

# NOMINATION PACKAGE

## INTERNATIONAL DARK SKY PARK DESIGNATION

### HORTOBÁGY NATIONAL PARK



**SUBMITTED TO INTERNATIONAL DARK-SKY ASSOCIATION  
SEPTEMBER 4 2010**

“1. An unpolluted night sky that allows the enjoyment and contemplation of the firmament should be considered a fundamental socio-cultural and environmental right, and that the progressive degradation of the night sky should be regarded as a fundamental loss.

2. Control of obtrusive and sky glow-enhancing lighting should be a basic element of nature conservation policies since it has adverse impacts on humans and wildlife, habitats, ecosystems, and landscapes.

3. Responsible tourism, in its many forms, should be encouraged to take on board the night sky as a resource to protect and value in all destinations.”

*(The International Astronomical Union 2009 Resolution B5 in Defence of the Night Sky and the Right to Starlight — XXVII General Assembly, Rio de Janeiro, August 14, 2009)*



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## Introduction

The first Hungarian Light Pollution Meeting was organized by the Hortobágy National Park in Debrecen in 2004. The 2nd such meeting was the first milestone in the Hungarian dark sky park project in 2006, when the formation of the Zselic Starry Sky Park was initiated. However, from the beginning, the Hortobágy region has been considered as one of the first two potential international dark sky parks in Hungary. Hortobágy and Zselic provided a guide for other national parks and protected area in Hungary, and these efforts realized in a very positive decision: The Hungarian law on environmental protection was modified with the inclusion of an article related to light pollution. This law helps other national parks and landscape protection areas to include anti light pollution regulations in their management plans.

The quality of the night sky definitely reaches the silver tier in the whole area of the National Park. However there are lots of small enterprises and farms inside the territory. These stakeholders provides only a little amount of luminous flux, which do not deteriorate the night sky. However the quality of the lighting systems itself is not perfect, and so it does not satisfy the lighting plan of the National Park. The lighting system cannot be improved within a year but timespan of a few years. Then it should be decided to split the nomination if the Hortobágy National Park for two steps. In the first cadence a 10000 hectares part of the National Park is nominated with the best infrastructure. Then this firs step can help to force the improvements of the lighting systems at other parts of the park, and finally, to make it possible that in a second cadence, the whole Hortobágy National Park will satisfy all the requirements of an International Dark Sky Park.

The nomination of the Hortobágy Starry Sky Park is a very important new step in the Hungarian light pollution reduction movements, as it rises the attention to this growing, but not well know, ecological problem.



# MAGNITÚDÓ ASTRONOMICAL SOCIETY

**IDA Board of Directors  
International Dark-Sky Association  
3225 North First Avenue  
Tucson, Arizona 85719-2103**

June 20, 2010

Dear IDA Board Directors,

As an IDA member, and the vice-president of the Magnitudo Astronomical Society, I hereby recommend the Hortobágy National Park for designation as an International Dark Sky Park.

Our society together with an other non-governmental organization (South-Nyírség Bihar Landscape Protection Society) contacted the Hortobágy National Park Directorate with the plans of founding the Dark Sky Park, following the guidelines of the International Dark-Sky Association. All the three organizations has signed Agreements to achieve this goal and the biggest landuser the Hortobágy Public Company jointed to this effort too.

We applied to an international fund (Norwegian Fund) to finance the preparation work, and we started to investigate the quality of the night sky and the nocturnal landscape in the Hortobágy region. Our sky luminance measurements confirmed the good quality of the sky, so I can state that the quality of the night sky is better than the minimal expectations for a "Silver" tier.

The park staff and the major part of stakeholders is interested in founding the Dark Sky Park. We also organized nighttime hikes in the area – as the National Park's website show it, and the astronomy became part of the park's field study center's curriculum.

Now more and more people realize that protecting the nighttime environment is a vital part for preserving our first and biggest national park's values (which is part of the world heritage, the Man and Biosphere programme and the Ramsar Convention). The park would be a good pilot area for all the other protected areas in Hungary as it has very good reputation. The press has had several articles and reports about our efforts, and enhanced the public's awareness about this issue.

We decided to establish the Dark Sky Park on a part of the whole National Park as a first stage. The reason is that although the whole National Park could fulfill the criteria of the Dark Sky Park there is one exception: this is the proportion of the fully shielded luminaries – which is less than the recommended 67%.

We are convinced that in a second stage – after a limited time period - all the National Park area can conform for this requirement and the Dark Sky Park status of the park's one part will help to achieve this.

I highly recommend that the IDA Board of Directors grant for the Hortobágy National Park the title of an International Dark Sky Park. With this act the protection of the night sky of the internationally well known Hortobágy National Park could be guaranteed.

Sincerely Yours,

István Gyarmathy

**IDA Board of Directors  
International Dark-Sky Association  
3225 North First Avenue  
Tucson, Arizona 85719-2103**

August 23, 2010

Dear IDA Board Directors,

As an IDA Section Leader, the president of the Hungarian Astronomical Association, I hereby recommend the Hortobágy National Park for designation as an International Dark Sky Park.

I spent my childhood in a small village next to the Hortobágy National Park. Then it was quite natural for me that the night sky was decorated with thousands of stars and the Milky-way itself. This environment was one of the first experiments that forced me to chose physics and astronomy as my profession. Later I moved to other parts of Hungary (finally next to the Zselic area where we established Hungary's first dark sky park). When I returned to Hortobágy very recently decades after my childhood experiments, I was happy that the degradation of the sky had been only minute, not as bad as at other part of the country and the world. I rejoiced in experiencing the starry sky above the 'Alföld' region, the Great Hungarian Plain and the Hortobágy again.

However, childhood memories can be nostalgic and subjective. So I have contributed to the measurements of the night sky quality and their interpretation. Those objective data have confirmed that the Hortobágy still provides great opportunities for stargazers. Based on our observations and measurements, I can confirm that the quality of the night sky is definitely better than the minimal expectations for a "Silver" tier.

I highly recommend that the IDA Board of Directors grant the dedicated part of the Hortobágy National Park the title of an International Dark Sky Park.

Zoltán Kolláth PhD, DSc

research advisor, Konkoly Observatory of the Hungarian Academy of Sciences  
section leader, IDA Hungary  
president, Hungarian Astronomical Association  
member of IDA, International Astronomical Union, Lighting Society of Hungary


**Hortobágyi Nemzeti Park Igazgatóság**

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Kérjük, válaszában hivatkozzon iktatószámunkra!

IDA Board of Directors  
 International Dark-Sky Association  
 3225 North First Avenue  
 Tucson, Arizona 85719-2103

June 01, 2010

Dear IDA Board Directors,

As the director of the Hortobágy National Park Directorate I strongly support the nomination of the Hortobágy National Park to be an International Dark Sky Park.

Our Park is the first and biggest Hungarian national park (82 000 hectares), and also a world heritage and Ramsar site. The park is a great and continuous grassland area with wetland mosaics, the most extended in its category in Europe. Hortobágy is one of the biggest unpopulated and darkest areas in Hungary, and we believe it could be the best candidate to be the second national "Dark Sky Park". Its significance is mostly related to the protection of biodiversity, especially the great number of migrating bird species and special nocturnal insect species.

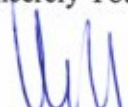
To be a Dark Sky Park would be an important tool in the protection of our nocturnal wildlife habitats and also the landscape values of Hortobágy as an outstanding and unaltered wilderness area in the Great Hungarian Plain, in the middle of Europe.

We have cooperation agreement with the promoter NGO – the Dél-Nyírség Bihar Landscape Protection Society - to protect the area's dark sky values.

We included the articles of the Lighting Plan of the Dark Sky Park to our Management Plan to protect the natural and scenic values of the undisturbed nighttime environment. We also organize in our Park nighttime walks, special interpretation programs related to the Dark Sky Park values and good lighting practices. Astronomy became part of our Field Study Center's curriculum. We plan to build a public astronomical observatory as part of the development of the Center.

Please give this nomination your utmost consideration!

Sincerely Yours,

  
 István Sándor director



IDA Board of Directors  
3225 North First Ave.  
Tucson, AZ 85719

20. June 2010.

Dear IDA Management,

I have been conducting astronomical observations and mass education in the field for twenty-two years. Over the decades, on the occasions of camps and family excursions, I carried out astronomical observations in all areas of Hungary having the least light pollution, including the edge of Hortobágy.

I was born at Szolnok, the city lying in the middle of the Great Plain. Every year I spent some weeks of the summer vacation there. In the mid 1990s, with my amateur astronomer friend from Szolnok, we again and again looked for locations far from settlements, free from light pollution, suitable for astrophotography and deep-sky observations. That is how we found the Southwest edge of Hortobágy.

In moisture-free periods, the sky was a wonderful sight from the edge of Hortobágy. I could see stars less bright than 7 magnitudes with unaided eyes. The constellations were difficult to make out due to the big number of visible stars. The summer Milky Way almost reached down to the horizon. It was here that I saw Zodiac light for the first time in my life. In Andromeda Galaxy, the spiral arms showed well through binoculars. The Triangle Galaxy could be seen with unaided eyes.

Declaring Hortobágy as a Dark Sky Park is well substantiated, rather I consider it a very important step and I give wholehearted support to it.



Dr. Péter Gyenizse  
Ida Hungary member

University of Pécs, Institute of Geography

## Statement

June 18, 2010

As the Managing Director of the Hortobágy Nature Conservation and Gene Preservation Non-profit Ltd., 4071 Hortobágy, Czinege J. u. 1. (henceforth Nonprofit Ltd.) on behalf of the Nonprofit Ltd. I make the following statement:


1. The Nonprofit Ltd, being one of the biggest land users of the area and one of the caretakers of the natural and cultural values of Hortobágy, wholeheartedly welcomes the establishment of the Hortobágy Dark Sky Park, and will support its realization with all possible means.
2. The Nonprofit Ltd. takes into consideration the Lighting Plan of the Hortobágy Dark Sky Park (which is attached to the present declaration) in the outdoor illumination of its animal husbandry premises and other establishments, and will do so in the implementation of any future lighting establishments.
3. The Nonprofit Ltd. will tailor the outdoor lighting of its depots – in accordance with its financial means - to the regulations of the Lighting Plan.
4. The Nonprofit Ltd. will popularize the vision of the Dark Sky Park and will make use of it in its marketing, and also places the link of the Park (<http://csillagpark.hu/>) to its website.



Zoltán Gencsi  
Managing Director,  
Hortobágy Nature Conservation  
and Gene Preservation Non-profit Ltd.

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TÁRSASÁGI SZÁM: 1-60200304-0000017



**Cooperation Agreement between the South-Nyírség Bihar Association for the Protection of Landscape and Cultural Values and the Magnitúdó Astronomical Association Debrecen**

Debrecen

May 18, 2010

The leaders of the South-Nyírség Bihar Association for the Protection of Landscape and Cultural Values (DNYBTE) and the Magnitúdó Astronomical Association Debrecen (MACSED) have decided today to confirm their long-lasting friendship and collaborative relation with the present document.

The two associations agree to continue working hand in hand in close cooperation and helping each other goaded by the realizations that

- promoting astronomy among the public and strengthening the amateur astronomers movement, and also acting effectively against light pollution can be achieved only through mutual cooperation and collaboration of the different civil astronomical organizations;
- these are the only two associations in Hajdú-Bihar County disseminating astronomical knowledge in general, and knowledge affecting the astronomical and ecological aspects of light pollution in particular.

MACSED undertakes that:

1. It provides opportunity for DNYBTE members to attend its events, and also to make use of its services.
2. It organizes collective programs with DNYBTE.
3. It shares its observations and findings with DNYBTE, and keeps close relation with DNYBTE helping its work.
4. It takes part in the formation of the Hortobágy Dark Sky Park, in developing and operating the monitoring system, and in the educational work of the Park.
5. It places the link to the DNYBTE website onto its own website.

DNYBTE undertakes that:

1. According to its capacity, it gives moral and any other support to MACSED, and helps in conducting and/or organizing courses and lectures.
2. It organizes collective programs with MACSED and invites MACSED members to its summer camps.
3. In its campaigns against light pollution, it stresses the importance of making MACSED's observation spots free of light disturbance.
4. It involves MACSED in the preparatory works of establishing the Hortobágy Dark Sky Park and in the subsequent tasks as well.
5. It supports MACSED's program connected to the educative astronomical observatory.
6. It places the link to the MACSED website onto its own website.

Apart from the above, both associations undertake to provide moral, in-kind and financial help to each other according to their capacities, and further commit that they will collaborate actively for achieving fruitful astronomical mass education, better observation results, and effective steps against light pollution and successful protection of the starry sky.

With the aim of fruitful cooperation, the organizations authenticate this agreement with the signatures of their representatives.



László Papp  
President  
South-Nyírség Bihar Association for the  
Protection of Landscape and Cultural Values




György Zajác  
President  
Magnitúdó Astronomical Association  
Debrecen

Magnitúdó Csillagászati  
Egyesület Debrecen  
4031 Debrecen, István út. 83. VI/19.  
Adószám: 18558618 1-09

## Cooperation Agreement

Debrecen

January 5, 2010

The present Cooperation Agreement is reached between the *Hortobágy National Park Directorate* (henceforth Directorate, represented by Director István Sándor) and the *South-Nyírség Bihar Association for the Protection of Landscape and Cultural Values* (henceforth Association, represented by President László Papp) with the aim of *creating a Dark Sky Park* in the area of the Hortobágy National Park.

**Antecedents:** Hortobágy is one of the few areas of Hungary where artificial lights hardly disturb the sight of the starry sky. Considering that during the last decades, light pollution disturbing the fauna and transforming the natural landscape has been increasing rapidly, it is desirable to form a "reserve" where the natural night landscape, the habitats of protected species, and the sight of the starry sky can be preserved in their original state. Within the range of the Hortobágy National Park, the conditions are ideal for the designation of an area like this.

The Directorate undertakes:

- That during the development of the Hortobágy National Park's management plan, it will endeavor to minimize light pollution and preserve according to its capacity the natural night landscape and the sight of the starry sky as part of it.
- That it prepares the lighting inventory of the depots within the borders of the Park.
- That it modifies the outdoor lighting facilities of its own establishments to be light pollution free as far as finances permit.
- That it will urge the settlements in the vicinity of the National Park as well as the owners of depots within the borders of the Park to make their outdoor lighting facilities light pollution free.

The Association undertakes:

- That it starts monitoring light sensitive species.
- That it takes measurements of the background brightness of the night sky in order to define the extent of light pollution thus documenting in an objective manner the present state of light pollution and its future changes.
- That based on the surveys, it prepares the Hortobágy Dark Sky Park recommendation documents to be submitted to the International Dark Sky Association.
- That it prepares a publication about and the website of the Dark Sky Park.

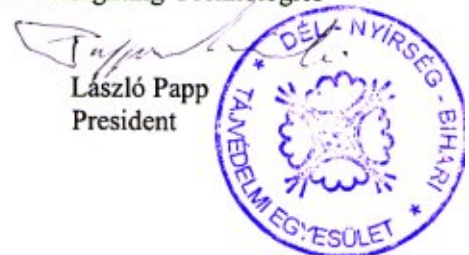
The Directorate will set up an educative astronomical observatory in Fecskeház Forest School, and will also organize night walks hand in hand with the Association to show the pollution free, ideal night environment and starry sky.

The collaborating parties formulate recommendations towards the municipalities of the settlements in the National Park's vicinity to give support to the establishment of the Dark Sky Park and to set up local regulations for the preservation of the undisturbed night environment based on the recommendations put forward by the MEE Lighting Technologies Society.

István Sándor  
Director



László Papp  
President



## The Hortobágy National Park

Hortobágy – the first proclaimed Hungarian national park – is an almost flat plain landscape which had been temporally (not from year to year) inundated by the neighbouring Tisza river before the region-size river-regulation of the 19th century.

Parts which have not turned to cropland or fish-pond since that time in the last hundred years, are still occupied by alkaline marshes, meadows, dry alkline pasture of *Festuca pseudonia* grass and remnant loess-steppe vegetation. These habitats appear in obvious mosaic habitat structure.

The alkalinization of Hortobágy is not a human-caused stage but roots back to ice ages called Würm period, appr. 30,000 years ago. Since that time, rivers coming from north originally accumulating Hortobágy with sediments could have not reached the region anymore. The Tisza river appeared then from NE, and cutted the



perpendicular older river-beds. From this time, Hortobágy has not been a simple flooding area, but a mixture, where geological accumulation from rare river-floodings and erosion from derasion of loess-textures coexist. This geological background with the relatively dry climate and the low unit discharge of surface resulted in extensive alkalinization of soils. In fact, if one does not take into account the Volga-delta region, Hortobágy is the largest alkaline area in Europe. Similarly speaking this is the

largest continuous remnant native grassland area of the continent.

It is a bit controversial that – against of the above mentioned geological background – Hortobágy is a world heritage site – as a cultural landscape. This controversion is not so strict if we take some other WH sites from the huge continental steppe zones in the world in cultural landscape category. In fact, pastures of Hortobágy are scattered with traditional buildings of ancient pastoral activity (some of them are abandoned yet). These buildings were significant units of the world heritage nomination.

Hortobágy is most famous for its rich avi-fauna. The number of nesting species is 159 and there are additional 178 species which are regular or irregular visitors. Hortobágy is generally the best birding place in Hungary (possibly in the whole Karpathian Basine) and the most important IBA (Important Bird Area) too. Migration is particularly significant. Continental rarities, for instance the only continental (not sea-shore) migration root and resting-molting place of Dotterel (*Charadrius morinellus*), regular occurrences of pae harrier (*Circus macrourus*) or 12 sightings of the probably extinct Slender-billed Curlew in the 20th century are to be mentioned.

The masses of migration are remarkable too: for instance 100,000-300,000 of grey geese species (*Anser* sp.), appr. 100,000 cranes (*Grus grus*), or 50,000-200,000 Ruffs stop at Hortobágy (the last one basicly while shallow-water covered conditions occur on grasslands). 10-20 years ago hundreds of thousands of different duck species stopped here too, but their mass has been less significant recently.

Notable nesting species are aquatic warbler (*Acrocephalus paludicola*) /a globally threatened species which has a healthy population here/, Bailon's crane (*Porzana pusilla*) /perhaps the only regular nesting place in Hungary/, all the three European black-turn species (*Chlidonias* sp.), 100-150 individuals of great bustard (*Otis tarda*) and a good amount of raptors /Montagu's harrier (*Circus pygargus*), saker (*Falco cherrug*), hundreds of pairs of red-footed falcon (*Falco vespertinus*) etc./.

It is notable that many of the important breeding and nesting species (geese, crain, crakes etc.) are light-pollution sensitive.



## Hortobágy Starry Sky Park — Basic Facts

**Official Hungarian name:** Hortobágyi Csillagoségbolt-park

**Official English name:** Hortobágy Starry Sky Park

**Location:** Selected area of the Hortobágy National Park - HSSP on the map on page 15.

**Proposed quality tier:** Silver

**Supervisory governmental nature-conservation organization:** Hortobágy National Park Directorate

**Astronomical supervisory organizations:** IDA Hungary, Magnitudo Astronomical Association and Hungarian Astronomical Association

**Area of the Starry Sky park:** 10000 hectares

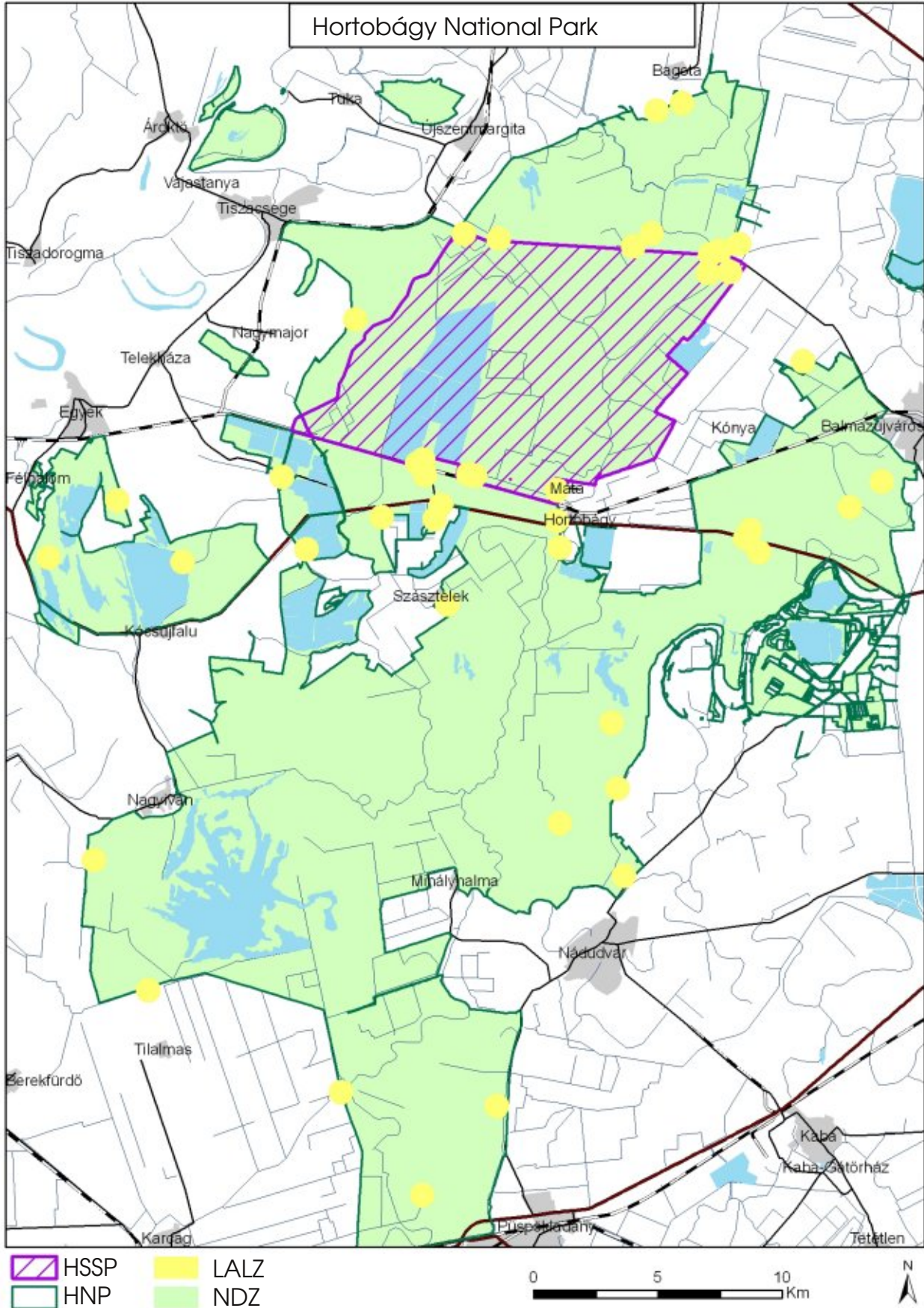
**Whoe area of the National Park:** 80700 hectares

**Web page:** <http://csillagpark.hu>

**Accessibility:** The area of the park is freely accessible on foot at the nature trails, There are several entrance points close to main roads.



## The Map of Hortobágy National Park



## Articles of the Management Plan of the Hortobágy National Park related to the Starry Sky Park

### **2.3.4 Ecological tourism, vacation, tourism, conservation education and presentation**

According to the night sky makings of the NP, public events which display the starry sky are emphasized. (These events are nighttime hikes, public events for schools, extension of open-air schools, etc.) The light pollutionless environment also means naturalness and an undisturbed status, so it enhances the ecological touristic appeal of the region.

### **2.4. Landscape values**

The view of starry sky, disturbed only by a minimal amount of artificial light, contributes to a great extent to the landscape value of the NP. The dark sky and the absence of obtrusive light as landscape values should be considered as elemental proportion of scenery.

### **3.1. Ideal conservation aims**

#### ***3.1.1. Management areas and the main aims of the conservation of natural values.***

An important aim is the long term protection of the quality of the night sky. Inside the NP outdoor lighting can be used only in justified cases. In order to protect the quality of the night sky, the NP collaborates with the neighbouring settlements to minimize the risk to the night sky originating from the villages.

#### ***3.2.1. Derogatory and risk factors***

|   | Derogatory factor                                | Value affected   | Possible prevention  |
|---|--|--|--|
| 6 | Obtrusive light inside the NP                    | Close lights disturb directly the wildlife and the natural nocturnal landscape   | Artificial lighting can be established inside the NP only if they suit the Lighting Plan. Lighting devices not obeying the Lighting Plan should be replaced. |
| 7 | Obtrusive lights from settlements outside the NP | The major part of the outside light sources are unavoidable, because they serve public lighting. The background luminance of the night sky increase as a result. The artificial glare of the night sky degrades the visibility of the starry sky and the value of the nocturnal landscape. | It is necessary to include articles against obtrusive lights in the regulation plans of the neighbouring settlements.  |

#### **4.1 Practical conservatist aims**

One of the natural values of the NP is the almost unaffected dark night sky. The quality of the night sky is an important part of the landscape values of the NP; it influences the ecological state of the NP.

#### ***4.2.3. Protection of the species***

The low-light nocturnal environment highly contributes to the biodiversity of the NP, including nocturnal species adapted to the night sky, and migratory ones. Artificial lights act as a significant negative effect on several groups of creatures (insects, amphibians, birds, bats). For the protection of these species, the protection of the darkness of the night sky plays an important role.

Avoidable interference with the protected species or the ones with Community importance (e.g. functionless lighting or light emission that can be minimized by the elimination, shielding or modification of the lighting fixtures) should not be allowed. It gives reasoning to elimination of direct obtrusive light, but diffuse light pollution due to the many locally indirect lights should also be controlled

#### ***4.2.5 Education and presentations***

The spreading and publication of knowledge related to the natural night time environment is considered as an important part of the educational program of the NP. Educational programs and demonstrations include the the definition of obtrusive light and the impact of light pollution to the nocturnal environment, wildlife and landscape values. The NP regularly organizes public shows, hikes, where the public at large can become acquainted with the undisturbed night sky and the nocturnal landscape. Public programs related to astronomy, light pollution and undisturbed nocturnal landscape are included in the schedule of open-air schools. The NP cooperates with astronomical and environmental institutions and organizations to organize programs related to astronomy and the values of light pollutionless environment.

#### ***4.3.5 Ordinances related to traffic***

Traffic routes and intersections can be established inside the NP only if they do not require artificial lighting. The only exceptions are the lights of the vehicles and the traffic signals. It is possible to designate such areas where night time traffic or the use of vehicle lights is restricted (such areas are the neighbourhood of the habitat of species irritable by artificial light or locations close to astronomical observation posts). At existing traffic routes the lighting facilities should be established according to the lighting plan, or the existing ones should be modified within 1 years to satisfy that.

## Lighting Inventory

| Location                        | Purpose          | Quantity       |            |
|---------------------------------|------------------|----------------|------------|
|                                 |                  | Fully shielded | Unshielded |
| Darassa (Balmazújváros)         | Road/parking lot | 1              | 1          |
| Darassa (Balmazújváros)         | Safety light     | 1              | 0          |
| Vókonya (Balmazújváros)         | Safety light     | 4              | 4          |
| Fűszálló - HNPD (Balmazújváros) | Safety light     | 2              | 2          |
| Máta - HNPD (Hortobágy)         | Safety light     | 36             | 0          |
| Kungyörgy 1 - HNC (Hortobágy)   | Road/parking lot | 8              | 2          |
| Kungyörgy 1 - HNC (Hortobágy)   | Safety light     | 0              | 10         |
| Kungyörgy 2 - HNC (Hortobágy)   | Road/parking lot | 8              | 0          |
| Kungyörgy 2 - HNC (Hortobágy)   | Safety light     | 2              | 5          |
| Cserepes (Tiszacsege)           | Road/parking lot | 2              | 0          |
| Cserepes (Tiszacsege)           | Safety light     | 0              | 7          |
| Sum                             |                  | 64             | 31         |

Abbreviations in the table:

HNPD: Hortobágy National Park Directorate

HNC: Hortobágy Nature Conservation and Gene Preservation Non-profit Ltd.

The statements of these entities are attached to the document.

All shielded lamps are in agreement with the Lighting Plan

## Lighting Plan

The purpose of this Lighting Plan is to provide regulations and guidance for outdoor lighting in the Hortobágy National Park. Natural dark skies are considered as the most important values of the region, which should be protected. In principle, no outdoor lights can be used in the National Park that jeopardize the quality of the nocturnal environment and landscape.

For the definitions of the terms and units used in this Lighting Plan we refer to the attached Hungarian documents ("Handbook of public lighting" - section "Obtrusive light")

Some abbreviations used in this document:

NP: National Park

NDZ: Natural Dark Zone

LALZ: Low Ambient Light Zone

IDA: International Dark Sky Association

### ***1. General aims and rules***

Except for the locations mentioned in article 2 (LALZ), no permanent outdoor lights may be used in the NP. The only non-permanent (mobile or temporary) lights allowed in the NP are the ones used in emergency situations, and the lights of vehicles used for the safety of traffic.

A general prescriptive rule is that the permanent artificial lights, used in the NP, cannot result in any observable deterioration of the night sky and nocturnal landscape outside a circle with a radius of 500 meters around the light sources themselves. (For this regulation, observable deterioration means the direct view of light sources, or the increase of sky luminance by 1%.)

Outdoor lights may be used in the NP only for the purpose of the safety of the traffic, the walkways and parking lots. In special conditions light can also be used for construction works. No ornamental or advertising lights can be used, and no artificial light sources can be used for forestry works, hunting and fishing.

### ***2. Lighting Zones***

The major part of the Hortobágy National Park is a natural dark zone with no artificial lights. This continuous region is designed as Natural Dark Zone (NDZ)

The only locations in the park where permanent outdoor lights are allowed are the premises in the attached document.

In general these locations mentioned as Low Ambient Light Zones (LALZ).

### ***3. Lighting regulations***

The following conditions should be satisfied by any outdoor lighting in the LALZs:

Only fully shielded fixtures can be used, and they should be installed and serviced so that no light should be emitted above the horizontal plane.

The maximum allowable light output (luminous flux) per fixture is 1800 lumens.

If the total luminous flux of a premise or realty exceeds 10000 lumens, a detailed lighting permit plan should be prepared. Any construction should be started only after approval by Hortobágy National Park Directorate as the competent nature conservation management organisation, and by IDA Hungary.

The illumination levels cannot exceed the minimum norms available for the given purposes.

Outdoor lights can only be used when pedestrian or considerable vehicular traffic is expected. Motion sensors or time switches are preferred in locations with infrequent traffic.

Use the most energy efficient lamp available (Sodium lamps or compact fluorescent lamps are preferred).

## Sky Quality at the Hortobágy National Park

### Visual Quality

Visual naked eye limiting magnitude: better than 6 magnitude

Bortle Scale: 3-4

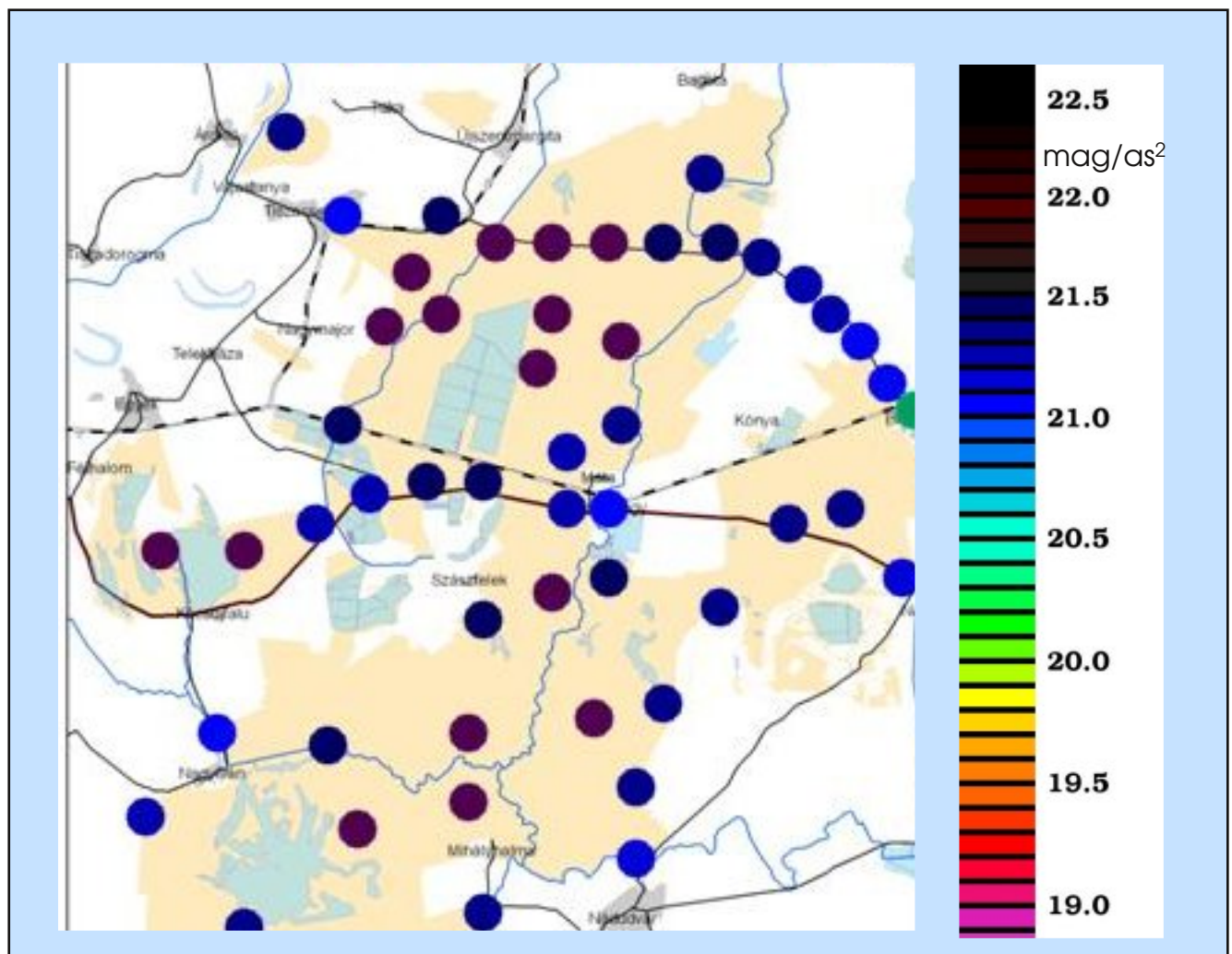
Objects visible on the sky:

M13, M31,

Milky Way: all around the year, in summer with complex structures

Zodiacal light is easily visible in spring and autumn

### Measurements



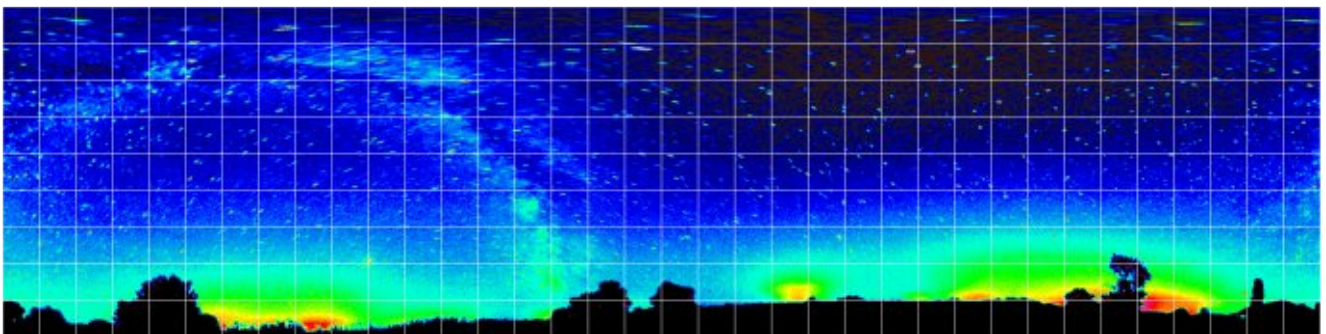
Sky quality measurements in the Hortobágy National Park. The circles represent the luminance of the sky in a colour scale; the values are given in mag/sqas.

At the Hortobágy we have used the same methods as in the case of the Zselic Landscape Protection Area. Detailed information can be found in the nomination package of the Zselic Starry Sky Park and in the following publication: Kolláth, Z. (2010) " Measuring and modelling light pollution at the Zselic Starry Sky Park", Journal of Physics: Conference Series 218 012001 (<http://iopscience.iop.org/1742-6596/218/1/012001/>). Hereafter we refer to these articles for the description of the measurement methods.

In general it can be concluded that inside and in the close neighborhood of the Hortobágy National Park there are no light sources which contribute significantly to the luminance of the night sky. Then a few measurements at the perimeter can be sufficient to describe the quality of the night sky. However, a more thorough project has been started, since the makings of the Hortobágy (almost perfectly plain territory, good view among the horizon) provide good opportunity to scientific studies based on the observed data.

SQM measurements show that the quality of the night sky is everywhere in the National Park is better than 21.0 mag/sqas. The typical value is around 21.3-21.4 mag/sqas, in ideal weather conditions it can reach 21.5 mag/sqas.

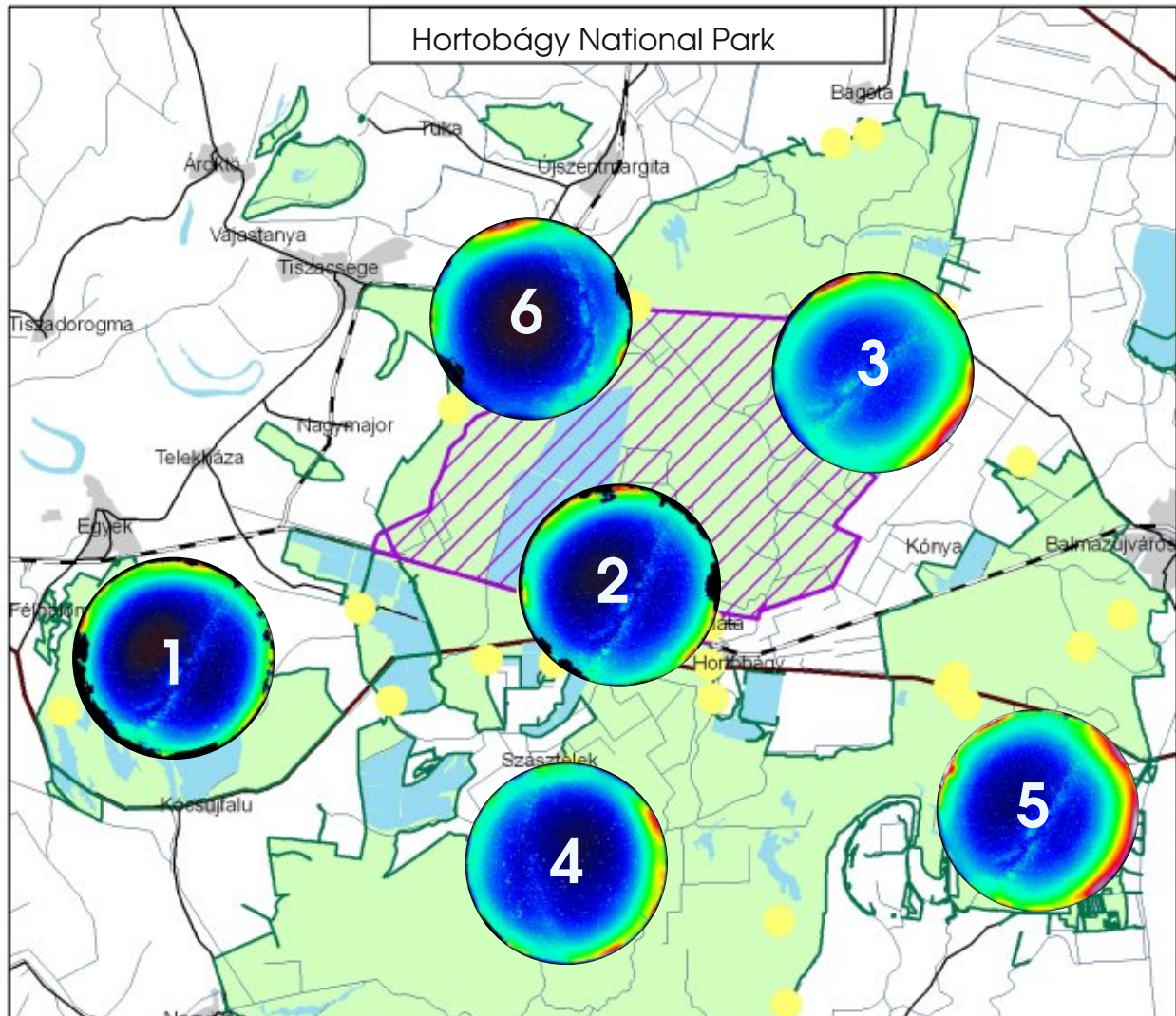
Local settlements have only a minimal effect on the quality of the sky. The luminance is only slightly increased in the vicinity of small villages. The lights from the cities of Hajdúszoboszló, Balmazújváros, Karcag, Tiszafüred, Nagyhegyes, Polgár and Egyek are the main sources of light pollution. However these cities do not have any significant effect on the SQM values, i.e. the quality of the night around the zenith inside the park.



*Typical panoramic luminance map in the Hortobágy. The displayed grid has 10 degree wide dividing.*

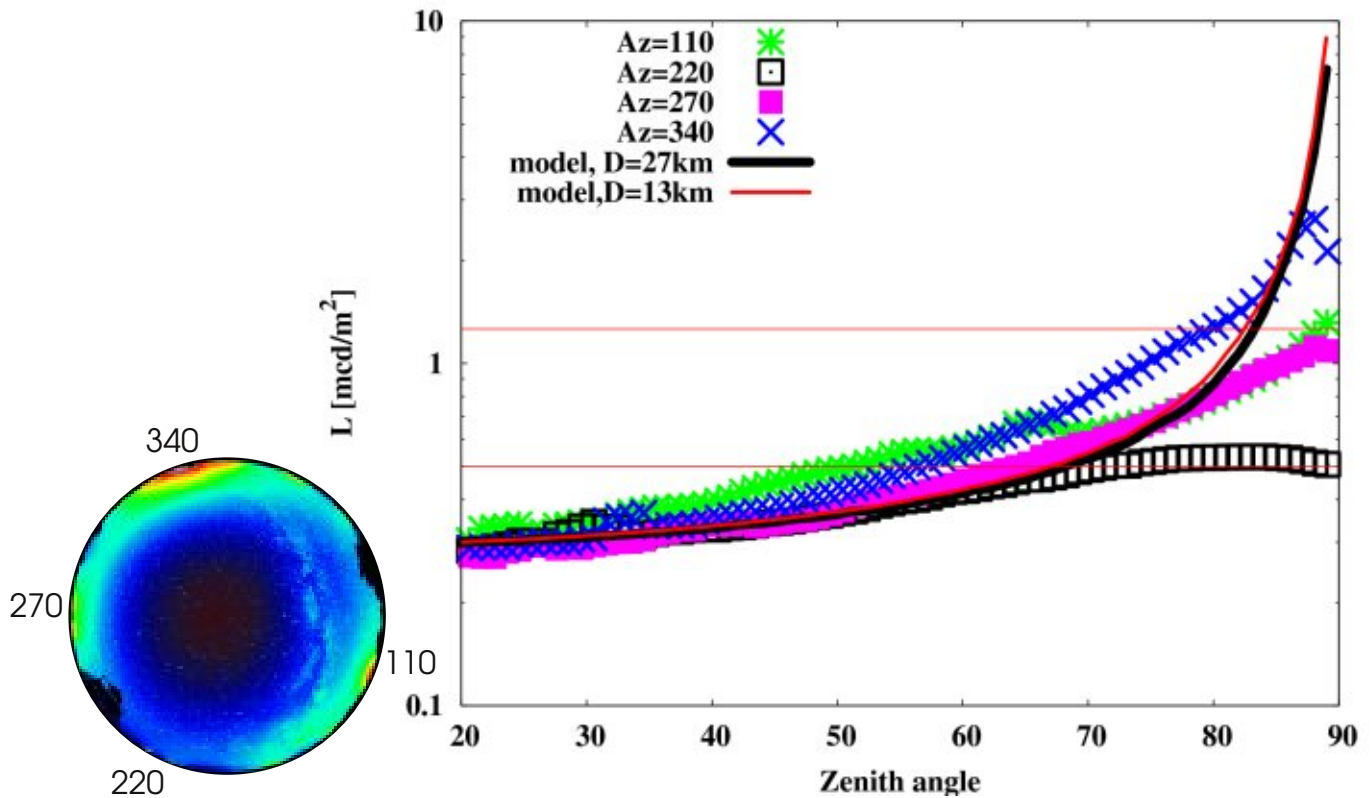
Based on fisheye all sky DSLR images the luminance distribution on the night sky is determined. These images show that the effect of nearby settlements is significant only close to the horizon. The deterioration of the nocturnal sky for zenith distances less than 80 degrees is acceptable. This fact is proved by the total light flux of the sky more than 20 degrees above the horizon (TSB<sub>20</sub>) and the simulated SQM values:

| image | TSB <sub>20</sub> | SQM <sub>sim</sub> |
|-------|-------------------|--------------------|
| 1     | -7.3              | 21.3               |
| 2     | -7.4              | 21.2               |
| 3     | -7.7              | 21.0               |
| 4     | -7.4              | 21.2               |
| 5     | -7.5              | 21.1               |
| 6     | -7.3              | 21.5               |



*The luminance calibrated images are displayed on a false color scale to display the luminance distribution on the sky. The major obtrusive sources can be clearly identified when such images (after a mirroring) are displayed on a map of the region. It is also possible to get the spatial dependence of sky quality inside the National Park.*

The full sky luminance maps give the opportunity to determine the sky brightness as a function of zenith distance. Such profiles of sky quality at different azimuths provide quantitative data on the light pollution by different sources. According to our experience, at zenith distances more than 80-85 degrees the measurements strongly depend on the neighborhood, as plants and buildings obscure the view. A useful quantity is the average luminance in a narrow range of zenith distance (e.g. 70-80 degrees). At low light pollution locations the nearby sources have only limited effect on the sky at less than 40 degrees below the zenith, so another average can be used from the 30-40 degrees interval.



Night sky luminance as the function of zenith distance for different horizontal directions - location #6. The red horizontal lines indicate the sky brightness level of 20 and 21 mag/sqas.

Location #6 (Cserepes) was selected to display the dependence of luminance on zenith distance. On this image only the profile at 110 deg azimuth is contaminated by the light of the Milky Way. In the southwest direction the the local background (sum of natural and distant sources) is provided. Here the sky brightness does not rise above 21 mag/sqas. Results of model calculations are also displayed in the figure. These curves are the theoretical profiles with the local background and a single settlement. Two models with different source distances are shown. The total light output of the settlement was fitted to provide the best match to the Az=340 profile around zenith distance of 80 degrees. The Az = 340 deg profile cannot be fitted with these models at lower zenith distances. The most probable reason for this discrepancy is that lots of distant settlements with higher luminous flux provide a higher background in these directions. The city of Miskolc at the distance of 60 km is one of the possible sources. That is clear, that all anthropogenic light source within around 200 km should be taken into consideration to fit perfectly the night sky luminance.

The comparison of observations with the models shows the possible threats of the Starry Sky Park. Although there are no immediate hazards for the quality of the sky, these results should be considered seriously to sustain the Park for a long term. The best solution would be a nationwide law against light pollution which has been already initiated.

All the measurements prove that the quality of the sky at The Hortobágy National Park is better than the minimal limits for silver tier, and this state can be conserved for further generations.

## Public Outreach

The Hortobágy National Park Directorate and the Magnitudo Astronomical Association regularly organize astronomical programs at the “Fecskeház” open-air school. These events and the night watching hikes are very popular for the visitors of the Hortobágy region.



A public observatory is planned to be build in the Hortobágy National Park, to provide further possibilities for public outreach in the Starry Sky Park.



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