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CHANGING OF ECOSYSTEM FUNCTIONS IN THE HORTOBAGY AREA

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ABSRACT
The study presents the interactions between people, biodiversity and ecosystem in the last 50 years. Changing anthropogenic conditions drive, both directly and indirectly, changes in biodiversity, ecosystems and ecosystem services. To enhance the conservation and sustainable use of ecosystem and their contributions to meeting human needs. Because the basis of all ecosystems includes a dynamic complex of plants, animals, microorganisms and biological diversity. Stability of ecosystems, and the changes of ecosystem functions to affect the land uses by human activity. That is changing supporting, provisioning, regulating and cultural ecosystem function.
Many factors depend on changes in biodiversity affect the human condition and that biodiversity is influenced by many natural forces that are not associated with humans. Present paper discuss these changes of the sensitive area of the Hortobágy plain (NE Hungary),the largest continuous natural grassland (puszta) in Europe. Changes of ecosystem functions were studied from the 1960s, broken down by ten-year periods, giving median values. The study targeted the different agricultural land uses, changes of the ratios of agriculturally used crop lands and livestock, and also changes of the ratio numbers of protected animals, and plants.

Keywords: natural resources, land-use, Hortobágy

INTRODUCTION:

Ecosystem service and classification his function has been a hot topic in ecological reserch. Ecosystem services are increasigly promoted as a means for documenting the value humans place on ecosystems eveluating benefitts derived from natural resources (Millennium Ecosystem Assessement, 2005) This is an important trend, and particularly important in the case of biodiversity conservation where values are often difficult to describe in economic terms and rarely well-explained in natural resource decisions. Ecosystem services can be defined as the conditios a process trought which natural ecosystems and the species that comprise them, sustain and fulfil human life (Daily, 1997), or the goods and services provided by ecosystem which contribute to human welfare, both directly and indirectly (Constanza et. al., 1997a). The concept of ecosystem services encompasses the delivery, provision, production, protection or maintenance of a set of goods and service that people perceive to be important. Ecosystem services can be defined in myriad ways dependent on scale and perspective. I will estimate changes in land-use and ecosystem services values due to urban (agricultural) spawl in Hortobágy. This territory is the largest continuous natural grassland (puszta) in North-Eastern Hungary with, 80.000 ha area. The soil characteristics of Hortobágy are grassland clay, sodic, chernozem loam, sandy loam, alluvial and sandy soils. The land-use was started in the 1200s, and it was a near-natural land-use, but this form of land-use has changed after the 2nd World War, especially from 1960.

Classification of ecosystem functions, goods and services

An **ecosystem** is a dynamic complex of plants, animals, microbes, and physical environmental features that interact with one another. **Ecosystem services** are the benefits that humans obtain from ecosystems, and they are produced by interactions within the ecosystem. Ecosystems like forests, grasslands, and urban areas provide different services to society. These include provisioning, regulating, and cultural services that directly affect people. They also include supporting services needed to maintain all other services. Some ecosystem services are local (provision of pollinators), others are regional (flood control or water purification), and still others are global (climate regulation). Ecosystem services affect human well-being and all its components, including basic material needs such as food and shelter, individual health, security, good social relations, and freedom of choice and action (Millennium Ecosystem Assessement, 2005).

In the past few decades, the field of ecological economics has witnessed a spectacular rise of concern with the valuation of ecosystem functions, goods and services. Early references to the concept of ecosystem functions, services and their economic value date back to the mid-1960s and early 1970s (King, 1966; Helliwell, 1969; Hueting, 1970; Odum and Odum, 1972). More recently, there has been an almost exponential growth in publications on the benefits of natural ecosystems to human society (Turner, 1993; De Groot, 1992, 1994; Bingham et al., 1995; Daily 1997; Costanza et al.,1997). The first step towards a comprehensive assessment of ecosystem goods and services involves the translation

of ecological complexity (structures and processes) into a more limited number of ecosystem functions. These functions, in turn, provide the goods and services that are valued by humans. In the ecological literature, the term 'ecosystem function' has been subject to various, and sometimes contradictory, interpretations. Sometimes the concept is used to describe the internal functioning of the ecosystem (maintenance of energy fluxes, nutrient (re) cycling, food-web interactions), and sometimes it relates to the benefits derived by humans from the properties and processes of ecosystems (food production and waste treatment).

Ecosystem services are to provide an effective framework for natural resource decisions, they must be classified in a way that allows comparisons and trade-offs amongst the relevant set of potential benefits. In the language of the Millennium Ecosystem Assessment (2005), this means that the full range of benefits reflecting human well-being from ecosystems must be represented in any effective typology of ecosystem services.

Table 1 below provides an overview of the main functions, goods and services that can be attributed to natural ecosystems and their associated ecological structures and processes. The first column indicates a list of 23 functions and the second column lists the ecological structures and processes underlying these functions. The third column provides a more detailed list with examples of specific goods and services derived from these functions.

Table 1: Function and servises of natural ecosystems, (by de Groot, 2002, MA, 2005)

Functions	Ecosystem process	Goods and service
Regulation function		
Air quality regulation	Role of ecosystem in bio-geochemical cycles	UVb – protection, maintenace of (good) air quality, influence on climate
Climate regulation	Influence of land cover, and biol. mediated process on climate	Maintence of a favorable climate (human habitation, health, culivation)
Disturbance prevention	Influence of ecosystem structure on dampening env. disturbances	Storm protection, flood prevention (by wetlands and forests)
Water regulation	role of land cover in regulating runoff and river discharge	Drainage and natural irrigation, medium, for transport
Erosion regulation	Role of vegetation root matrix and soil biota	Maintenance of arable land soil retention Prevention of damage from erosion/siltation
Diaseas regulation	Population control through trophic-dynamic	Control of pests and diseases relations Reduction of herbivory (crop damage)
Pest regulation	natural control degraded through pesticide use	Control of pests and diseases.relations Reduction of herbivory (crop damage)
Pollination	Role of biota in movement of floral gametes	Pollination of wild flora Pollination of crops
Natural hazard regulation	Loss of natural buffers (wetlands)	
Provisioning function		
Food	Conversion of solar energy into edible plants and animals	Crops, livestock, capture fisheries, aquaculture, wild foods Fuel and energy (fuel wood, organic matter). Fodder and fertilizer (krill, leaves, litter).
Raw materieals (fiber)	Conversion of solar energy into biomass for human construction and other uses	Timber, cotton, hemp, silk, wood fuel
Genetic resources	Genetic material and evolution in wild plants and animal	Lost throught extinction, and corp genetic resource loss
Medicinal resources	Variety in (bio)chemical substances in, and other medicinal uses of, natural biota	Biochemicals, natural medicines, pharmaceuticals
Habitat functions	Providing habitat (suitable living space) for wild plant and animal species	Maintenance of biological & genetic diversity (and thus the basis for most other functions)
Refugium function	Suitable living space for wild plants and animals	Maintenance of commercially harvested species

Nursery function	Suitable reproduction habitat	Hunting, gathering of fish, game, fruits Small-scale subsistence farming & aquaculture
Water supply	Filtering, retention and storage of fresh water	Provision of water for consumptive use (drinking, irrigation, indrustrial use)
Cultural Function		
Cultural and artistic information	Variety in natural features with cultural and artistic value	Use of nature as motive in books, film, painting folklore, national symbols, architect., advertising
Aesthetic information	Attractive landscape features	Enjoyment of scenery (scenic roads, housing)
Recreation	Variety in landscapes with (potential) recreational uses	Travel to natural ecosystems for eco-tourism, outdoor sports,
Spiritual and historic information	Variety in natural features with spiritual and historic value	Use of nature for religious or historic purposes (heritage value of natural ecosystems and features)
Science and education	Variety in nature with scientific and educational value	Use of natural systems for school excursions. Use of nature for scientific research

Given these restrictions, important non-renewable natural mineral resources are excluded. Furthermore, energy sources that cannot be at tributed to a certain ecosystem type are excluded, like a wind and solar-energy. Some non-ecosystem specific functions that can be used without (permanently) affecting the other functions, such as the use of natural waterways for transportation, are included. Also some mineral resources that are renewable within a time-frame of 100–1000 years are included. Natural processes, in turn, are the result of complex interactions between biotic (living organisms) and abiotic (chemical and physical) components of ecosystems through the universal driving forces of matter and energy.

Materials and methods:

In addition to my own collection, necessary information was obtained from the Central Statistical Office and the T-STAR database. Changes of the farming structure were studied from the 1960s, in ten-year periods, giving median values. The study targeted the different agricultural land uses, changes of the ratios of agriculturally used crop lands and livestock. This deep interview was made by me and Mr. Csaba Göcz who was in charge of agricultural production on this territory of over 150 000 ha from the late 1960s. I have a contact with staff of the Natural Park, funded in 1972, in this territory. I estimated changes in land-use between 1960 and 2000.

RESULTS AND DISCUSSION:

Land-use calssification

Most of the north-eastern Hungary has been extensively altered by human activity since the late Neolith period. Hortobágy belonged to earlier communities in this territory. The natural richness of the Hortobágy is a typical example of how important a role the traditional ways of land use, existing and functioning for several thousand years, can play in the preservation of this area of great biological diversity. The land-use changes during the last 200 years were a response to human history that was dynamic in population size, technology, mobility, economic structure, and intensive interaction with the landscape. The effect of human history on the structure and management of the territory of Hortobágy has been a focus of study for soil scientist (Várallyay, 2006), economists (Oláh, Nemessályi, 2002), and ecologists (Veress, et al., 2000).

The necessary land-use database of Hortobágy was complied with the help of raw data from the agricultural census conducted by the Central Statistical Office and the T-STAR database in the years 1972, 1981, 1991 and 2000. I will use the database of Hortobagy State Company and database his forber Hortobágy Syndicate Commission.

Changes of farming structure were studied from the 1750s, broken down by ten-year periods, giving median values. The study targeted the different agricultural land uses, changes of the ratios of agriculturally used crop lands and livestock.

The territorries of elaborate land was change permanently. In the 1960s, farming started on an area of 30 351 ha, whereof, in correspondence with the planned agricultural profile, the largest share was given to meadows and pastures that occupied approximately twice as much area as the plough-lands at the time. Many especial forms of the agricultural were attended in Hortobágy puszta. That was the cultivation cotton, and gum dandelion and breeding of gees. Table 2 below provides an overview of the main landuse forms in the Hortobágy.

In the aspect of this examination I choosed these categories and sub-categories in case of Hortobágy.The signed categories in the table are recognable among the provisioning ecosystem service functions. The main part of these affect is the regulating functions.

Table 2: Landuse categories in Hortobágy

Categories	Definition
Plough land	Plough land, paddy field, irrigable land, and vegetable field
Orchard	Orchard that is cultivation in small garden fruit and vegetable
Grassland	Natural grassland and man made grassland, it's mean meadows and pastureland, crops
Woodland	Some forests alog the fields and coastal lines
Water body	Rivers, canals, fish ponds
Wetland	Sodic lake, mosses, awash territories, settling lakes
Build up land	Land used for industrial, commercial, residential, transportation ends
Unused land	Land unused or difficult for using, barren lick

Plough-land: mainly using for arable farming. Products: corn (seed and fodder), wheat, oat, barley, millet, rape, sunflower, alfalfa. All these products need farm inputs and with an irrigation system the yield are raiseable. The rice growing was in cages in the natural fields, but today the rice growing is ended but these cages service good ecological potential with a special animal fauna.

The home gardening can contribute a smaller part to the ecosystem services. Grassland, such as pauster land and meadows are typical signals of the Hortbágy landscape, service the extensive animal husbandry.

Woodland is not an important habitat in case of Hortobágy. There are some larger (2-300 acres) natural oak forest such as Ohati, Margitai, Juhosháti, Papegyházi. Main function is the natural protection.

Waterbodies – permanent or periodic forms. The permanent water bodies are the rivers (River Tisza, River Hortobágy, the Árkus and the Kadarcs) and the lakes. In case of the lakes there are old lakes (the Öreg-lake and the Ohat-lake) before the ragulation of rivers and after the river control the dead channels. The permanent water bodies are disorganised and extended, typical in the spring and in autumn. Build up lands are populated, settlements, bitumen covert and hasn't got ecological functions. Unused land – barren licks, wastelands are not good for production.

Factors which influence the changing of ecosystem services

The effect of changes in land use on ecosystem services was studied by me.

Handling of the Hortobágy puszta began very early in the history. We can distinguish different periods in interventions.

The early relationship of man and nature was characterized by gentle use. This gentle use did not harm the natural systems, which were made up of a mosaic of dry and wet habitats, nor did it decrease their biological diversity interfere in the ecological processes determining the operation of the system. Man exploited a negligable part of the natural resources and wildlife for his own purposes and, with his vital functions; he did not harm the quality of his natural environment, either. Man discovered that, following floods, rich pastures and hayfields spring. He tried to control the water from the floods, and make it serve to his advantage. This conscious, controlled use was based on the exploitment of the potentials provided by the natural floodplain, and did not disturb the water balance of the area (Prokisch, et al., 2007).

The regulation of the river Tisza played an important role in the development of the present appearance of the Hortobágy. The floods that had covered a major part of the grassland ceased to exist, and the river no longer spread rich silt on its surface. The extension of the marshlands that had become isolated from the river decreased rapidly, and so did the area of the meadow-lands. The draining process and the periodical water cover caused by rainwater started a secondary alkalization process. The series of ecological changes that began after the regulation of the Tisza has not ended yet, since the delayed ecological processes still play – an will probably do so for a long time – a determinant part in the modification of the natural scenery of the plain. The proportion and composition of the characteristic plant communities of the alkali grasslands has changed, and the grass yield of the pastures has decreased.

The different forms of farming on the area greatly influenced the development of the surface of the Hortobágy. The basis of farming is grass, so grazing animal keeping has proved to be the self-evident way of agriculture. The livestock population has increased, which led to the beginning of an over-grazing process, and the internal grazing lands were ploughed up so as to ensure the winter feedstuff. At that time, Debrecen – as regards its number of livestock – got on the world ranking list (Table 3)

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Table 3: Landuse changes in the Hortobágy

Land use categories	1960 Area (ha)	1970 Area (ha)	1980 Area (ha)	1990 Area (ha)	2000 Area (ha)	1960-2000 Area (ha)
Plougland	5379	5610	5350	3215	2802	-2577
Orchard	3	4	7	7	7	4
Grassland	16179	10221	10100	12821	13006	-3173
Woodland	875	825	820	814	796	-79
Waterbody (fish ponds)	7150	6920	6431	5011	4070	-3080
Reed	551	570	1345	1869	2183	1632

After the 2nd World War, economy began to decline due to the conjugate effects of several factors. Change in the ownership of land (parcelling up into state estates and then their re-unification), development of inappropriate branches (exceeding the natural tolerance bounds, keeping fast economical profit animals), change in the market demands on animal final products, qualitative and quantitative decrease of grazing lands, spreading of plant cultivation.

Table 4: Livestock changes in the Hortobágy

	1960	1970	1980	1990	2000	1960-2000
Cattle	2172	2615	2980	2955	2681	509
Pig	7489	7820	7905	5015	1870	-5619
Horse	630	715	608	520	385	-245
Sheep	31838	33200	29020	14835	6485	-25353
Poultry	59949	450300	690100	71500	20891	-39058
Bee	48	69	36	55	46	-2

Table 4 presents that an area rich in resources was developed from the 1950s, leaving the potential of natural sources out of consideration. The run out of resources (overpasturing) involved the collapse of economic which based on the resources. About this the society was stimulaten by economical arguments. The society is accountable for the downward tendency of forest ecosystems. This area is unsuitable for economical silviculture. The forest can play on the temperature regulation. After the 1980s the cultivation of plants and the animal husbandry decreased. Without farm inputs the growing is not working in the ploughed lawn. The large livestock decreased, weakened and perished without fodder. Consequently the economical inteventions usually made a negative effect on the natural resources of the Hortobágy puszta.

NATIONAL PARK IN HORTOBÁGY

The beginning of a positive process from the point of view of ecosystem services.

The Hortobágy National Park, established in 1973 was the first national park in Hungary. It covers of ca. 53.000 hectares. Today this National Park is the largest protected area in Hungary, with ca. 82 .000 hectares. The major part of the area is formed by natural habitats, alkaline grasslandsand meadows, smaller and larger marshes enclosed between them. Hortobágy National Park has been inscribed on the World Heritage List by UNESCO on the first of December in 1999 in the category of cultural landscapes.

Ecosystem services show a rising tendency mainly in rich biodiversity areas. National Parks with theirs protecting and reconstruction activities contribute to fortification of provisioning function of ecosystem services in a passive way, that National Parks stabilize genetical resources, Biochemicals and natural medicines cathegories. The Hortobágy National Park with other activities contributes to stability of ecosystem services, such as: water management, water recources development, hunting and wild animal managment, silviculture, lawn management, reed management, horticulture, bee-keeping, herbs, ornamental plant management.

Ecosystem sevices value

In the results of the table can be seen, that the bigger parts of natural areas were plought for agriculture. How did it influence on ecosystem functions? Using the method of the Millennium Assesement we can see how is the position of the present ecosystem service in this area. (Table 5)

Table 5: Changes of ecosystem services in Hortobágy

Provisioning Function Services	Sub-services	Status
Food	Crops	decreasing
	Livestock	decreasing
	Capture fisheries	decreasing
	Aquaculture	increasing
	Wild foods	decreasing
Fiber	Timber, wood fuel, reed	increasing
Genetic resources	Protected species (animals/plants)	increasing
	Extraordinary species (animals/plants)	increasing
	Increased protected species (animals/ plants)	increasing
Biochemicals, natural medicines	Herbs	increasing
Water	fresh water	decreasing

The effect of the decreasing of plough-lands will appear in the other side of the ecosystem service (as constituents of well being), in the food supply (basic material for good life) and later in the human health. The decreasing of livestocks will cause a same situation. But against the theory of the MEA, in this case the environmental overuse caused that status. Other cause was the sensitivity of the area and the low productivity of genetical solis.

The decrasing of captured fisheries follows the MEA theory. Earlier data than examed years prove, that the area was suitable for natural fishery. After drainage, stocks of fishes wich arrived with periodic water are missing. In the 1800s started the aquaculture and could make some change. The varying rate of aquaculture was influenced mainly by the political transformation and the privatization. In spite of the fact the aquaculture is the one of the most important sector in the area, and in the future it would be a good possibility.

Because this area is a wet territory the stock of game are suitable for this area. The wild animals, as food, played an important role mainly until the 1900s. The withdrawal of theirs populations and processes of protection decreased the functions of the stock of game. Wild geese, wild ducks, bustards, cranes, foxes, wolves, hamsters and hares pertained to former stock of game. Radical change of territories explains the decrease of these populations.

The reed management is determinant in the fiber function. The forests play an important role in genetical resoureces. The reed management keeps growing continuously and this can be another good possibilitiy in the future.

Genetic resources – the forming of the National Park produced a positive effect on plants – and animal populations, thus on the protection of the genetical resources and fortify the provisioning - and regulation functions in ecosystem services.

The Hortobágy have been being famous from earlier time about its herbs, as the Chamomilla recutita, and Artemisia absinthium, Origanum majoranna.

The water supply is decreasing, the fresh water supply is the Eastern Channel.

CONCLUSIONS

As the human society plays an ever more determining role in the ecosystem metabolism, the research of the activities and material handling of man as a key species, i.e. of the society metabolism necessarily comes to the front. In this, the demography, economy, culture, sociology, political and power structure and operation of local communities are determining.

With the method of MEA can establish how far influenced the land use in past the status of ecosystems in present. This form of land use provide a future picture, that it can be ascertained the measure of damage of natural resources and does damaged natural resources enough for covering society welfare.

In case of Hortobágy landuse reportable, that it show different pictures int he last 50 years. In the 1960' we can meet intensive plant growing and animal husbandry, but the husbandry show a slow drop, the plant growing a faster. The explanation is the sensitivity of this area. The result of this process the conformation a secondary area, which needs maintenance. The Natural Park plays an inportant role in it.

Thus the landuse of this area has changed from the last 50 years. In these days the sustainable use characterize, such as animals, that was kept sometime on an intensive mode: grey cattle, 'racka'sheep, horse and 'mangalica' swine. Their was kept earlier as genetical livestock but today as bio product for food.

The plant growing dicreased, the uncultivated areas used as pastureland for re-enactment and herb growing is momentous.

An extra form of sustanable managements the reed- and the fish management. These forms were typical in the

early Hortobágy also. The prevalent inland inundation was very favorable for both of them and in these days their can contribute to imagination of present landscape and supply work, living and income for society for long term period. Supposedly, these two forms of managements become dominant in the future picture of Hortobágy.

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