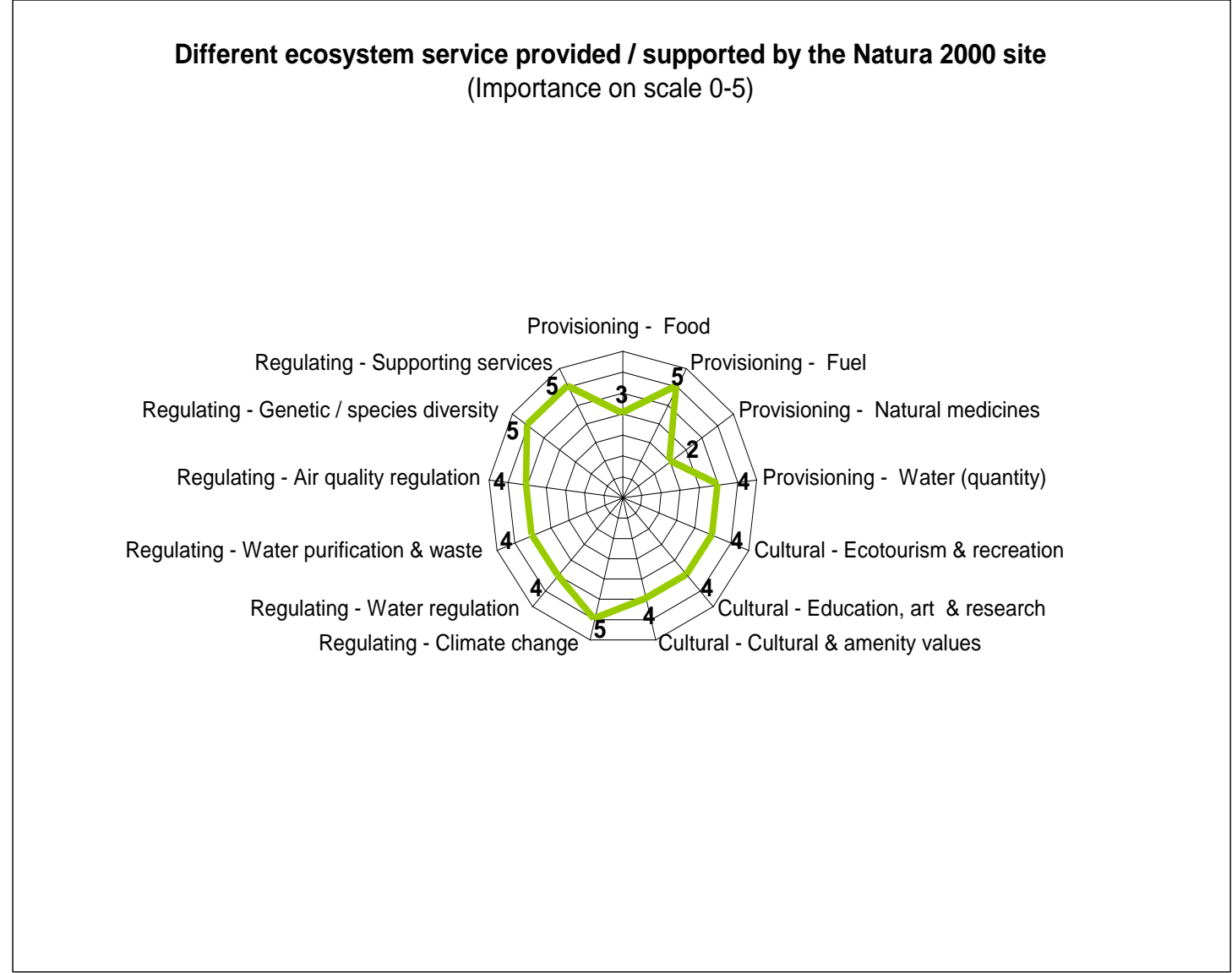
All forests possess the capacity to stop dusts and absorb air pollutants. Białowieża Forest is in remote corner of Poland, where air pollution and population density is very low so the importance of this service is not great.

Genetic / species diversity maintenance

The benefits in the case of Białowieża Forest are very high as this site is one of the last refuges for many natural forest relicts. But maintaining genetic/species diversity becomes more and more difficult due to climatic changes causing shifts in natural geographical ranges of species (the process already observed) and due to fragmentation and isolation of small populations of rare and highly specialized species. The pharmaceutical industry can benefit greatly from the genetic diversity of species safeguarded Natura 2000 site which ensures potential for future discoveries of new medicines.

The spider diagram (Fig. 2.1) summarises the above. The scores are the authors own estimates. It indicates clearly that supporting and regulating services are the most important at the site (they have value 4 to 5), especially those connected to biodiversity, pollination and seed dispersal and climate change maintenance. They are well developed in Białowieża Forest owing to its natural character and high (in comparison to surroundings) diversity of organisms and habitats. Provisioning services have a lower value (3 to 4), the same as cultural ones. There is only one exception in provisioning services, which is ranked 5, and it is fuel (firewood for heating). We expect, however that its importance will decrease in the future due to changes in heating technology.

Figure 2.1 The overall socio-economic benefits provided by the site



Geographically, provisioning services are also important locally and regionally, with the extension of their beneficiaries to national level in the case of timber and game. Conversely, benefits associated with ecological processes (genetic/species diversity, floods regulation, climate change mitigation, etc.) have a much wider array of beneficiaries (regional, national and global) this is shown in Table 2.1. This is a crucial point to understand when considering who should pay for the benefits and what options are available to obtaining funding. There is a contradiction between the benefits most important locally and those important at a wider scale, as over exploitation of supporting services would diminish regulation and supporting services. Local beneficiaries of provisioning services (e.g. timber, firewood) may need to be compensated if preserving regulatory benefits for wider society limits their use of forest resources.

Table 2.1 Who is responsible for managing the benefits provided by the site and who are the different beneficiaries.

Service / providers"	Ecosystem service	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers (National Park Administration / State Forest Administration) Farmers Other landowners / managers	Food Fibre/natural materials Fuel Natural medicines Ornamental resources Biochemicals & pharmaceuticals	Local Communities Individuals: Households Businesses Visitors	Local (regional)	collecting forest goods for own use (berries and mushrooms for home made products like: wild berries jam, pickled mushrooms etc) Game meat Sustainable collection of goods for sale on local markets forest "products" (fresh forest fruit or mushrooms, or homemade products)
		Food processing industry	Local Regional Global	Some local companies produce products based on local forest products (dry berries, herbal teas etc) and distribute it locally in the region, as well as around Europe

		Administration (State Forest/ National Park)	Local National	Some natural resources (like game) are managed by stateadministration – State Forest, and they are responsible to give permissions and collect fees for use of this resources (like hunting)
		Governments & administration	Local Regional National Global	Support of Natura 2000 sites to maintaining food supply and security
	water provision	Water consumers, Household, Business	Local Regional Global	Maintaining water supply for household, industry, irrigation, livestock. Purchase of material and goods that require water for their production process.
Local Natura 2000 site managers (National Park Addministration / State Forest	Ecotourism & recreation	site managers Local businesses communities visitors	Local (Regional)	Creation of jobs for site managers or other individuals providing supporting services

Administration)				Decline in health sector's costs due to reduced risk for diseases, allergies and mental health problems
Farmers				Reduced risk for diseases caused by pathogens
Other landowners / managers				Reduced risk for allergies etc.
		Health sector	Local Regional	Access to nature and green areas that supports mental health
				Restorative effects and increased health
				Income to protected sites through entrance fees or excursions
				Income to local and regional businesses providing services related to recreation and tourism
				Economic development of a region
				Creation of regional trade mark

	Education, art & research	Local communities businesses visitors	Local (Regional) Global	Education Inspiration goods for own use or for sale (e.g. crops, livestock, wood for fuel) linked to traditional knowledge and cultural values Research resulting in technological development Inspiration for the development of products such as books, movies, TV programmes Traditional knowledge
		Research Institutions	Local Regional National Global	Research exploring natural processes and diversity of nature of forest
		businesses & households	Local Regional (Global)	Increased value of real estate property
	Landscape & amenity values			
Local Natura 2000 site managers (National Park Administration / State Forest Administration) Farmers Other landowners / managers	Regulating climate / climate change	Individuals, local inhabitants	Local (Regional)	Reduced risk for diseases caused by pathogens Reduced risk for allergies etc.
		Local residents, farmers etc	Local (Regional)	Climate regulation (e.g. precipitation, temperature etc, including extreme weather events) affecting human well being, security, health, food production etc
		Society at large	Global	Contribution to climate change mitigation through carbon sequestration.

	water regulation	Individuals, e.g. site managers themselves, property owners	Local Regional	Reduced risks of flooding and related costs, e.g. cost to crops and reduced water quality Maintenance of natural water supply, e.g. ground water balance
		Different businesses & industries (small / large)	Local Regional	Reduced risks of flooding and related costs to business and industries, e.g. damage to infrastructure, reduced availability of processed resources
		Governments & administration	Local Regional Global	reduced flood risk and maintain water security
	water purification & waste management	local communities e.g. site managers themselves	Local (Regional)	Cleaner drinking water for local households. Cleaner bathing water for residents.
		Different businesses & industries (small / large) – public and private water companies	Local Regional (Global)	lower costs of water treatment and purification for water supply and waste water treatment companies (public or private):
	Air quality regulation	Local communities visitors and tourists	Local (Regional)	Reduced respiratory diseases and increased health
		Different businesses & industries (small / large)	Local Regional (Global)	Reduced damage to timber production due to increased health of ecosystems Preserved recreational values of a site leading to increased housing values
	storm damage control	local communities tourists	Local	Reduced damage to public and private buildings and infrastructures due to reduced storm impacts.

		Farmers and some local business	Local (regional/national)	Reduced damage to business buildings, plants and infrastructures and tourism installations
	Erosion control	Land owners Local communities	Local (Regional)	Preventing the degradation of nearby water bodies due to sediments, e.g. maintaining the quality of drinking water and preserving area's recreation value
		Different businesses & industries (small / large)	Local Regional (Global)	Maintaining the quality of rivers supporting tourism business
		Water purification plants	Local Regional	Securing the quality of drinking water
	Fire regulation	Individuals, e.g. site managers themselves	Local	Reduced damage to buildings and infrastructures – roads, schools etc
		Different businesses & industries (small / large)	Local Regional (Global)	Reduced damage to local industrial/commercial buildings, equipments and infrastructures. Reduced damage to local produce – e.g. wood
	Biological control	Local communities visitors and tourists	Local (Regional)	Decreased health impacts due to decreased use of fertilisers and pesticides
	Pollination	Crop producers, e.g. site managers themselves	Local (Regional)	Maintaining natural pollination of crops to secure yields
		Other individuals	Local Regional	Availability of biodiversity resources dependent on pollination, e.g. wild fruits

		Different businesses & industries dependent on crop production (small / large)	Local Regional (Global)	Maintained supply of “raw material” for production
		Governments & administration	Local Regional (Global)	Role of natural pollination in maintaining food supply and security
	Regulating human health	Individuals	Local (Regional)	Reduced risk for diseases caused by pathogens
				Reduced risk for allergies etc.
		Health sector	Local (Regional)	Decline in health sector’s costs due to reduced risk for diseases, allergies and mental health problems
	Maintenance of genetic/species diversity	Private and public sector employers	Local Regional National	Reduced cost related to employees’ health and higher work efficiency
		Individuals, e.g. site managers themselves landowners	Local (Regional) Global	Availability of natural pollinators and natural pest control agents
				Availability of crop varieties and breeds that can sustain different environmental conditions
		Different businesses & industries (small / large)	Local Regional (Global)	Availability of game
				Availability of resources (crop, meat, fish etc.) required for the production of goods

Local Natura 2000 site managers (National Park Administration / State Forest Administration) Farmers Other landowners / managers	Supporting services	Individuals, e.g. site managers themselves Landowners	Local (Regional)	Maintaining conditions supporting production, e.g. soil formation, nutrient cycling, primary production etc. Supporting availability of game and wild products. Maintaining conditions favourable for human wellbeing, e.g. economy, social aspects, culture, health, safety etc.
		Different businesses & industries (small / large)	Local Regional (Global)	Secured resources for production of biodiversity related goods and services, e.g. food, tourism etc.
		Governments & administration	Local Regional (Global)	Maintenance of food and water supply, support to safety and reduction of environmental risks

2.2. Detailed valuation of different benefits

Food

The most popular products collected in the Białowieża Forest are: **wild berries, mushrooms, nuts and game**. They are used by local households and B&Bs, with an estimated **€250,000** (see table 2.2. for details) sold for food processing. Honey and mushrooms (*Armillaria* sp.) are collected in large quantities and sold to the food processing industry with estimated annual values of **€100,000** and **€180,000** respectively. For honey, a local trademark for high quality produce, 'Białowieżski lipiec' has been established. Game is sold to a game trading company, which in turn sells it to local restaurants, B&Bs, and for individuals. Commercial hunting is controlled in Poland by a few licensed entrepreneurs and fees for hunting are paid for State Forests Administration. From the point of view of the local economy hunters do not bring much extra income in comparison to regular tourists. Vegetables and fruits are produced in small quantities mainly by B&Bs owners and locals.

Timber

This is currently the main benefit provided by the site for the State Forests Administration and worth approximately **€ 6,000,000** per annum. This service brings limited benefits for local communities (over 80 per cent of timber is sold out of the region). Wood from the Białowieża Forest is very high quality. Aside from the State Forests Administration, only forest workers extracting wood in the forest have a direct

income from this benefit. It is the only service at the site which brings benefits for a narrow but strong interest group (foresters and forest workers), but at the same time entails losses to other stakeholders, e.g. the recreation and tourism sector.

Ornamental products

Game generates a number of additional benefits through recreation (discussed later) and by products. For example, deer antlers, cast down antlers in autumn/winter, are used for trophies, knife handgrips, corkscrew handgrips, buttons and chandeliers. Furs are also used commercially. Estimation of the value of this benefit is very difficult as most of the trade is unofficial.

There is also demand for wooden handcrafts which are sold as souvenirs for visitors. Selling takes place at main tourists' locations in Białowieża. A few hundred Christmas trees are sold each year in the region, mostly for use of local households

Fuel:

Firewood is used by local inhabitants for heating. At the edge of the site, in Hajnówka city, there is a large energy company, which currently uses biomass fuel. Currently the feedstock is bought from outside the region but the future potential to source sustainable biomass from the region should be explored.

Natural medicines & bioprospecting:

Some natural products are used in small quantities by herb processing enterprises. At the northern edge of the site extraction of herbs from the natural sites is more intensive and trade is organized by a large national company Herbapol. The site still has capacity to increase this benefit through collection of herbs from natural sites and cultivation of fallow lands. Herbs, fungi and wild berries are processed in the region and sold as herbal and medicines and cosmetics. Białowieża Forest is a promising site for bioprospecting due to its high natural species diversity. To date there have been no serious biochemical or pharmaceutical research carried out at the site.

Water Provisioning and Regulation

Water for domestic, business and recreational use is an important ecosystem service. All the water in used in Białowieża comes from deep drilled wells of a central water system. In recent years, during the summer months, when hotels are full and local people are watering their gardens, shortages occur. The last 20 years has seen a decrease of the ground water table by approximately 20-40 cm. The capacity of **aquifer recharge** must be considered if water resources are to be sustainably managed in future. This is a topical issue and it will become even more important in the future. It is not known how efficient aquifer recharge is and what factors control it but one may suppose that site is playing an important role in water cycling on local and regional level. The price paid by consumers for water is below supply costs (see Table 2.2.). One company in the Białowieża village using its own deep drilled well provides commercial drinking water. To date, not conflict with the central water system has been observed. The benefits of this activity accrue to the company and its workers.

Ecotourism & recreation

Expansion of the national park in 1996 stimulated investments by tourist operators in Białowieża village: four large hotels, three pensions and many B&Bs have been built since 2000.

Walking, wildlife watching, biking, horse riding, canoeing and narrow gauge railroads are the main activities. Recreational benefits are ‘captured’ in a monetary sense, in a number of ways. The Museum and core area of the national park are open to the public who pay an entrance fee. Tourists in the museum and core area must also hire a guide licensed by the National Park. Tourism trails outside of the core area of the national park are open to public without limitation (approximately 200 km of trails).

Increasing numbers of tourists has led to more restaurants and pubs. Development of the hospitality industry is limited by the seasonal nature of tourism in Białowieża: the main season being from April to mid-September.

Most visitors come to Białowieża by car reflecting the poor public transport alternatives. Private buses connect Białowieża to Hajnówka, Bielsk Podlaski, Białystok and other cities in the region. The railroad to Białowieża has been dormant since 1995 but there are plans to revitalize it as a tourist attraction.

As noted, hunting activities is managed by the State Forests Administration which organizes commercial hunts for Polish and foreign (mostly German) hunters. Hunters hunt red deer and wild boar. The European bison is not hunted, but is culled by the Park authorities who sell the meat to local restaurants.

A border crossing to Belarus was opened in Białowieża in 2005. It allows pedestrian and biker traffic. Since Polish accession to EU, procedures to obtain a visa to Belarus are complicated and co-development with the Belarussian park is limited.

Education, art & research.

There are two education centres operating in Białowieża village: undertaking workshops, lectures and seminars are for local schools. There are also three scientific institutes based in Białowieża village running conferences and summer camps. They employ approximately 30 scientists (70 employees including technical and administration staff) – there is great potential to develop the site as an intellectual hotspot for the region.

In terms of cultural benefits, Białowieża has always provided inspiration for artists, writers and photographers. The Forest has fuelled myths and imagination and featured in novels and poetry and in paintings of well known Polish and Russian artists. The site hosts a number of local folk festivals including “Peretocze” – a multicultural folk festival and an Orthodox Music Festival. These and other events help attract few thousands visitors per year. A further feature of the site is its multicultural character (overlapping of Polish, Belarussian and Ukrainian cultures and languages). This mosaic of traditions, rituals and languages find expression in folk music, local habits and architecture. Many villages in the region still speak their own dialect. Traditionally, villagers are still very open and hospitable to visitors. These cultural services of site are therefore highly important though hard to express in monetary terms.

Landscape & amenity values

The landscape attracts many visitors. Many houses in the region are of decorative wood design. The houses are still well maintained though only few new houses are built in traditional style. The layout of some villages date from the Medieval age. Some of the older houses and spatial designs are inscribed on the list of local cultural heritage maintained by the Regional Heritage Conservator.

The region has a very strong sense of place and history, which enhances its attractiveness as a tourist attraction and as a locality to live or work near.

Climate / climate change regulation

Carbon storage and sequestration has become very important with the acceleration of climate change. Sequestration depends on many features of the site, including age of stands, their species composition, physiological shape, water balance and many other factors. There are no detailed studies of this service for the site, however based on published scientific papers it could be hypothesized that this benefit is extremely important for the Białowieża Forest. Measuring carbon stored/sequestered depends on both natural and management factors.

Regulation of microclimate

Forest modify temperature, humidity, wind speed, and daily, monthly and annual amplitudes of these characteristics. Białowieża Forest provides these benefits. The value of this benefit is rather difficult to estimate.

Water purification & waste management

With the development of local communities and an increasing number of visitors to the site, the importance of this service is steadily increasing. Close to 100 per cent of households in the region have central or individual water purification system. Still the system is not closed and water from purification plants is transferred to local rivers or the ground. Maintaining quality is very important for local communities, so they do not lose their water's natural purity, and for communities living downstream who do not benefit from tourism development. Due to investment in sewage purification, an expected increase in tourism should not bring serious threat to capacity of this service. The local benefits can be estimated in monetary value, based on the commercial price of one cubic meter of sewage transfer to a sewage purification plant. The regional benefits are not possible to estimate.

Air quality regulation

As noted, all forests possess the capacity to stop dusts and absorb air pollutants. Białowieża Forest is in remote corner of Poland, where air pollution and population density is very low so the importance of this service is not great. The monetary value of this benefit can be calculated basing on the potential costs of treatment of respiratory diseases in polluted areas.

Natural Hazards

The site is flat and water run off is extremely slow. Erosion is not a major problem but could become so with climate change leading to loss of the forest cover. Most of the climate change scenarios forecast increases in the number and intensity of extreme weather phenomena. The forest acts as a natural barrier, but in extreme situations, it may be damaged by high winds. Monetary value of this service can be calculated

basing on costs of infrastructure requirements in the region in the case of strong storm damage.

Biological control

Biological control in the sense of ecosystem self-regulation is a feature of well functioning forests although natural disturbances are part of the forest ecosystem dynamic. Currently the Białowieża Forest is resilient to disturbances but deterioration could lead to damaging outbreaks of pests or a failing in ecosystem processes. In this sense, conservation provides an insurance value against ecosystem failings which could jeopardise many other services.

Pollination / seed dispersal

These services are crucial to functioning of diverse natural forest ecosystems. Pollination of all plants is possible only if high number and high diversity of pollinators are present at the site. Pollination is crucial for maintenance of plant genetic diversity as many flowers are crosspollinated by pollen from another flowers or individuals. This service in temperate climate is provided mainly by invertebrates, in the case of Białowieża Forest these are domestic honey bees, bumble bees and over one hundred species of wild solitary bees. Due to limited working range of honey bees (maximum between 3 km and 5 km from beehive) their role is very important at clearings but decreases inside of forest ecosystems, where increases the role of less numerous but very often highly specialized solitary bees.

The seed dispersal service is of very high importance in diverse ecosystems, like the Białowieża forest, with its mosaic of habitat types. Efficient seed dispersal maintains a high **species diversity** of the site. Important but usually underestimated role in seed dispersal is played by herbivorous vertebrates, eating plants with their seeds and transferring them via alimentary tracts. European bison transfers a few thousands of viable seeds per one litre of its stomach content. The number of vascular plant species dispersed by this animal is close to 20 per cent of the Białowieża Forest's flora. The role of other vertebrates in seed dispersal needs further study but it is expected that the whole guild of dispersers transfer large share of plant species inside of the site as well as across of its boundaries.

Regulation of human health (physical and mental)

Since the 18th century, Poland has cultivated a specific type of naturotherapy – centred on forests with good climate, especially those surrounding water springs or therapeutic peat mud resources (*uzdrowiska* 'healing sites' in Polish). Białowieża Forest was not recognized as therapeutic site but provides fresh air and plenty of natural green space which have a positive effect on human health and potential to develop this service.

Species diversity maintenance

The Białowieża Forest is one of the best researched sites in Poland (maybe even in Europe), with over 12,000 animal species, close to 1,500 plant species and close to 1,000 fungi species documented. The knowledge about bacterial or algal diversity is very low. Animal diversity is very likely at least twice as high and number of fungi species is probably four to five times higher than documented. Benefits of high species diversity are very diverse: food, medicines, stability of the ecosystems, touristic attractiveness, etc.

Aggregated estimates on the total value

The total value of the ecosystem services offered by the Białowieża Forest is difficult to estimate because some services, like carbon sequestration, have not been measured and because some benefits, like landscape attractiveness, are hard to value. However, the estimates we can make give a good indication of the forests importance. In terms of provisioning goods and services, we estimate they are worth approximately **€7,000,000** per annum. Much of this is accounted for by timber sales. The value of recreational services can be gauged by the value of annual entrance fees (€300,000) and expenditure by hunters (€100,000). Educational institutes account for expenditure of over €1,000,000, which indicates their importance but not their value in terms of services generated. The value of cultural services could be indicated on the basis of annual income brought by visitors to the site (see Table 2.2.). A value of recreational and cultural services of **€ 4,000,000,000** has been obtained from a Willing To Pay survey of visitors. This figure probably incorporates a range of benefits (from landscape values, existence values of species, recreational opportunities) provided by the forest. This figure incorporates a number of indirect services and should not be added to others so as to avoid double counting.

This study has identified some important services, which have yet to be quantified and valued. It is possible to value both water (provision, regulation and quality) and climate regulation services but primary data does not currently exist. We anticipate quantifying these services would increase the value of the ecosystem services generated by the forest substantially. This study also identifies the importance of support services like pollination. These services have not been valued because they will be included in the final value of the goods they produce.

Table 2.2. A synthesis of the benefits of a Natura 2000 site related ecosystem services.

BENEFIT CATEGORY	BENEFIT DESCRIPTION	ESTIMATED VALUE OF THE BENEFIT				WHO ARE THE BENEFICIARIES?	WHAT IS THE CURRENT STATUS OF THE BENEFIT	IS THE IMPORTANCE OF THIS SERVICE LIKELY TO INCREASE IN THE FUTURE?
		Qualitative	Quantitative	Monetary	Relative value of this benefit at the site Authors' own estimate on scale 1-5			
Ecosystem service related benefits								
Provisioning services								
Food, e.g. crops, fruit, livestock, wild berries & fungi, game	Wild berries	In the region of the Białowieża Forest are collected: Blackberry (<i>Vaccinium myrtillus</i>), Raspberry (<i>Rubus idaeus</i>), wild strawberry (<i>Fragaria sp.</i>), crane berry (<i>Vaccinium oxycoccus</i>)	The berries are collected mostly on household use and partly (in the case of blackberry) for sell for other households as well as for local restaurants and B&Bs. The real amount of collected berries is difficult to estimate as most of them are selfused by	20,000 EUR per annum	3	Local inhabitants (local private benefit) Local B&Bs (local private benefit) Local restaurants (local/regional private benefit) Local/regional/national food processing industry (local/regional/national private benefit),	Service in good condition	Yes due to observed increasing demand for natural food especially if collected in the regions famous for their naturalness. The amount of berries accessible can decrease due to changes in environment (crane berry

			households or selling transactions are not registered. Registered amount of berries 75 tones per annum					and blackberry are decreasing due to eutrophication of forest soils, raspberry and wild strawberry are decreasing due to decreasing area of open spaces in the forest).
	Mushrooms	There are approximately 20 species of mushrooms collected in the Białowieża Forest, mostly from the genus <i>Boletus</i> , <i>Xerocomus</i> , <i>Suillus</i> , <i>Lactarius</i> , <i>Cantharellus</i> and <i>Armillaria</i> . The highest commercial importance has <i>Armillaria</i> , as it occurs in high numbers and is harvested in high amounts	Most of mushrooms types are collected and selfused by local households. Commercial trade usually includes: edible <i>boletus</i> (highest economical value, rather low amounts), <i>hallymush</i> <i>Armillaria</i> sp. (lower economical value, very large amounts), <i>chanterelle</i> <i>Cantharellus</i> sp. (high	180,000 EUR per annum	5	Local inhabitants (local private benefit) Local B&Bs (local private benefit) Local restaurants (local/regional private benefit) Local/regional/national food processing industry (local/regional/national private benefit), Regional/national/global shops (regional/national/global private benefit)	Service in good condition	Yes due to observed increasing demand for natural food especially if collected in the regions famous for their naturalness.

			economical value, low amounts) Registered amount of mushrooms 120tones/annum					
	Nuts	Only nuts of hazelnut <i>Coryllus avellanus</i> are collected from nature, predominantly for own use of households.	No data available	No data available	1	Local households (local private benefits)	Service in good condition	No due to supply of high quality and high amounts of nuts from orchards
	Game meat	European bison <i>Bison bonasus</i> , red deer <i>Cervus elaphus</i> , roe deer <i>Capreolus capreolus</i> , wild boar <i>Sus scrofa</i> are game species hunted in the Białowieża Forest.	Numbers of hunted game in 2008: European bison: 23 Red deer: 157 Roe deer: 72 Wild boar: 586	55,080 EUR per annum	4	Local inhabitants (local private benefit) Local B&Bs (local private benefit) Local restaurants (local/regional private benefit) Local/regional/national food processing industry (local/regional/national private benefit), Regional/national/global shops (regional/national/global private benefit)	Service in good condition	No due to decrease of interest in hunting as a way of food gaining

						State Forests Administration (national state benefit) National Park (national state benefit)		
	Fish	Very marginal importance. Fish are gained only by angling in ponds in Białowieża village and along the Narewka River.	Not possible to estimate, some anglers are not angling for fish but only for recreational value of this activity	No data available	1	Local/regional inhabitants (local/regional private benefit)	Service in poor condition (there are no good angling ponds and rivers in the site)	No due to lack of natural conditions for increase of its importance.
	Crops (cereals, potatoes, etc.)	Very marginal importance. Agricultural land has a share of approximately 5 per cent of the total site area and most of them are not in agricultural use any more			1	Local inhabitants (local private benefit)	Service in poor condition due to poor, not fertile soils and damages in crops done by game.	No due to lack of natural conditions for increase of crops production.
	Honey and other bee products (wax, propolis, plant pollen)	Honey from Białowieża Forest is of very high quality owing to high diversity of flowering	The amount of beehives in the limits of the site exceeds 700 pieces. Some of them are very extensively used (usually	100,000 EUR per annum	5	Local and regional inhabitants (local/regional private benefit) Local, regional and national shops (local/regional private	Service in good condition	No due to the fact that number of apiaries is already very high in the region

		plants in the region and purity of the region. One of its types: linden honey is registered under own trademark "Lipiec Białowiecki"	those in small apiaries up to 10-20 beehives), some are quite intensively used (large apiaries 50-200 beehives). In average annual honey production is on the level of approximately 15 kg/beehive, it makes 10,500 kg of honey produced annually.			benefit)		
Fibre / materials, e.g. wool, skins, leather, plant fibre, timber, cork	Timber	Timber of high quality has a quite large share in wood harvested in the Białowieża Forest. This forest is especially recognized for high quality timber of pedunculate oak <i>Quercus robur</i> , silver birch <i>Betula</i>	Amount of harvested wood in 2008 was 120,450 m ³	6,000,000 EUR	4	Local/regional/national /global wood processing business (local/regional/ national/global private benefits) State Forests Administration (national state benefit)	Service in good condition due to remains of old trees of the natural origin. Status of the service will decrease with further exploitation.	No due to increasing awareness of the nature conservation and pressure of international conservation societies on protection of the Białowieża Forest

		<i>pendula</i> , aspen <i>Populus tremula</i> , black alder <i>Alnus glutinosa</i> , ash <i>Fraxinus excelsior</i>						
	Game (red deer) antlers	Red deer are casting their antlers each winter. Single antlers are collected for production of knife handgrips, chandeliers, buttons etc. Paired antlers of high quality are sold as trophies.	No data available	No data available	3	Local/regional inhabitants (local/regional benefits) Local/regional souvenir shops (local/regional benefits)	Service in good condition	No, due to increase of wealth level among local inhabitants importance of this source of income will decrease
Fuel, e.g. biomass, firewood	Firewood	Wood is used as fuel for heating in large amount of local houses	Approximately 15,000 cubic metres	450,000 EUR	5	Local/regional inhabitants (local/regional private benefit) State Forests Administration (national state benefit)	Service in good condition	No due to increasing share of houses heated by oil and gas furnaces
Natural medicines	Herbs (flowers, roots, leaves, seeds, sap)	Herbs of many types and species are collected from wild sites as	No data available		4	Local inhabitants (local private benefits) Local/regional/national herb processing	Service in good condition	No, due to increase of wealth level among local inhabitants

		well as cultivated (some species)				business (local/regional/national private benefits) Local/regional/national/global shops (local/regional/national/global private and state benefits)		importance of this source of income will decrease. Yes due to growing demand for natural medicines.
	Fungi	At least one species <i>Inonotus obliquus</i> is used as material for supplementary treatment in oncologic problems	Not possible to estimate (trade is not official)	Not possible to estimate (trade is not official)	1	Local and regional inhabitants (local private benefit)	Service in poor condition	No due to traditional medicine decrease
	Wild berries	Blackberry are used in gastric problems and eye treatment, raspberry are used in cold	Marginal, not possible to estimate	Not possible to estimate	2	Local and regional inhabitants (local/regional private benefits) Local/regional/national pharmacies (local/regional/national private benefits)	Service in good condition	No due to increasing importance of berries from plantations.
Ornamental resources, e.g. wild plants, wood for handcraft, seashells	Wood for handcraft (sculptures, basket weaving)	Linden, maple and birch wood are preferred by handcraft producers. Both species are rare in the	A few hundred of cubic meters per annum.	20,000 EUR	3	Local inhabitants (local private benefits) Local souvenir shops (local private benefits)	Service in medium condition (shortage of good wood for handcrafts,	Yes due to development of tourism and increase of demand for souvenirs if external source

		Białowieża Forest. There are no willow plantations in the limits of site, importance of natural row material is however low.					the external source of supply must be obtained)	of row material is available
	Christmas trees	Only Norway spruce <i>Picea abies</i> is used as Christmas tree in the region. Approximately 50 per cent of trees are originated from plantations.	544	3,000 EUR	3	Local inhabitants (local private benefits) Local/regional and national trading centers (local/regional/national private benefits) State Forest Administration (national state benefit)	Service in good condition	No due to trends for changing traditional spruce Christmas trees for exotic species (e.g. <i>Picea pungens</i>, <i>Douglasia menziesii</i>) and for artificial plastic Christmas trees.
	Hunting trophies	Heads of hunted bison, red deer, roe deer and wild boar	Less than 100	50,000 EUR	2	Local inhabitants (local private benefits) Local/regional/national and global hunters (local/regional/national and global private benefits)	Service in good condition	No due to changes in environmental awareness.
Biochemicals & pharmaceuticals	Natural products for pharmacology	Potentially plant, fungi and animal	Not possible for estimation, rather potential	No data available	1	Not known	Status not known	Potentially can become important

		products						owing to research aimed on finding active components in plants, fungi and animals living in the Forest.
Water	Water for households and hotels	Water from central water system	3.0 – 4.0 m3/ month/person Cost of water 0,75EUR/ 1m3	22,000 EUR per annum	5	Local inhabitants (local private benefit) Local municipality (local municipal benefit)	Service in good condition	Yes due to development of tourism and increasing demand for clean fresh water.
	Drinking water (bottled and sold)	Water from deep wells	no data available	no data available	3	Local/regional inhabitants (local/regional private benefit) Local/regional/national shops (local/regional/national private benefits)	Service in good condition	Yes due to increasing demand for good drinking water.
Cultural & social services								
Ecotourism & recreation	Value of tourism (nature walks, animal watching, biking, horse riding, canoeing, angling)	Ecotourism in Białowieża Forest has a character of short-term visits (very often one-day visits), however	150,000 visitors annually	4,000,000,000 EUR (total value based on “Willing To Pay” estimation, not annual income from	5	Local inhabitants (local private benefits) Local/regional/national and global travel agencies (local/regional/ national and global private benefits)	Service in good condition	Yes due to growing demand for contacts with untouched nature.

		some visitors stay a few days. Value of ecotourism was calculated by “Willing To Pay” method (Bartczak et al. 2005)*		tourism!				
	Value of accommodation related to tourism	There is a wide range of accommodation offered to tourists in Białowieża Forest: from various levels of B&Bs up to four star hotel.	The number of available places was estimated in 2004 for approximately 1,200. Use of available places at the Hotels: 70 per cent-40 per cent	Income to community budget (taxes): 70,000 EUR	5	Local inhabitants (local private benefits) Local/regional/national and global hotel companies (local/regional/national and global private benefits) Local communities and municipalities (local municipal benefit)	Service in good condition	Yes due to growing demand for contacts with unspoiled nature.
	Value of nature interpretation (guiding)	Access to most precious part of the Białowieża Forest – the core area of the Białowieża National Park is possible only with the licensed guide. Guides are hired also by groups visiting	There are approximately 120 guides licensed by Białowieża National Park.	Income to community budget (taxes): 75,000 EUR	4	Local/regional inhabitants (local/regional private benefits) Local/regional/national and global travel agencies (local/regional/national and global private benefits) Local communities end	Service in good condition	Yes due to growing demand for nature interpretation and plans to expand the National Park.

		the other part of the forest but rarer.				municipalities (local municipal benefit)		
	Entrance fees	Entrance fees are paid by visitors to Białowieża National Park at three points: Bison reserve (1.5 EUR and 0.75 EUR) Nature History Museum (3.0 EUR and 1.5 EUR) and Core area (1.5 EUR and 0.75 EUR)	Number of visitors is different at each point: Bison reserve approximately 150,000 visitors per annum, Museum 78,000, Core area 20,000	300,000 EUR per annum	4	Local/regional inhabitants (ticket sellers) (local/regional private benefits) Białowieża National Park (national state benefit)	Service in good condition	Yes due to observed increasing trend of the visitors number
	Licences (guides, tourist offices)	Guides/nature interpreters and tourist companies operating on the area administered by national park must pay an annual license fee	There are approximately 120 guides and approximately 10 tourist companies licensed	4,000 EUR	3	Białowieża National Park (national state benefit)	Service in good condition	Yes due to increasing demand for guiding service
	Food	Food service is used by visitors in very variable way: one day visitors very often bring	Food is offered for visitors in 4 restaurants, 1 pizzeria, 1 inn and 10 shops. Each B&B	no data available	4	Local/regional inhabitants employed in restaurants and shops (local/regional private benefit)	Service in poor condition (small number of places, lack	Yes due to increasing number of visitors and increasing wealth of Polish

		most of the food with themselves and buy only drinks (or nothing). Visitors staying longer are using full service.	offers at least breakfasts for its guests as well.			Local/regional shops (local/regional private benefit) Local/regional/national and global hotel companies (local/regional/national and global private benefit)	of cafeterias)	visitors
	Souvenirs	Souvenirs sold in the region of Białowieża Forest are of 2 types: 1) original handcraft connected to the site (e.g. wooden sculptures of European bison); 2) common souvenirs related to any forest and made very often abroad. Original handcraft is of high quality and supports local culture and local	Souvenirs are sold at Nature History Museum, at the parking lot in Białowieża, at the Bison reserve and in some shops in Hajnówka. Most of Hotels have souvenir shops as well.	No data available	5	Local inhabitants (handcraftsmen) (local private benefits) Local/regional shops (local/regional private benefits) Local/regional/national and global enterprises (local/regional/national/global private benefits) Białowieża National Park (national state benefit)	Service in good condition	Yes due to increasing number of tourists visiting the site

		handcraft.						
	Local tourist transportation (horse carriages)	Horse carriages are used for visiting of the core area of Białowieża National Park and some points of interest in the surrounding forest. Buses operate between Białowieża, Hajnówka, Narewka, Bielsk Podlaski, Białystok, Warsaw and some other minor settlements	There are approximately 60 horse carriages operating in the area. A trip costs 20-40 EUR and depends on the trip length	150,000 EUR	4	Local inhabitants (local private benefit)	Service in good condition	Yes due increasing number of visitors
	Regional and national tourist transportation (airplanes, buses, trains, taxis)	All types of transportation are operating in the region. Airplanes are used by some visitors from abroad.	Average cost of travel to Białowieża Forest was estimated by Bartczak et al. (2005) for approximately 10 EUR. Foreign visitors have share of	4,350,000 EUR	4	Local inhabitants (local private benefit) Local/regional/national and global carrier companies (local/regional/national and global private and state benefits)	Service in good condition, except for trains which are not operating inside of the site at all.	Yes due to increasing number of visitors.

			approximately 10 per cent in the total number of visitors and in their case average cost we estimated for 200 EUR					
	Narrow gauge railroads	There are 2 lines of narrow gauge railroad used for tourist transportation from Hajnówka to Topiło and from Hajnówka to Postołowo.	In 2008 price of the narrow gauge ride was: 350 EUR for group of adults, 250 EUR for group of children	10,000 EUR	3	Hajnówka Forest District (national state benefit)	Service in poor condition (technical condition of railroads is bad)	Yes due to increasing number of visitors.
	Horse riding	There are no big stables in the area. Horses are kept by some B&Bs.	Number of horses for horse riding does not exceed 30. One hour of horse riding costs 7-10 EUR	20,000 EUR	1	Local inhabitants (local private benefit)	Service in poor condition	Yes due to increasing number of visitors and increasing interest in that type of recreation.
	Huntings	Hunting is type of the activity that brings to the site specific sector of Polish and foreign tourists. It plays however an important role as they are	Each year approximately 50 red deer and 70 wild boars are hunted by hunters from out of the region	100,000 EUR	3	Local inhabitants (local private benefit) National and global hunting tourist operators (national and global private benefit) State Forests Administration (national	Service in good operation	No due to the planned expansion of the Białowieża National Park

		usually rich and coming during autumn and winter, when number of other tourists is decreasing.				state benefit)		
	Incentive tourism	Incentive tourism is organized by 3 large hotels operating in Białowieża. There also some number of events organized in other places (hostels, pensions) by interested parties.	No data available	No data available	3	Local inhabitants (local private benefits) Local/regional/national and global hotel companies (local/regional/national and global private benefits) Regional/national companies (regional/national private benefit)	Service in good condition	Yes due to increasing demand for incentive events among Polish companies
	Conferences, seminars, workshops (science, economy, etc.)	Conferences are organized by large hotels operating in Białowieża as well as by scientific institutes and Białowieża National Park. There also some number of events	No data available	No data available	4	Local inhabitants (local private benefits) Local/regional/national and global hotel companies (local/regional/national and global private benefits) Regional/national and global scientific institutes, universities,	Service in good condition	Yes due to development of scientific studies in Białowieża Forest

		organized in other places (hostels, pensions) by interested parties.				associations, etc. (regional/national and global state benefit)		
	Border crossing with Belarus	A border crossing for bicyclers and pedestrians	A few thousand people are crossing through this point annually	Not possible to estimate	1	Local/regional inhabitants (local/regional private benefit) Local/regional shops, souvenir shops and hotels (local/regional private benefit) Customs and other national organisations (national state benefits)	Service in good condition	Yes due to increasing number of visitors in the National Parks on both sites of the border and due to normalisation of relations between EU and Belarus
	Other services (e. g. bonfires, local food, etc.)	Services offered to tourist as supplements to their programs.	No data available	Not possible to estimate (rather marginal)	2	Local inhabitants (local private benefit) Local hotels, B&Bs, pensions etc. (local/regional and national private benefits) State Forest Administration (national state benefit)	Service in good condition	Yes due to increasing number of visitors, incentive events, conferences, etc.

Cultural values & inspirational services, e.g. education, art and research	Nature education curricula and education centers	Nature education is aimed mostly on pupils of primary and secondary schools.	There are 4 education centers operating (national parks' and 3 forest districts') they are employing 9 people	200,000 EUR annually	4	National park (national state benefit) State Forests Administration (national state benefit)	Service in good condition in national park and much weaker in State Forests	Yes due to increasing nature orientation of official school programs
	Research (locally based institutes and researches from institutes)	Researches carried in the region have a very long tradition (over 200 years) and they are considering mostly elements of nature (ecology, botany, zoology, geology, climatology) and social sciences	There are 3 scientific institutes based in Białowieża but many more carry research using local accommodation	1,000,000 EUR annually	5	Local inhabitants (local private benefits) Local/regional/national and global scientific institutes and associations (national state benefits) Local accommodation owners (local/regional/national and global private benefits) Local shops (local/regional/national and global private benefits)	Service in good condition	Yes due to increasing interest in ecosystem services, climate change, social importance of nature etc.
	Nature photographers	Nature photographers are attracted by well preserved forest landscape and rare animal and plant species	Not possible to estimate	Not possible to estimate	2	Local accommodation owners (local/regional/national and global private benefits) Local/regional/national and global photographers	Service in good operation	Yes due to increasing demand for pictures showing natural elements

						(local/regional/ national and global private benefits) Local/regional/national and global companies using pictures taken in the site (local/regional/ national and global private benefits)		
	Arts workshops	Białowieża Forest for centuries has been an inspiration for musicians, poets, painters, etc.	Not possible to estimate	Not possible to estimate	1	Local accommodation owners (local/regional/ national and global private benefits) Local/regional/national and global art recipients (local/regional/national and global private benefits)	Service in good condition	Yes due to inspirational character of natural landscapes
	Folk events	The region contains mixture of eastern (Belarusian, Ukrainian) and western (Polish) folk elements	Not possible to estimate	Not possible to estimate	3	Local/regional inhabitants (local/regional private benefit) Local/regional/national and global recipients of folk events (local/ regional/national and global private benefits)	Service in poor condition	No due to decreasing interest of local young generations in cultivation of folk

	Sacral music festivals	The region hosts two annual orthodox church music festivals and one annual organ festival	3 festivals gathering many of performers and a few thousands of visitors	Not possible to estimate	3	Local/regional inhabitants (local/regional private benefit) Local/regional accommodation owners (local/regional/national and global private benefits) Local municipalities (local municipal benefits) Local/regional/national and global recipients of folk events (local/regional/national and global private benefits)	Service in good condition	No due to limited interest in these very specific types of performances
Landscape & amenity values	Local architecture	There are still many wooden houses with specific wooden decorations	Not possible to estimate	Not possible to estimate	3	Local/regional inhabitants (local/regional private benefits) Visitors (local/regional/national and global private benefits)	Service in weak condition	No due to changes in mentality of local inhabitants
	Traditional rural spatial order	The villages in the region are organized according to medieval spatial order called	Not possible to estimate	Not possible to estimate	3	Local/regional inhabitants (local/regional private benefits) Visitors (local/regional/national and global	Service in weak condition	No due to lack of regulations conserving the spatial order in spatial planning

		“ulicówka” (a one street village)				private benefits)		
	Natural forest landscape	Białowieża Forest is known as one of the best preserved fragments of lowland European forests	Not possible to estimate	Not possible to estimate	5	<p>Local/regional inhabitants (local/regional private benefit)</p> <p>Local/regional entrepreneurs (shops, hotels, etc.) (local/regional private benefit)</p> <p>Local/regional communities and municipalities (municipal benefit)</p> <p>National companies and institutions (national state benefits)</p>	Service in good condition but threatened by forest extraction around of the protected areas	Yes due to increasing outstanding character of the Białowieża Forest in comparison to gradual degeneration of European forest landscape
	Myths and believes connected to Białowieża Forest	There are some myths and legends connected to Białowieża Forest	Not possible to estimate	Not possible to estimate	5	Local/regional inhabitants (local/regional private benefit)	Service in good condition	Yes if new myths bringing more people year-round will develop
	Traditional hospitality	The tradition of hospitality is very strong in the region	Not possible to estimate	Not possible to estimate	4	<p>Local/regional inhabitants (local/regional private benefit)</p> <p>Local/regional/national and global visitors</p>	Service in good condition	No due to conflict between hospitality and mass tourism

						(local/regional/national private benefit)		
	Mosaic of nationalities, culture and religion	The region contains mixture of eastern (Belarusian, Ukrainian) and western (Polish) folk elements	Not possible to estimate	Not possible to estimate	4	Local/regional inhabitants (local/regional private benefit) Local/regional/national and global visitors (local/regional/national private benefit)	Service in medium condition	No due to disappearance of traditional values and differences between minorities
	Presence of European bison	The Białowieża Forest is the place where European bison has been preserved and restituted. Recently it hosts the largest free roaming herd of the bison.	The Białowieża herd accounted of 459 heads in January 2009	Commercial value of animals 1,500,000 EUR Touristic, natural, aesthetic, cultural and other values not possible to estimate	5	Local/regional inhabitants (local/regional private benefits) Local/regional communities and municipalities (local and regional municipal benefit) Local/regional and national research institutes (local/regional and national state benefit) National Park (national state benefit) National government (national state benefit)	Service in good condition	No due to increasing number of European bison and increasing number of its herds
	Local historical context	Białowieża Forest since	Not possible to estimate	Not possible to estimate	4	Local/regional inhabitants	Service in good	Yes due to use of historical

		15 th Century had been a royal property of Polish kings, in 18 th Century it was property of Russian empire and since 1880 property of Russian tsars. In interwar period it was an important official hunting ground of Polish government.				(local/regional private benefits) Local/regional communities and municipalities (local and regional municipal benefit)	condition	contexts by local entrepreneurs for attracting visitors
Regulating services								
Climate / climate change regulation	Carbon sequestration	According to last researches old forests are able to serve as a carbon sink	Data not available	Data not available	5	Local/regional/national and global inhabitants (local/regional/national and global private benefit) Local/regional/national and global business dealing with food production, exhausting greenhouse gases, health service etc. (local/regional/national and global private and	Service in good condition	No due to warming of the climate which will accelerate rate of decomposition

						state benefit)		
	Regulation of microclimate	Microclimate of the Białowieża Forest stands out of the region	Winters are more snowy, longer and with lower temperatures, summers are drier and colder	Lack of data	5	Local/regional inhabitants (local/regional private benefit)	Service in good condition	Yes due to climate mitigating attributes of the forest
Water regulation, e.g. flood prevention, aquifer recharge	Flood prevention down the rivers: Narew, Leśna, Jasiółda	The forest slows down outflow of spring waters (from melting snow) and rain waters.	Rivers Narew, Leśna and Jasiółda (and their tributaries) have their sources in the Białowieża Forest	Lack of data	4	Local/regional/national inhabitants (local/regional/national private benefit) Local/regional/national entrepreneurs (local/regional/national private benefit) Local/regional/national communities and municipalities (local/regional/national municipal benefit) National government (national state benefit)	Service in medium condition	No due to the fact that Białowieża Forest lies on the lowland
	Regulation of surface water run-off	The forest slows down outflow of spring waters (from melting snow) and rain waters.	Forest cover favours cumulation of water in ground	Lack of data	5	Local/regional/national inhabitants (local/regional/national private benefit) Local/regional/national entrepreneurs	Service in medium condition (needs artificial constructions for slowing	Yes due to climate change and already developed projects of small water retention

						(local/regional/national private benefit) Local/regional/national communities and municipalities (local/regional/national municipal benefit) National park (national state benefit) State Forests Administration (national state benefit)	down surface water outflow)	increase
	Aquifer recharge	The Forest favours collecting water in ground and its sinking into deeper layers and aquifer recharge	3.0 – 4.0 m3/ month/person Cost of water 0,75EUR/ 1m3	22,000 EUR per annum	5	Local inhabitants (local private benefit) Local communities and municipalities (local municipal benefit) Local hotels, B&Bs, restaurants etc. (local/ regional/national and global private benefit)	Service in good condition	Yes due to development of tourism
Water purification & waste management	Water purification	Forest and its rivers are very efficient natural purification systems		Not possible to estimate	4	Local/regional inhabitants (local/regional private benefits) Local/regional entrepreneurs (local/regional private benefit)	Service in good condition	Yes due to increasing volume of wastes produced by communities and municipalities (and visitors)

Air quality regulation		Forested areas are catching dusts and producing oxygen	Lack of data	Lack of data	4	Local inhabitants (local private benefit) Local enterprises (local/regional/national/global private benefit)	Service in good condition	No due to increasing level of dusts reduced at producers outlets
Erosion control	Preventing negative effects of erosion	Forest cover conserves soils	On lowlands erosion does not play a detrimental role	Lack of data	4	Local inhabitants (local private benefit) Local communities and municipalities (local municipal benefit)	Service in good condition	No due to permanent aforestation of the site
Avalanche control	Not adequate				0			
Storm damage control	Mitigation of wind speed	Forest cover mitigate speed of the winds	Lack of data	Lack of data	3	Local inhabitants (local private benefit) Local communities and municipalities (local municipal benefit)	Service in good condition	Yes due to increasing number of storms and increasing speed of winds
Fire regulation	Wet deciduous forests can serve as fire barriers	The level of fire risk in the region is low	Lack of data	Lack of data	3	Local inhabitants (local private benefit) Local communities and municipalities (local municipal benefit)	Service in medium condition (coniferous forest may increase fire risk)	Yes due to climate change which will bring increase of the fire risk
Biological control	Maintenance of outbreaks of forest pests	Natural forests are more immune for outbreaks of forest pests	From 10,000 to 30,000 m ³ of wood is extracted annually due to sanitary reasons (trees killed by forest pests)	250,000-750,000 EUR	4	Local inhabitants (local private benefit) Local communities and municipalities (local municipal benefit) National park (national	Service in good condition	Yes due to anthropogenic changes of the forest diversity and stands species composition

						state benefit) State Forest Administration (national state benefit)		
Pollination /	Pollination of natural herb yield and seed dispersal by animal vectors	Forest ecosystems are not very rich in pollinators and in many cases they are not travelling out of the stands to pollinate crops. They play however an important role in pollination of forest plants. There are also many animals playing a role of vector in seed dispersal	Lack of data	Lack of data	5	Local inhabitants (local private benefit) Local communities and municipalities (local municipal benefit) National park (national state benefit) State Forests Administration (national state benefit)	Service in medium condition (some pollinators extinct)	Yes due to decrease in number and diversity of pollinators in global scale.
Regulation of human health (physical and mental)		Forests play an important role as recreational sites. Trees excrete volatile chemical substances that influence physical and mental condition of	Lack of data	Lack of data	4	Local inhabitants (local private benefit) Local communities and municipalities (local municipal benefit) Local/regional/national and global visitors (local/regional/national and global private	Service in good condition	No due to large number of forests in Poland with recognized therapeutic and healing attributes

		human				benefit)		
Genetic / species diversity maintenance, e.g. protection of local and endemic breeds and varieties	Maintenance of local forest trees ecotypes gene pools and species diversity of natural forest organisms	Białowieża Forest is widely known as a “gene bank in situ” of at least some trees species (e.g. oak, ash, birch), which are outstanding value form the forestry point of view.	126 ha of treestands of various tree species devoted for seed production	2,000,000 value of wood, value of protected gene pools not possible to estimate	5	National Park (National state benefit) State Forests Administration (national state benefit)	Service in good condition	Yes due to decreasing genetic diversity of tree populations outside of the Białowieża Forest
Supporting services								
Production	Harvested natural products	The site is an important source of sustainably produced natural products (wild fruits, mushrooms, wood)	Lack of data and research	Lack of data and research	5	Local inhabitants (local private benefits) Local/regional business (local/regional private benefit) National Park (national state benefit) State Forests Administration (national state benefit)	Service in good condition	No due to planned change of the character of forest use toward the forest protection

	Carbon sequestration	The site is an important carbon sink.	Lack of data	Lack of data		National Park (national state benefit)	Service in good condition	No due to climate change and increase of the rate of decomposition
						State Forests Administration (national state benefit)		
						Global community (global private, municipal and state benefit)		
Decomposition	Natural capacity to decompose organic materials	Rates of decomposition at the site are similar to rates of increament	3,3 m ³ of wood/ha/ annum on 63,000 ha makes 207,000 of wood only potentially decomposed per annum	Difficult to estimate		Local/regional inhabitants (local/regional private benefit)	Service in good condition	Yes due to increasing naturalness of the forest and increasing speed of decomposition
						National Park (national state benefit)		
						State Forests Administration (national state benefit)		
Nutrient cycling	Sustainable cycling of nutrients	Nutrients are cycled (recycled) in the ecosystem with some export (wood, wild fruits, mushrooms) and import (air pollutants)	Lack of data	Lack of data		Local/regional inhabitants (local/regional private benefit)	Service in good condition	No value of this process will stay the same high
						National Park (national state benefit)		
						State Forests Administration (national state benefit)		

Water cycling	Regulation of flow of water in the area	The site plays an important role in regulation of flow of water in the area by slowing down spring outflow as well as by cumulation of water in the soils	Lack of data	Lack of data		Local/regional inhabitants (local/regional private benefit) Local/regional business (local/regional private benefit) National Park (national state benefit) State Forests Administration (national state benefit)	Service in good condition	Yes due to expected water shortage and irregular water input (changes of the climatic conditions)
Weathering / erosion	Low importance	The importance of this service at the site is low due to the fact that it is a lowland forest lying on flat terrain where weathering and erosion is already reduced by forest cover	Low importance	Lack of data		Local/regional inhabitants (local/regional private benefit) National Park (national state benefit) State Forests Administration (national state benefit)	Service in good condition	No if forest cover will stay on recent level

Ecological interactions	Very high biodiversity of organisms in ecosystems	The importance of ecological interactions is very high. The site is extremely rich (for its climatic zone) in diverse species of organisms, especially those dependent of presence of dead wood.	The ecosystem is built by (approximately) over 20,000 animal species, 4,000 fungi species, 1,500 plant species. It posses a high diversity of the species classified as “relicts of natural forests”	Not possible to estimate		<p>Local/regional inhabitants (local/regional private benefit)</p> <p>Local/regional/national and global tourist operators (local/regional/national and global private benefit)</p> <p>Research community (local/regional/national and global private and state benefits)</p> <p>National Park (national state benefit)</p> <p>State Forests Administration (national state benefit)</p>	Service in good operation	Yes due to acceleration of changes and decrease of naturalness of average forest in Europe
-------------------------	---	--	--	--------------------------	--	--	---------------------------	---

Evolutionary processes	Important refuge for natural forest species	The site plays a role of refuge for relicts of natural forest (in most of the cases they are invertebrates, fungi and plants dependent on dead wood)	Lack of complete data. There are some examples of the species which are recorded for last 50 years only from this site in Europe (<i>Aulanothroscus laticollis</i>). Probably there are many of such species.	Luck of data Not possible to estimate		Research communities (local/regional/national and global benefit) National Park (national state benefit) State Forests Administration (national state benefit)	Service in good condition	Yes due to decreasing naturalness of other forests and due to new role of the site in future (the source of species for other natural sites)
Wider socio-economic benefits								
Direct employment supported by Natura 2000 site	Lack of employment	In Poland single Natura 2000 sites do not have staff employed. Management and eventual active nature conservation is carried by site managers (usually State Forests Administration of National Park Administration)	0	0	Not applicable	0	Service is not in operation	Yes if any staff will be hired in the future

Indirect employment generated by Natura 2000 site	Staff employed in Life Nature projects	There are 2 Life projects carried in the site some site-related employment exists also on the regional (Regional Directorate of the Environment Conservation) and ministerial level	3	50,000 EUR		Local/regional inhabitants (local/regional private benefit)	Service in moderate operation	Yes due to fact that management of Natura 2000 will need more employment in the future and new Life+ programs will be implemented
Direct expenditure of the reserve	Preparation of management plans, species inventories,	The process of management plan preparation as well as inventories of species are not completed yet	The project of management plan has been prepared and some types of organisms have been inventoried	75,000 EUR		Local/regional inhabitants (local/regional private benefit) Local/regional/national research institutes (local/regional/national state benefit) Regional/national NGO (regional/national NGO benefit)	Service in moderate condition	Yes due to need of management plan effectiveness monitoring
Spending created by Natura 2000 site employees and volunteers supporting local economy	Lack of direct employees and volunteers	Lack of direct employees and volunteers	0	0		Lack of benefits	Service is not in operation	Yes due to future employment and need for volunteers

Natura 2000 site's role in supporting rural and regional development	Life Nature program	Bison land project has developed plan of regional development based on sustainable use of naturalness of the site	Life programs: 1. Bison land, 2. Protection of Emys orbicularis and amphibians in Lowland Europe	1,330,000 EUR		Local/regional inhabitants (local/regional private benefis) Local/regional communities and municipalities (local/regional municipal benefit) Local/regional business (local/regional private benefit)	Service in good operation	Yes due to increasing role of Natura 2000 sites in the future and increasing number of Life+ and similar programs
	Agro-environmental schemes	Payments for farmers at Natura 2000 land is higher	300-400EUR/ha			Local inhabitants (local private benefis)	Service in weak operation	Yes due to farmers' increasing knowledge about programs

	Additional scores for communities applying to European funds	Many regional and national programs funded by EU include an extra scoring for those communities which are operating at the Natura 2000 sites	8 communities have part of their territories in the site			Local/regional inhabitants (local/regional private benefit) Local/regional communities and municipalities (local/regional municipal benefit) Local/regional business (local/regional private benefit) Companies operating at the site (local/regional private benefit and national state benefit)	Service in good operation	Yes due to increasing rate of funds use
Natura 2000 role in regulation of real estate prices	The prices of parcels and buildings	The real estate prices in the Białowieża village and its vicinity are considerable higher than in other villages and municipalities in the region				Local inhabitants (local private benefit) Local/regional authorities (local municipal benefit)	Service in good condition	No, due to limited availability of real estates to sell

*Bartczak A., Buszko-Briggs M, Żylicz T. 2005. Koncepcja wyceny wartości lasów w Polsce. A report by Warsaw Center of Ecological Economy (University of Warsaw) for General Directorate of State Forests.

3. STATUS & FUTURE TRENDS OF DIFFERENT BENEFITS

Most of the identified benefits are in good status and their importance in the future is likely to increase. This increase is due to the expected development of tourism as opposed to forestry and wood processing which dominated in the previous century. Very important in that process are changes observed in environmental awareness and in attitudes to the forests. National society increasingly views the site as important for recreation or biodiversity conservation rather than for wood production. It is important to balance these with the broad array of benefits the site currently offers as a Natura2000 site. Nonetheless, a key issue remains the trade off between timber services and the broader recreational and cultural benefits the forest offers if not harvested for wood.

There are four types of benefits in Białowieża Forest site which are endangered and could deteriorate rapidly if appropriate care is not taken:

Water. Up to now this service has been secured in good condition. Its importance will increase in the future due to increased demand. At the same time there are important negative trends observed in the distribution and severity of precipitation events and an increase in mean annual temperatures (0.5°C since the 1950's) and decrease of the ground water table (approximately 20-40 cm in comparison to 1980's). These trends pose a risk for regulating services, especially for aquifer recharge.

Landscape & amenity values, especially those connected to local architecture, and broader cultural values. Technological progress and an influx of people from outside the region (even outside of the country) can cause a dilution of traditions. There is a lack of regulation concerning conservation of traditional architecture and spatial planning in national, regional and local law systems. The main action possible to undertake from the administrative point of view is development and implementation of effective spatial planning law which recognises ecosystem services.

Pollination. The decrease in number and diversity of pollinators observed globally is mirrored at the site. A worry trend given the role it plays in the provision of many plant products used by local communities. The pollination service in Białowieża Forest is supplemented by a high number of apiaries but often the problem is the quality not quantity. There are plant species that can only be pollinated by one species or one genus of pollinator and they can't be replaced by semi-domestic honeybees. The decrease in this service will negatively affect genetic and species diversity maintenance, crop production and many other provisioning services.

Genetic/species diversity maintenance is becoming more and more difficult due to climatic changes causing shifts in natural geographical ranges of species (the process already observed) and due to fragmentation and isolation of small populations of rare and highly specialized species (e.g. the natural forest relicts). Certainly these trends will pose a risk for supporting services, especially for **ecological interactions** (some species will decline, the other – invasive aliens will increase) and **evolutionary process** (decline of interacting partner species must bring change in evolution of species and ecosystems).

4. KEY MESSAGES FOR THE FUTURE MANAGEMENT OF THE SITE

4.1. The most important benefits provided by the site

The most important benefits have traditionally been timber and firewood. Firewood for local communities should remain a priority but the provision of timber jeopardises many other services provided by site. There is conflict between maximising wood extraction and nature conservation and tourism development) which has been escalating during last 20 years. Indications from this report suggest the non use values of the forest, estimated at **€4,000,000,000** substantially exceed the annual returns to forestry of **€6,500,000** annually. However, the non use benefits, associated with landscape and cultural attractiveness are not paid for by the beneficiaries, whereas, foresters obtain income from timber production.

Another important benefit provided by Białowieża Forest Site is honey and bee products which rely on pollination. These closely related services have an internal conflict as if the influence of very high densities of honey-bee reduces the diversity of other pollinators and, as a consequence, the pollination of specialized plants. The value of honey and other bee products is estimated to be **€ 100,000** per annum but the value of pollination is probably many times higher – though not possible to estimate for this report. Future management should develop monitoring scheme of pollinator species and populations.

High importance must be attached also to water service and its benefits. Its monetary value reflects direct benefits only (drinking, washing, etc.). The continued supply of this service depends on sustainability of use, which should not exceed capacity of aquifer recharge. Increasing consumption of water should be compatible with local annual water balance. Maintenance of forest cover at the site, slowing down water run-off and implementation of sustainable water use habits between the local stakeholders are essential to assure water ecosystem services.

As noted, ecotourism and recreation are already a key ecosystem service at the site, and it already generates the highest number of jobs in the Białowieża community (nature conservation and tourist sectors). This benefit has the potential to develop. Managers of the site must take care of ecosystems and prepare rules of access and touristic infrastructure in the way which will protect ecosystem services from overexploitation.

Research and Education activities are very well developed in Białowieża Forest. This service generates many side-benefits at the local level (employment, services, expertises) but the highest value (not possible to estimate in monetary units) benefit of this service is in understanding the functioning of natural forest ecosystems and populations of species building such an ecosystem. This benefit has global value.

Landscape / Amenity is a very important benefit and is built on the uniqueness of this natural landscape in modern Europe. Site managers must closely cooperate with the other authorities to assure continuity of these ecosystem services without harm for the rest of benefits.

Carbon sequestration will become more and more important as a site benefit. There is no data yet available on this service in Białowieża Forest itself but there are many scientific papers published worldwide pointing importance of forests in the process of carbon sequestration and by this also in moderating climate change.

Genetic/species diversity maintenance is extremely important for all levels of beneficiaries. The benefits in the case of Białowieża Forest are very high as this site is the last (or one of the last) refuges for many natural forest relict. Many regular species common in Poland or Europe have high genetic diversity, making them different from other Polish or European populations (e.g. grey wolf *Canis lupus*, chequered skipper *Carterocephalus palaemon*). This diversity is at least partly effect of very long tradition of forest protection at the site (according to some authors it is protected for various reasons since the beginning of 15th century) as well as effect of overlapping here ranges of genetic pools which survived glaciation in eastern and southern refuges. The future management of the site should minimize intervention in forest ecosystems to suport natural forest species (the main goal) but should intervene in clearings and river valleys to stop forest succession and allow survival for organisms typical for open areas surrounded by forest. Such approach will promote supporting services: such as decomposition, nutrient cycling and water cycling.

Many services discussed above are associated with the existence of the European bison, an iconic and charismatic species. It is a food source and symbolizes strength and robustness, becoming an emblem of many Polish products and enterprises. Many local (e.g. restaurant *Żubrówka*, sport club *Żubr*, B&B *Pod żubrami*), regional (e.g. Bison-Bial from Białystok – producer of technological equipment) and national (e.g. one of the biggest Polish banks – PKO SA) have a bison in emblem. It is also a recognized trademark (e.g. Polish flavoured “Bison Vodka” - *Żubrówka*). Bison serves also as a main model for local souvenirs sold to visitors. Current system of European bison protection is well organized at site, national and global level, and should be continued.

4.2. Benefits in danger

Water. It is one of the very important services under threat. One can't change the distribution of precipitation in time but one can slow down the surface water run-off by building artificial barriers or simply leaving dead trees lying on the ground and blocking water run-off. It is also possible (and very advisable) to decrease consumption of water per capita by local communities and visitors.

Landscape & amenity values: local architecture and traditional spatial order and mosaic of nationalities, cultures and religions. Counteracting the lost of cultural identity of local societies is very difficult, especially with increased population mobility in Europe. Local architecture and spatial order can be preserved in regional and national spatial planning laws.

4.3. Ecosystems services with potential to increase their importance

Large number of services provided by Białowieża Forest Natura 2000 site are likely to increase their importance. There are two main factors influencing them; an increase

in the number of visitors and negative changes in the climate and surrounding natural areas. The identified benefits with potential to increase their importance are: The importance of food gathered in the forest will increase because we observe increasing interest of customers searching for natural food products in fresh or processed form.

Wood handcrafts is not a sustainable service as the tree species (small-leaved lime *Tilia cordata* and Norway maple *Acer platanoides*) preferred by handcraft producing sculptures and other wooden souvenirs are much rarer than many other trees. The problem of raw material supply can be solved in two ways: by obtaining external sources of the wood (rather difficult as both species are rare in Polish forests) or by replacing them by another, more common species e.g. silver birch *Betula pendula*.

Biochemicals & pharmaceuticals are not sufficiently recognized in the region. It is possible however that this service can bring large benefits in the future owing to high plants and fungi diversity at the site.

The importance of all ecotourism & recreation benefits is very likely to increase. The number of visitors has increased during the last 15 years by 5-10 per cent annually. Increasing the number of tourists can jeopardize provision of this service, so management must be careful not to exceed tourist capacity at the site.

Landscape & amenity values: natural forest landscape is likely to increase its importance due to increasing difference between cultivated landscapes (agricultural and forest) and natural landscape of the Białowieża Forest.

Climate change regulation will very likely become an extremely important as climate change further accelerates. Scope of this benefit will depend on changes witnessed by region. As the Białowieża Forest ecosystem is still in quite natural state it will adapt to changing environment itself. If left intact it will provide service of the climate change regulation.

Wider socio-economic benefits will increase their importance if the Natura 2000 network develop further, with connections between the site and proper management. Funding, profits brought to the region owing to the site will change attitude of local inhabitants towards conservation. Future site managers will have to launch PR and educational programs to increase knowledge about benefits of Natura 2000.

4.4. Can identified benefits be sustainably managed and promoted?

It is possible to divide identified benefits into four distinctive groups which differ in resources implications and their sustainable management.

The first group of benefits relate to plant biomass production and regulating services. These are benefits which can be sustainably promoted but very often are not considered at the local scale because the benefits are not evident (e.g. the climate regulatory functions of forests) They are not in conflict with the conservation goals of Natura 2000 but need to be publicised more.

The second group of benefits are those associated with the sustainable use of forest resources. These include collecting wild berries, and other goods for household use or local trade. Extraction of these resources can be managed sustainably. They developed and evolved over a long time by interactions between the local people dependent on forest resources and the forest ecosystem. Most of these services do not jeopardize the conservation goals of the Natura 2000 site.

The third group of benefits are those developed primarily for commercial reasons such as timber, honey and hunting. These are services which could be in conflict with site's conservation goals. This group of benefits is very often in opposition to other services and there are many trade-offs needed between them and the other groups of benefits to achieve their sustainable management and promotion.

The fourth group of benefits are those increasingly recognised in post-industrial times and relate to more intangible benefits of inspiration, education and mental wellbeing associated with natural habitats. All of these are based on sustainable use of nature and very strongly dependent (locally) on the quality of the surrounding nature. For these benefits all three values: quantitative, qualitative and monetary are balanced.

The first two groups of benefits are nature oriented and very local. The fourth group of benefits includes those services, which are opening access to wider society and emphasising the forest's cultural importance. All of these services need very careful management and finding a balance between income of local communities and conservation of natural resources. The first, second and fourth groups of benefits are 'ecocentric'. The third group of benefits is often in opposition to other groups and there is a need for some trade-offs which site management needs to make.

4.5. Possible implications in the wider context of Natura 2000 Network

The Białowieża Forest Natura 2000 site is adjacent to another SPA Dolina Górnej Narwi but the character of this site is completely different. Dolina Górnej Narwi is a boggy river valley. It can't be treated as Network connectivity because habitats and goals of conservation are very different at the two sites. There is no connection with another site further north, SPA and SAC Puszcza Knyszyńska which is similar to the Białowieża Forest in character. There is a planned SAC site 'Jelonka' west of the Białowieża Forest, which has a forested cover but these are much younger and poorer forests.

In the light of situation described above it must be stated that there is no connectivity of the sites with Białowieża Forest, which makes migrations of plants and smaller animals impossible. To cope with this problem future managers of the site should launch projects aimed on rising of ecological awareness of local stakeholders and seek for external funds (e.g. Life+) allowing for paying for eventual modifications in land use by local land owners.

4.6. Suggestions of future actions

The first and most important action to undertake as soon as possible is development of the site's management plan. The project of management plan prepared in 2003 was

never implemented because it was contested by local authorities which did not accept and did not understand the idea of Natura 2000 network. So the second issue to address is providing information and educating the local authorities in the field of Natura 2000 network benefits, otherwise implementation of the management plan will still meet serious obstacles. This valuation exercise can contribute to gaining acceptance for the future management plan by showing the value of the wide range of benefits provided by the site. Only open public consultations will lead to development of good and acceptable management plan. We believe that this case study will become a useful tool in this process.

There is a need for improving the ecological connectivity between the existing Natura 2000 sites in the way which will allow the movement of species (e.g. protected species) between the sites. Connectivity of the network can be improved with use of supplementary funding from Life+ and other programs cofounded by EU. This case study can contribute to projects preparation through identification and valuation of benefits provided by the site.

4.7. Conclusions

The Białowieża Forest delivers local socio-economic benefits and several regional/global benefits related to the ecosystem's ability to maintain and control natural processes (e.g. maintenance of genetic/species diversity, floods regulation, climate change mitigation).

Recognition and support of the Natura 2000 network will be enhanced with more complex valuation of ecosystem services in the future. Even now, many beneficiaries (e.g. some B&Bs') do not see any connection between income generated by their enterprises and ecosystem services provided by the Białowieża Forest. They must be educated and informed in this subject and managers must develop mechanisms of recognising or capturing the services provided.

All decisions considering commercial use of goods from the Natura 2000 site should take into consideration the overall value of the site, not limited to the monetary value of one service. Management should always aim at finding a balance between biodiversity conservation, sustaining of ecosystem services and assuring fair distribution of the costs and benefits of conservation especially to local inhabitants.

Natura 2000 designation allows for a new, holistic approach to nature conservation in the Białowieża Forest. Local stakeholders must understand that the site provides not only monetary benefits but also a very wide range of regulatory and other socio-economic services. This evaluation exercise shows that these benefits are connected to each other, and that overexploitation of one service can jeopardize the others or disturb the whole system. This case study can be used in negotiations with local authorities and communities in the process of management plan implementation, to show benefits and trade-offs of the existing network of protected areas.