POTENTIAL POSITIVE AND NEGATIVE EFFECTS OF A SOLAR PARK ON WATER MANAGEMENT

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Introduction

- Energy crisis - renewable energy production – EU energy union and zero emission.
- Landscape quality – nature conservation – biodiversity – agricultural production.
- Installed capacity of solar power plants in Hungary 3,000< MW – April 2022.
- 5,000 megawatts of connection demand is registered.
- Solar energy is nearly 26% of the gross installed capacity of Hungary.
- Goal – 20% share of renewable energy by 2030: 6,645 MW of solar PV predicted.
- 2020: 98.6 % or 207 MW of the 210 MW installed capacity were green field investments.
- Large-scale solar farms almost exclusively installed in areas removed from agricultural production.
- Biological activity decreases – excess water?
- Poorly planned PV increase the rate of insects sensitive to polar light pollution and their death.
- <5% of the solar parks is physically built.
- After construction – for 20–30 years – free of human disturbance.
- Appropriate planning – contribute to the preservation of biodiversity.
- Solutions must fit the physical properties of the solar park.
- Connection to existing habitats – valuable species – producing solar energy.

Materials and methods

When selecting the sample area, the following aspects were taken into account:
1. it should be in the green field investment garden of the solar park,
2. it should be on the outskirt area of a settlement,
3. it should be in an agricultural environment and,
4. it should be located near valuable natural areas.

Based on the above criteria, two realized investments (one with an area of 4.4 and one with an area of 1.2 ha) will be selected (Table 1.).

Habitat mapping and use analysis carried out in a 1km radius. Maintenance plans of the two nearby Natura 2000 areas (HUKN10002, HUKN20010) were used for description of the current situation. The range of possible interventions could be determined. The solutions were further narrowed by the physical and topological features of the solar park and the undisturbed requirements of solar energy production.

Table 1. The main technical data of the sample areas

Technical data	Sampe area No. 1.	Sample area No. 2.
Location in Hungary	Szabadszállás	Szabadszállás
Start date	2019	2022
Installed capacity (kWp)	4 x 607.75	652
Output capacity of the inverter (Kva)	4 x 499	498
Total area (ha)	5.3	1.3
Area of the PV park (ha)	4.4	1.2
Target area of habitat development (ha)	2.3	0.5

The sample areas are located at a distance of 0.7-2.1 km from the Kiskunság saline lakes and the Turjánvidék (HUKN10002) and the Szabadszállás grassland of ground squirrels (HUKN20010) Natura 2000 areas. The HUKN10002 area is an important bird habitat of the Danube watershed both during the migration and the breeding season, and the HUKN20010 area is the habitat of the socially important ground squirrel (*Spermophilus citellus*). A significant part of the areas surrounding the sample areas are dominated by small plots of land, built-up areas with significant green areas and abandoned orchards (Figure 1).

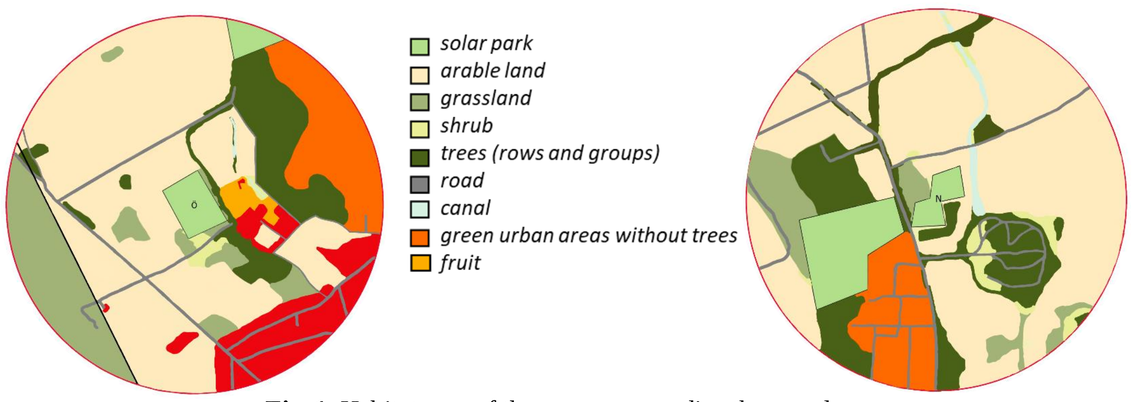

Fig. 1. Habitat map of the areas surrounding the sample areas

Fig. 2. Sample area No. 1. in Szabadszállás, Hungary

Sampe area No. 1. (Figure 2.)
- Location: Szabadszállás, Hungary
- Start date: 2019
- Installed capacity: 4 x 607.75 kWp
- Output capacity of the inverter: 4 x 499 Kva
- Total area: 5.3 ha
- Area of the PV park: 4.4 ha
- Built-in area: 3.0 ha
- Target area of habitat development: 2.3 ha

Fig. 3. Sample area No. 2. in Szabadszállás, Hungary

Sample area No. 2. (Figure 3.)
- Location: Szabadszállás, Hungary
- Start date: 2022
- Installed capacity: 652 kWp
- Output capacity of the inverter: 498 Kva
- Total area: 1.3 ha
- Area of the PV park: 1.2 ha
- Built-in area: 0.8 ha
- Target area of the habitat development: 0.5 ha

Results

In terms of increasing the biological diversity of the sample areas, the task is twofold. On the one hand, for the preservation of complex areas, canal and ditch banks, water-logged areas, and their rows of trees, groups of trees, grassy elms, and shrubs, and on the other hand, their improvement and development. By preserving and restoring these values, the diversity, mosaic, and diversity of the landscape can be maintained. The investigated solar panels can also be involved in this preservation and development process. On the one hand, the area of the park is suitable for the creation of natural lawns, grassy meadows, and bee pastures, and on the other hand, outside the fence, but within the plot, rows of shrubs and patches of shrubs consisting of native species (hawthorn-greenish-juniper dry shrubs) can be planted. The excess rainwater generated in the park area can contribute to the maintenance of aquatic habitats, which will become increasingly important due to the drier climate that related to climate change. However, in order to avoid the problems arising from the polar light pollution presented earlier, it is not advisable to create an open water habitat from the runoff rainwater in the area of the solar parks (Figure 4.).

A solution that ensures natural water retention, but does not cause the above ecological problem, can be the draining of the excess water and govern it to the surrounding, deep-lying grasslands (fens and mesotrophic wet meadows) that are periodically affected by water and thereby ensuring their water replenishment. The two depressions located near the sample areas (30–50 m), which are still periodically covered by water (Figure 4.), provide a good opportunity for this.

Fig. 4. Sample area No. 1. (two photos on the left) and No. 2. (two photos on the right) in Szabadszállás, Hungary

Conclusions

Dynamically growing solar park investments realized within the framework of green field investment have drawn attention to the fact that, in addition to their positive role in curbing climate change, they can have a significant negative impact on the biological diversity. Several studies have pointed out that after careful planning, the features of these areas can be improved and they can play an important role as habitats. The two domestic sample areas have pointed out that not only plant planting, but also the possibilities of rational drainage of excess water flowing from the surface of the panels should be included in the scope of the tests.