THE COMPARATIVE PHENOLOGICAL EXAMINATION OF REED NEAR KIS-BALATON WETLAND

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Abstract

In Central Europe Lake Balaton and Kis-Balaton wetland, with its filtering function, are unique natural formations as parts of the Balaton Uplands National Park. The large and coherent water habitat has unique significance in Europe. Natural reeds can be found in Lake Balaton and Kis-Balaton wetland and they provide habitat and food for herbivore organisms, they are valuable factors of nature, water and environmental protection. In our research we visited our measurement venues on a weekly basis and examined the plants. We measured their height above water and the maximum width and length of their leaves. We watched the changes of the water level and the weather conditions during the vegetation period of the reed. We examined common reed in different microclimatic factors during these comparative, phenological examinations we observed differences in the height and leaf area index (LAI).

Keywords: Kis-Balaton, common reed, LAI

Összefoglalás

A Kis-Balaton környékén elhelyezkedő eltérő vízborítású nádállományok magasság és levélfelület-index változását vizsgáltuk a közönséges nád (*Phragmites australis*) vegetációs időszakában, 2018-ban. Ebben az évben a Balaton és a Kis-Balaton természetes nádasait, a keszthelyi Agrometeorológiai Kutatóállomáson mesterségesen telepített nádállományát és a keszthelyi szennyvíztisztító telep melletti kifolyó özönnádasát jelöltük ki vizsgálatra. A kijelölt mintanapokon mértük a növénymagasságot, levélszámot, levelek hosszúságát és szélességét, továbbá figyelemmel kísértük a vízszint változását és számláltuk az egy négyzetméterre jutó nádsarjak számát. Az időjárás a 2018-as évben meleg és csapadékos volt, ami kedvezően befolyásolta az állományok magasság és levélfelület-index értékek alakulását.

A mérésekből levont következtetésünk az volt, hogy 2018-ban a melegebb és csapadékosabb időjárás kedvezett a nád magasság és levélfelület-index alakulásának. A Balaton nádasa esetén detektáltuk a legtöbb kiemelkedő értéket: legnagyobb átlagmagasság (380 cm), legnagyobb átlag levélfelület (1780 cm^2), a legsűrűbb nádállomány (50 nádsarj/m^2) és a legmagasabb átlag LAI érték (8,9). A vízborítás és a klímanormálnál (1970-2000) melegebb léghőmérséklet kedvezett a nád növekedésének. A vízborítás alatt álló nádállományok magasabb évi átlagos LAI értékkel rendelkeztek, melynek oka az egy négyzetméterre jutó sarjhajtásszám volt. A kis-balatoni part menti nádas volt a legritkább állomány (18 nádsarj/m^2), valamint a legkisebb átlag magasságértékeket virágzáskor (220 cm) számoltuk. A bugahányás után a leszáradás fokozatos volt, a vegetációs periódusnak megfelelő.

Introduction

The common reed (*Phragmites australis*) is a cosmopolitan plant (Clevering and Lissner,1999). This plant is tall, it can obtain heights of up to 4 m with stem (Hitchcock and Cronquist, 1973). It is perennial grass, which can create plant community. Natural reeds can be found from the tropical zone to cold temperate areas of both hemisphere. Reed grows in littoral zones of lakes, along rivers and in shallow freshwater and barkish wetlands BRIX,1999). The ecological adaptability of the reed is wide (Haslam, 1975). Reeds occupies a variety of habitats throughout its range including: non-tidal and tidal (Hickman, 1993; Welsh et al., 2003). Common reed has been farmed in Europe for thousands of years for roof thatching. Young plants of reed are considered palatable and readily grazed by cattle and sheep (Frankenberg, 1997). Mature plants are tough and unpalatable to wildlife (Leithead et al., 1971). These days, reed is being extensively used in constructed wetlands (Lambertini et al., 2012). Due to reed's dense root matrix and coarse stems, it can use for erosion control. Specialists recommended for shoreline and earthen dam stabilization by reed (USDA NRCS, 1999). Additionally reed is used by mining operations for stabilizing ditch banks (Walker and Grimes, 1997). Lake Balaton is a freshwater lake in Hungary. It is the largest lake in Central Europe. Lake Balaton is closely connected to Kis-Balaton. Kis-Balaton is a huge wetland habitat, which is a unique value in Europe. The River Zala is the main inflow of Kis-Balaton and Lake Balaton. Water quality had an obvious decline in Lake Balaton in the 1960's because the nutritient load of it increased. Due to this, a protection system was built. The Kis-Balaton Water Protection System was built on the lower part of the River Zala in a two-step project (Tátrai et al., 2000). Kis-Balaton wetland improves the water quality of the River Zala and Kis-Balaton Water Protection System can protect water quality, biodiversity and different habitats.

The goal of our examination was to detect differences in reed height and leaf area index (LAI) values of the five reed stands with different water supply.

Materials and Methods

We visited our measuring places weekly from April to October in 2018. We examined natural reeds with different water supplies in Kis-Balaton wetland and Lake Balaton; artificial (planted) reeds and invasive reeds in Keszthely. In the Ingói-berek of Kis-Balaton naturally reedy area stood in a 60-80 cm high water supply during vegetation period in the water zone. The natural reed stood in the dry zone during vegetation period, so these reeds stood without water coverage. Georgikon Faculty, University of Pannonia has a so-called Harbour II. at the Balaton Bay. The bay has naturally reedy area. The examined reed stood in a 80-90 cm high water supply during vegetation period. In Keszthely's Meteorological Research Station, the artificial (planted) reed stood in a 30-40 cm high water supply from April to October. These plants were planted in 2014. The outlet of Keszthely's wastewater treatment plant has invasive reeds. Invasive reeds meaning: reeds which can be found in other than its natural habitat. We took measurements of the following attributes: plant height, leaf area. We used a standard measure for measuring height and widths. On different points of the reed community with repetition we measured the height during vegetation period. For measuring leaf area we used an LI-3000A portable planimeter. In different reed communities we counted reed shoot per square meter in water and in the dry zone. Meteorological Research Station of Keszthely provided data which station is near our sampling areas.

Results and discusson

The reed's vegetative growth period started during warmer months in spring and there was significant water deficit in April. Lack of rain was unusual at this time of the year, it differed from the climate normal (1971-2000). The earliest growing started in station and in outlet because in the first week of April we found 15- 20 cm high reed shoots. At Balaton Bay and Kis-Balaton reeds without water coverage started to grow in the middle of April. Finally, Kis-Balaton's reed appeared above the water level. The appeared reed is due to decrease of water level from 108 cm to 80 cm in the second part of April.

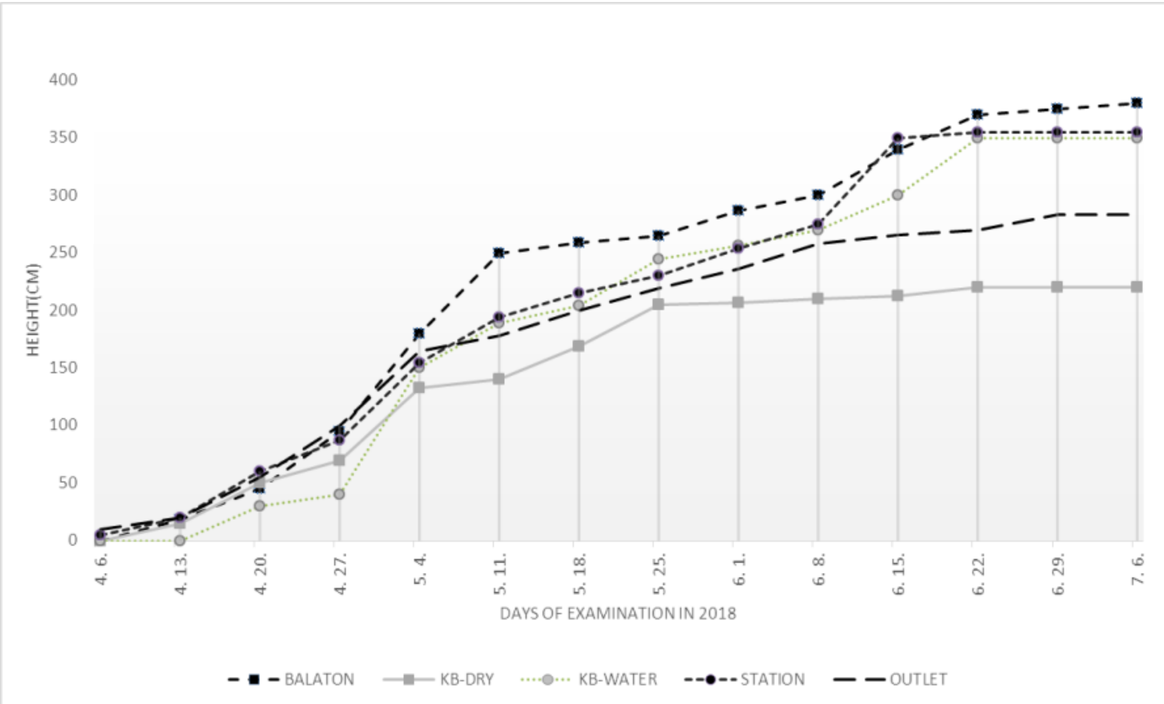

Figure 1: Reed's heights changing in 2018

The weather was favourable to the growth of reed. The height of all reed grew progressively in 2018 (Fig.1.). Instead of height, the reeds produced more leaves, and they grew longer and wider. Before the reed's flowering, the growing of height slowed down in May. The reeds reached their full height at flowering in June. The earliest flowering started in station, then at the bay. Finally, plants entered to flowering next to the wastewater treatment plant in the second part of June. The highest average height was in Balaton (380 cm) and the lowest average height was in dry zone in Kis-Balaton (220 cm) during flowering. The percentage difference was 53.33% ($P \leq 0.0001$).

Independently of area of examination, the curves of the leaf area changed in the same way as time went by (Fig.2.). The weather affected the drying of the leaves. The examined year did not have excessively wet conditions. The months were warm enough for growth and flowering during the vegetative period. During our research we could do the last field-day on 31st August 2018 in station. We measured the largest leaf areas in July. The reeds' leaves reached a large size after flowering. We measured the smallest leaf area (average) in station (895 cm^2), the largest leaf area (average) at Balaton Bay (1780 cm^2). The percentage difference was 62.24% ($P \leq 0.0001$). We kept a close eye on the growing of the leaf area, the growth was slow until the end of May, the curved lines were near each other. The averages were similar, but not exactly the same. The growth of the leaf area became faster from May, the line charts were continuous. The watery reeds' curved lines developed above the drier ones. In the middle of July the weather was windy and stormy. Due to the invasive reeds' stems bowed and some leaves damaged because of the heavy storms.

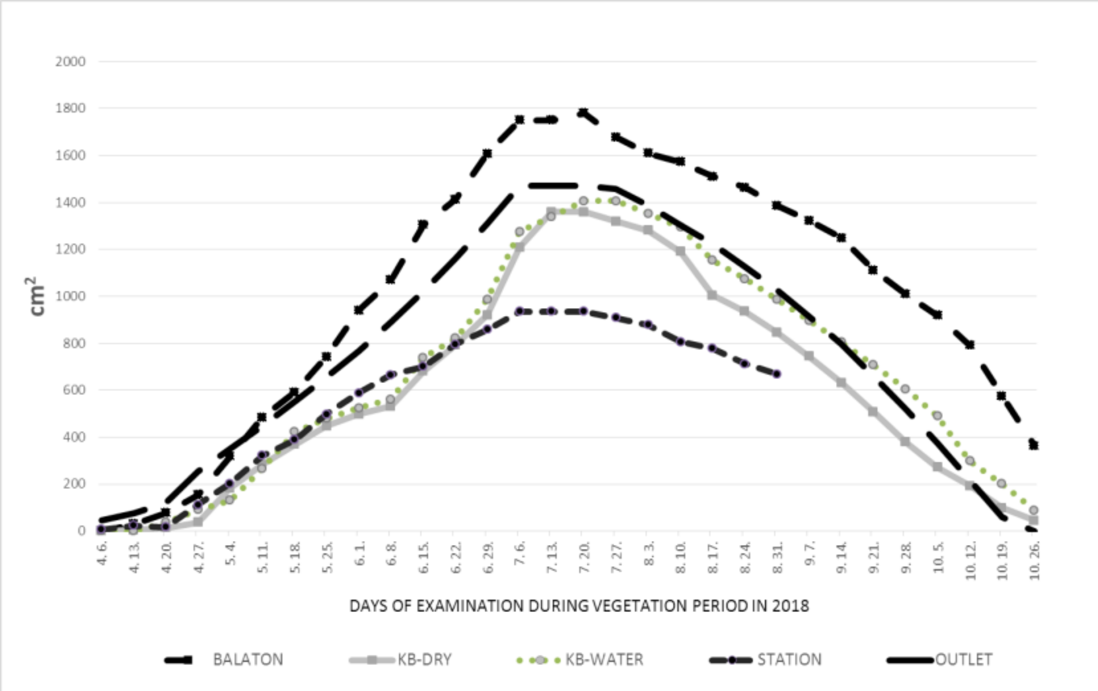

Figure 2: Reed's leaf area changing during vegetation period in 2018

The damaged leaves started to dry slowly and earlier than they should have in normal vegetative period. In July, after flowering we detected the largest leaf area values.

Leaf Area Index is a form of measurement. LAI takes into consideration the total leaf area determined per unit of ground area. In the beginning of April, the leaf area index values started to rise slowly, because reeds concentrated on growing of their height (Fig.3.). When all reeds reached about 130 centimetres in height, they started to have more, wider and longer leaves. From May until the end of June, LAI values increased intensively in all reeds. Differences could be seen in the LAI values of the reeds in vegetative period.

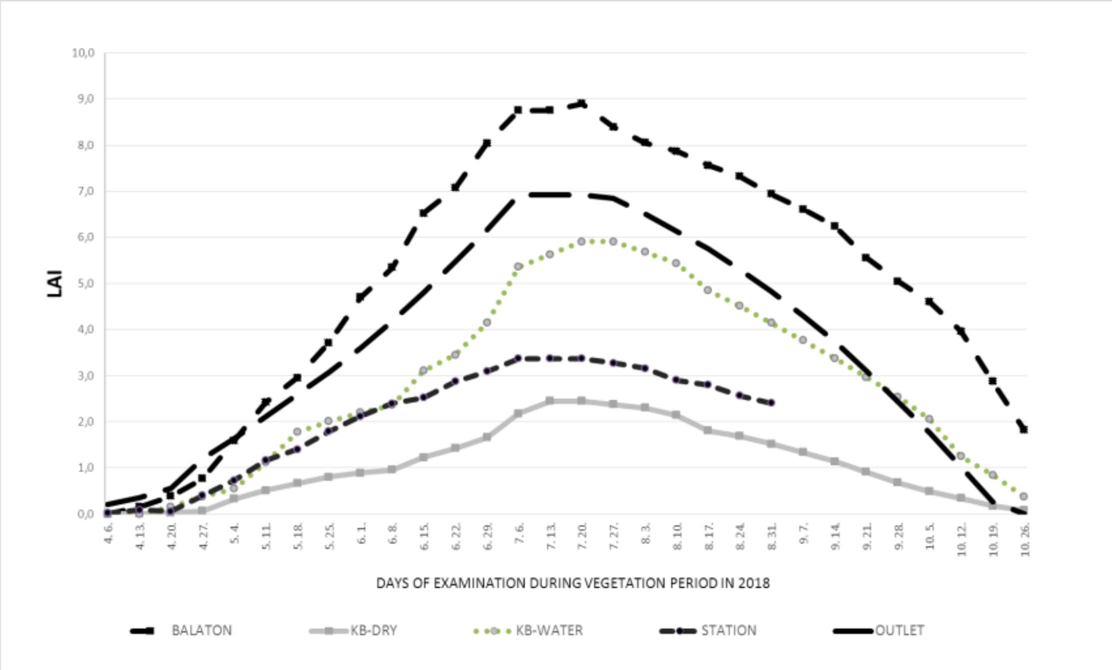

Figure 3: Reed's leaf area index changing during vegetation period in 2018

All reeds reached their largest average LAI values a month earlier than the average expected time. The average time is usually July and August. In 2018, the very first LAI value maximums were in outlet and station in the second part of June. The smallest average LAI of dry zone was 2.4. In the second part of July, Balaton had the largest average LAI: 8.9. This value was the largest in vegetation period in 2018. The percentage difference was 115.04% ($P \leq 0.0001$).

Conclusion

In 2018, the weather was warm and humid during examined vegetation period. The weather conditions favoured to growing of height and changing of leaf area index. We concluded: there were differences in values e.g. heights and leaf area indexes. We detected the reeds of Balaton had significant values: the highest average height, the largest average leaf area, the densest reeds and the largest average leaf area index value. We compared LAI values and we concluded that watery reeds disposed of larger average LAI. Dry zone reeds was the most sparsely reed shoot area and it produced the lowest average height values.

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