# GAME MANAGEMENT IN HUNGARY - HOW CAN IT BE INFLUENCED BY CLIMATE CHANGE?

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According to the theories accepted by the scientific community, the recent changes in climate can be at least partly attributed to the activities of mankind. As different parts of Earth are warmed separately, the changes in other meteorological parameters also show variations (LÁNG ET AL., 2007).

Changes in climate will force individual species of plants and animals to adjust, if they can, as they have in the past. Migrations would be much more difficult because they would entail migration across highways, agricultural zones, industrial parks, and 21st century cities. An even further complication arises with the imposition of the direct effects of changes in $CO_2$, which can change primary productivity as well as alter the competitive relations among photosynthetic organisms (ROOT AND SCHNEIDER, 2002). During this century, projected changes in temperature and precipitation patterns are expected to intensify the impacts on species and ecosystems in many areas. Floods, rapid expansion of invasive species, and disease outbreaks — all attributed at least in part to climate change — are challenging the management of natural resources throughout the world (TWS, 2005).

Even in Europe there are areas where the rising temperatures are accompanied by drying; meanwhile in other areas the amount of precipitation is increasing. In order to prepare for the approaching climate changes it is necessary to recognize what kind of climate and/or the frequency of natural disasters can be expected in the future. These changes can be studied by climate models projecting different long-term scenarios. On the basis of the model projections it is possible to evaluate the actual patterns of meteorological parameters as well as the expected future patterns. Making this distinction is important, because in many cases the real values don't agree with those projected by the climate models (e.g. seasonal patterns of precipitation in Hungary: SZALAI, 2010).

Furthermore, it should be emphasized that climate can't be forecasted with a high level of confidence and the probabilities are continuously changing as knowledge and understanding improves. In Hungary the temperature is increasing at a rate that is higher than the global average. This increasing tendency applies to the yearly averages and also to the seasonal means. The highest change is observed in the summers where it is >1 °C. In the case of precipitation the pattern is different, because, with the exception of summer, the average rainfall amounts are decreasing. One of the most significant consequences of the climate changes is the longer vegetation period, which is 1 week on the European level. This results in faster development of plants in the spring. As a consequence of the meteorological changes, the global and regional distribution of production sites, habitats, and optimal conditions can be shifted. This can be critical in case of species at the edge of the range, or it could open the way to range expansion for invasive species (SZALAI, 2010).

In Hungary, water (precipitation) is the primary limiting factor for agricultural production and natural ecosystems. As several elements of surface water supplies show unfavourable changes, this pattern will influence the habitats and living conditions of species living in areas used for agricultural production, forestry or reserved for nature conservation. According to the climate projections for 2050 and 2100, the climate in Hungary will be much drier, and in the case of woodlands, conditions favouring forest-steppe vegetation will occur (LÁNG ET AL., 2007). In the mid-21st century the humid zones of west Hungary will vanish and by 2100 the central parts of Hungary will be dominated by semiarid zone. It is important to stress that temperature and precipitation changes interact with soil changes and vegetation (DRUCZA AND ÁCS, 2004).

According to the latest ministerial decree, 32 species are listed as game species in Hungary. (FVM, 2010). Regarding the 8 big game species listed, five can be considered as important in game management and hunting (red deer, roe deer, fallow deer, mouflon, and wild boar). Of the 24 small game species, only four (brown hare, common pheasant, mallard, and red fox) have a country-wide range and larger management importance. Other small game species either have diminishing game management and shooting roles or their shooting bags are only locally important (waterfowl, pigeons).
The population sizes and the harvests of five big game species showed a considerable increase during the last half century (1960 - 2008/2009):

- Red deer - the population increased from 16700 to 87100 (521%) and the harvest from 3800 to 36200 (954%)
- Fallow deer - the population increased from 900 to 26700 (2967%) and the harvest from 100 to 9600 (960%)
- Roe deer - the population increased from 68800 to 350000 (508%) and the harvest from 37008 to 6100 (1251%)
- Mouflon - the population increased from 1400 to 10500 (752%) and the harvest from 200 to 2900 (1450%)
- Wild boar - the population increased from 8300 to 99300 (1197%) and the harvest from 3900 to 94400 (2420%)

At the same time, the most important small game populations declined seriously (1960 - 2008/2009):

- Brown hare- the population decreased from 1240000 to 524000 (44%) and the harvest from 508000 to 132000 (26%)
- Common pheasant - the population increased from 383000 to 795000 (208%) and the harvest from 97000 to 422000 (435%)[1]
- Grey partridge - the population decreased from 759000 to 37000 (5%) and the harvest from 100000 to 11000 (11%)[2]
- Wild ducks (mainly mallard) – their harvest declined from 90000 in early 1970s to 51000 in 2008 (56%).

Similar patterns of population trends of game species can be found throughout Europe. In general, the most common ungulates (big game) show marked population increases, especially roe deer, wild boar, and red deer (MILNER ET AL., 2006; BURBAITE AND CSÁNYI, 2009; APOLLONIO ET AL., 2010). Simultaneously with population increase, a fast range

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1 Here it should be noted that the maximum spring population was 2428 thousand pheasants recorded in 1978 and the maximum pheasant harvest was 1102 thousand in 1977. Since those times the trend of pheasant populations and harvests was the same as for brown hare and grey partridge.

2 Only hand-reared and released birds are allowed to shoot. Consequently, partridge harvest is not related to the status of the wild populations.

extension of big game species occurred in Hungary. In case of red deer (CSÁNYI, 1999; TÓTH AND SZEMETHY, 2000), roe deer (CSÁNYI AND SZIDNAI, 1994), and wild boar (CSÁNYI, 1995) these were consequences of mostly natural population expansions. In case of fallow deer (TÓTH, 1991) and mouflon, (NÁHLIK, 1996) the expansion was assisted by deliberate introduction and establishment of fenced hunting enclosures (CSÁNYI AND LEHOCZKI, 2010). For the population increase of red deer, roe deer, and wild boar the following factors and their interactions can be proposed (APOLLONIO ET AL., 2010):

- Increasing forest cover providing more available habitat for big game species.
- Changes of agricultural land-use offering better habitat conditions for ungulates.
- More restrictive hunting legislation influencing hunting pressure (seasons, methods, number of hunters) and allowing ungulate populations to escape out of control.
- Ecological effects resulting from human activities and environmental changes, like climate change, locally or regionally improving the conditions for these species.

In case of small game species their declining trends can be accredited to human and/or environmental impacts (POTTS, 1986; FARAGÓ, 1997; CSÁNYI ET AL., 2006):

- Changes of agricultural technologies and land-use patterns reducing the biodiversity of farm-lands.
- Unfavourable changes in key habitats like wetlands and grasslands, important reproductive, migration, or wintering habitats of sedentary or migratory small game species.
- More restrictive hunting legislation influencing hunting pressure on predators, especially the full protection of birds of prey while not allowing the control of predators of small game.

It can be stated that the most important factors influencing game populations are directly or indirectly related to habitat changes. Climate changes are not explicitly included among these factors but cannot be avoided, including the short- and long-term effects they have on ecosystem processes. The synergistic, or combined, effects of habitat fragmentation and climate change represent one of the most potentially serious problems of global change (ROOT AND SCHNEIDER, 2002). The critical issue is no longer *if* climate change is occurring, but rather *how to address its effects on wildlife and wildlife habitats*. Although temperature variations can in some cases be localized and are often cyclical, evidence is accumulating that wildlife and wildlife habitats have been and will continue to be significantly affected by ongoing large-scale rapid climate change (TWS, 2005).

In Hungary several scenarios were evaluated in order to predict the potential impacts of climate change on biodiversity, agriculture, and forestry (LÁNG ET AL., 2007). Actually, the scenario of *rising temperatures accompanied by declining precipitation* (rainfall) is considered the most probable one. These slow processes can bring about considerable changes in the regional ecological systems of the Carpathian Basin. Regarding game, these can change the population dynamics and the distribution range of these species (FARAGÓ, 2005):

- Hydrological changes: the frequency of floods, inland inundation, drying and droughts, effects of drying on migrating species, shortage of surface water and its physiological effects.
- Vegetation changes: forest changes and their effects on big game, grassland changes and their effects on small game, arable land changes and their effects on game, and wetland changes and their effects on waterfowl.

It is necessary to remind that the knowledge about the potential climate induced impacts on game species are not well supported by comprehensive research but are based on anecdotal evidence or sporadic observation. In a shifting landscape, managing for the *status quo* becomes obsolete, and restoration of habitats may be unproductive. Effective planning for resource management instead requires being able to anticipate the impacts of climate change on plant and animal communities and to devise strategies to mitigate the changes or to adapt to them (TWS, 2005). This means that the current information available and the proposed changes/solutions should be treated carefully.

Regarding the hydrological changes, the drying periods of the past decades can serve as examples. Based on these it is expected that the migration routes of wild geese and ducks could be translocated out of the Carpathian Basin. Short distance movement of sedentary species can result in increasing predator pressure (wild boar), increased game damage around local water sources (big game), and increasing vehicle-wildlife collisions during movements (FARAGÓ, 2005).

Climate change will also influence the size and composition of Hungarian woodlands. This is especially important in the Great Hungarian Plain where mostly planted forests are found on edge sites and small changes in the climate regime may result in profound alterations. In these edge/suboptimal sites massive forest die-off occurred in less adaptive stands during the dying periods of the 1980s and 1990s. If these patterns are applicable for long-term climate changes in lowland forests these can be influential in the composition and productivity of future game habitats. Losses in zonal forests can be replaced with planted forests which will not influence the available forest area for game management. In some areas even the carrying capacity of the forests can be improved with more productive tree species and better understory vegetation (FARAGÓ, 2005).

In the case of grasslands and arable lands, irrigation can have adverse effects on wildlife species as a consequence of more intensive agricultural technology. Introduction of drought resistant plant varieties are not expected to cause serious habitat changes. If the crop rotation system changes fundamentally and lands are converted to grasslands or afforested the new game habitat can evolve. Grasslands can offer better living conditions for small game and forest blocks for big game. In the case of large-scale forest plantation projects, massive increase of big game habitats can be expected regardless of the tree species used. Based on results of the afforestation programs of the past decades it can be expected that 1 $km^2$ increase of the forest area results in the increase of deer and wild boar population by one individual. This process of deer population increase occurs at a threshold of 13-15% of forest cover (CSÁNYI, 1999).

In summary it can be concluded that available knowledge about the potential impacts of climate change is scarce in Hungary. Most of the assumptions are based on indirect evidence or uncontrolled observations. In order to be better prepared for the climatic changes focused research, more relevant information, and practical guidance are required. In 2007, the US Government Accountability Office summed up the problem facing resource managers as follows (cit. TWS and ESA, 2009): "*Resource managers have limited guidance about whether or how to address climate change and, therefore, are uncertain about what actions, if any, they should take. In general, resource managers lack specific guidance for incorporating climate change into their management actions and planning efforts. Without such guidance, their ability to address climate change and effectively manage resources is constrained.*"

On the basis of the North American example the following points may be applied to the situation in Hungary (TWS AND ESA, 2009):

- Forecasting wildlife and habitat responses depends on the ability to downscale climate models to temporal and spatial scales that will be useful to managers.
- Assess and synthesize the current state of scientific knowledge concerning climate changes and potential impact on wildlife and their habitats. Prioritize scientific gaps in order to forecast the ecological impacts of climate change on wildlife at the ecosystem, habitat, community, population, and species levels.
- Develop and improve tools to identify, evaluate, and link together different scientific approaches and models for forecasting the impacts of climate change and adaptation on wildlife and their habitats. Such tools include monitoring, predictive models, vulnerability analyses, risk assessments, and decision support systems to help managers make informed decisions.

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