Dry matter production of common reed *(Phragmites australis)* in different zones of the reed belt in lake Neusiedlersee (Austria)

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Abstract

Comparative studies of the dry matter production of *Phragmites australis* (Cav.) Trin. ex Steudel were carried out in the reed belt near Purbach (on the western shore of lake Neusiedlersee) during the vegetation periods of 1981 and 1982.

The reed belt can be subdivided into three major production zones, with the landward marginal zone of *Scirpo-Phragmitetum utricularietosum* being the most productive. At the peak of the aboveground biomass (late July / early August) 1.2–1.5 $kg.m^{-2}$ of stem and leaf dry mass are formed. In contrast, *Phragmites* from the central part of the reed belt achieves on an average only 75 % of this amount. In the long run an appreciable increase in dry matter production will be possible only in the lakeward marginal zone of the reed belt. On the basis of the results, the importance of the common reed for the reed-belt ecosystem is discussed and emphasized.

Introduction

As a consequence of an increased influx of nutrients, in recent years marked changes in the phytoplankton community as well as an increased biomass of the phytoplankton and zooplankton of lake Neusiedlersee have been observed (GUNATILAKA, 1978; HERZIG, 1977). In particular, the diffuse influx of phosphorus into the lake, which, according to computer calculations, amounts to as much as 75 t per year (STALZER and SPATZIERER, 1987), has an adverse effect on the entire ecosystem. In numerous detailed studies the reed belt has been accorded the hypothetical role of a "nutrient trap" (deprivation of sediment and nutrient depository) or as a "natural filter system" (AGN-Forschungsbericht, 1985).

In order to investigate the effects of this "overfertilisation" of the lake water and sediments on the reed crop, studies concerning the dry matter production of *Phragmites australis* were carried out in the reed belt near Purbach/See as a part of an AGN research project.

Material and Methods

Shoots of *Phragmites australis* were harvested from three different sampling plots along the Purbach Canal on the western shore of the lake within a dense and uniform population of reeds (for more details about vegetation conditions and production zones of the reed belt, see BURIAN, 1973). Plot 1 was situated in the landward marginal zone of the reed belt: This riparian zone is distinguished by a higher soil activity and less anaerobic properties in the root region than in the lakeward part of the reed belt and is subject to periodical drying-out (MAIER, 1976).

Harvesting plot 2 was located in the central portion of the *Scirpo-Phragmitetum utricularietosum,* which occupies the main part of the reed belt between the lakeward monospecific *Phragmites* community and that situated furthest inland: a constantly flooded zone with clear and brown reed water, where the reed forms numerous clones of different habit and is associated with *Utricularia vulgaris* L. (GEISSLHOFER and BURIAN, 1970).

Harvesting plot 3 was located in the outermost, lakeward marginal zone of the reed belt, which is monospecific and greatly influenced by waves.

The reed shoots were harvested by means of the random sampling technique (described in more detail by ONDOK in ŠESTÁK, ČATSKÝ & JARVIS, 1971) and the material was divided into the different organs (leaves, stems with leaf-sheaths) on the spot. From each plot 2 m^2 of reeds were harvested. The selection of the size of the sampling plots depended on the type of the stand and the distribution of the shoots. Within all plots the average stand density was estimated in a non destructive way, by counting shoots in adjacent quadrates sized 1 × 1 m along a transect from the landward marginal zone up to the lakeward marginal zone of the reed belt. This method provides a relatively good estimate of an average aboveground biomass in the whole stand. The sampled material was dried in a ventilated drier to constant mass at 85°C.

Results

The presented data are from 1981 and 1982 and were obtained in the course of periodic harvests of reeds during the production period. The highest stem density per unit area was recorded from nearly natural stands (i. e. uncut in winter) in the central part of the *Scirpo-Phragmitetum utricularietosum* (zone 2) with an average of 200 stems per m^2; however, only about 35–40 % of these stems belonged to the respective summer generation, while the remainder were dead old reeds. In both vegetation periods, the mean number of live stems per m^2 was 75 and did not increase significantly in subsequent years; a fact which results in a relatively low figure for the biomass. The highest live stem density was measured in zone 1 (landward marginal zone) of the reed belt with a mean stem density of 112 per m^2 (summer shoots). The reed there is favoured both by the environmental factors (radiation microclimate and the temperature) and

by a sufficient supply of mineral nutrients from the water, soil and bottom sediments; thus a high level of primary production is attained. This may be one of the reasons for the highest aboveground dry matter production in this zone (Fig. 1). With 80 stems per m^2 and a maximum aboveground biomass of 950 $g.m^{-2}$ the lakeward marginal zone of the reed belt takes up a middle position. These stands are exposed to high mechanical loads by the wind and lashing of waves – a fact which plays an important role during the juvenile phase of the reeds.

When comparing the seasonal fluctuations in the aboveground biomass and rate of dry matter production, it is evident that despite different crop growth rates the peak in the aboveground dry matter production is reached at the same time (August) (Fig. 1).

The crop growth rate (CGR) (Fig. 2a) shows relatively high starting values in zones 1 and 3. In contrast, the reed in zone 2 starts to show positive values only after the development of the entire photosynthetic apparatus. The steep decline of the curves in early / mid-August signals a reversal in the direction of assimilate transport to the rhizomes and the investment into their growth.

The relative growth rate (RGR) of the aboveground biomass is highest at the beginning of the production period, when young reed stems, well-supplied with energy reserves from the rhizomes, show an intensive increase in stem height and leaf growth (Fig. 2c). A slight

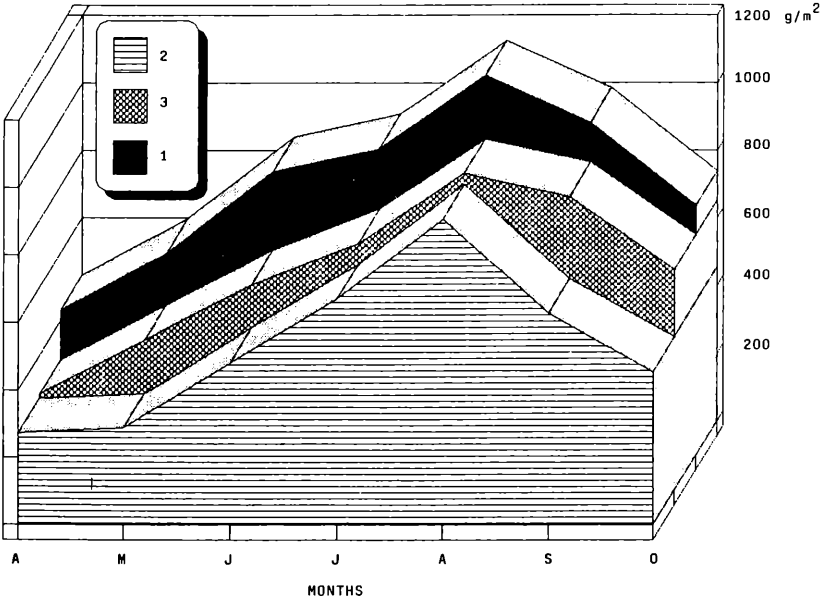

Fig. 1: Seasonal changes in total shoot dry mass ($g.m^{-2}$) of *Phragmites australis* during the 1981/82 growing season (mean values). 1: landward progression zone; 2: *Scirpo-Phragmitetum utricularietosum;* 3: zone of monospecific reed stands.

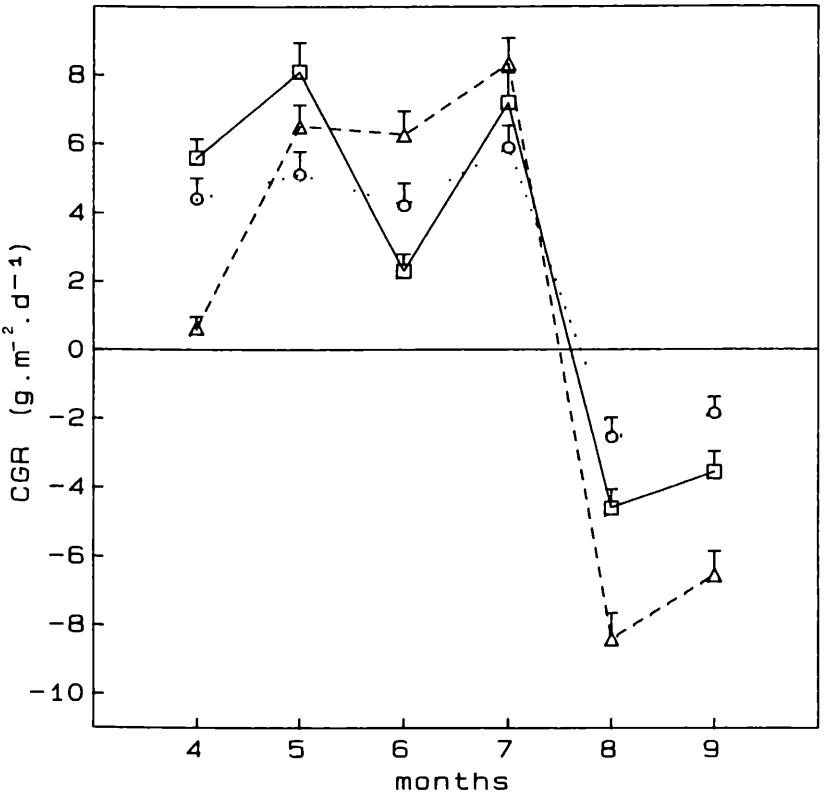

Fig. 2a: *Phragmites australis*. Seasonal changes in rates of dry matter production (CGR) (vertical bars ± standard error). (For symbol parameter see Fig. 2b)

increase in the RGR in zones 1 and 3 in July indicates a second growth spurt of so-called summer stems, which, however, do not reach full size. The reeds of the lakeward marginal zone still produce relatively much new leaf mass at this time of the year, which results in another rise of the leaf area index (LAI) (cf. Fig. 2b).

Discussion

The results of the present study show that the reed belt at Purbach can be subdivided into three major production zones (SIEGHARDT and MAIER, 1985). The first one is the landward, intermittently wet area of the *Scirpo-Phragmitetum utricularietosum* with a dense and uniform reed population and high growth rates in the first half of the production period (cf. Figs. 1 and 2a). In the central portion of the *Scirpo-Phragmitetum*

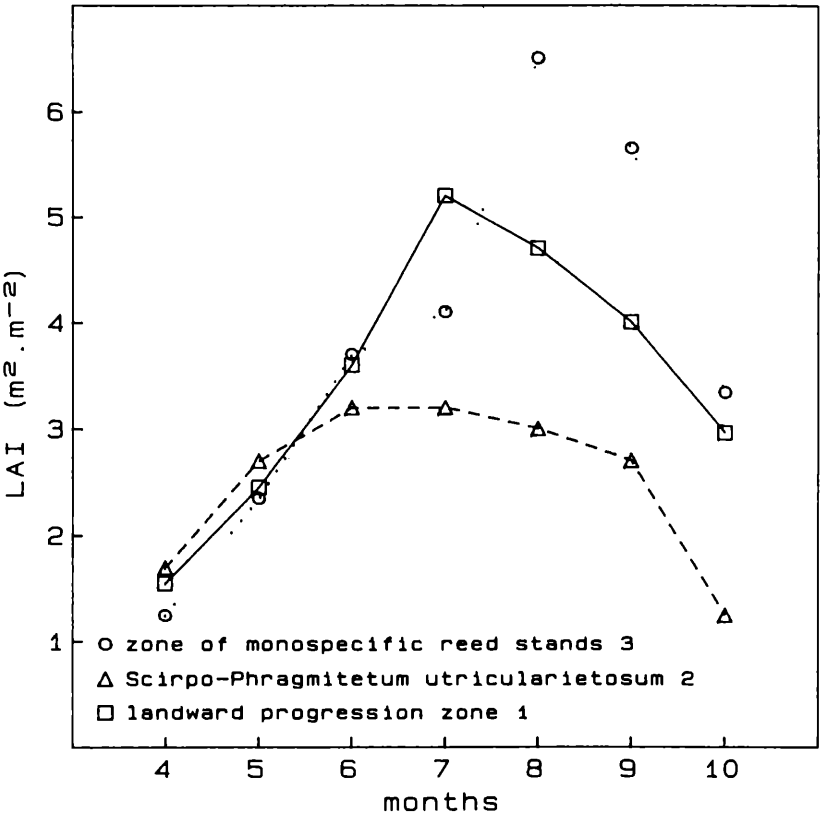

Fig. 2b: *Phragmites australis.* Seasonal changes in the leaf area index (LAI).

utricularietosum the conditions for production appear to be stable over extended periods; but there, too, losses in the area of stands result from human interferences. It is difficult to give an accurate account of the situation, not least since the underground biomass represents the sum of several years production and it is almost impossible to determine the exact age of the rhizomes (BURIAN, 1973). An appreciable increase in reed production is only possible in the lakeward marginal zones of pure *Phragmites* populations of the *Phragmitetum nudum* (BURIAN and SIEGHARDT, 1979). As MAIER and SIEGHARDT (1977) were able to demonstrate, constantly flooded stands in the area of Rust/See are more productive than the stands growing on intermittently wet soils of the landward progression zone. As far as the reed belt at Purbach is concerned, this result can be confirmed only in part. The influx of nutrients into the lake which comes from diffuse sources (STALZER, 1980) may be one reason for the relatively high crop growth rate in the landward

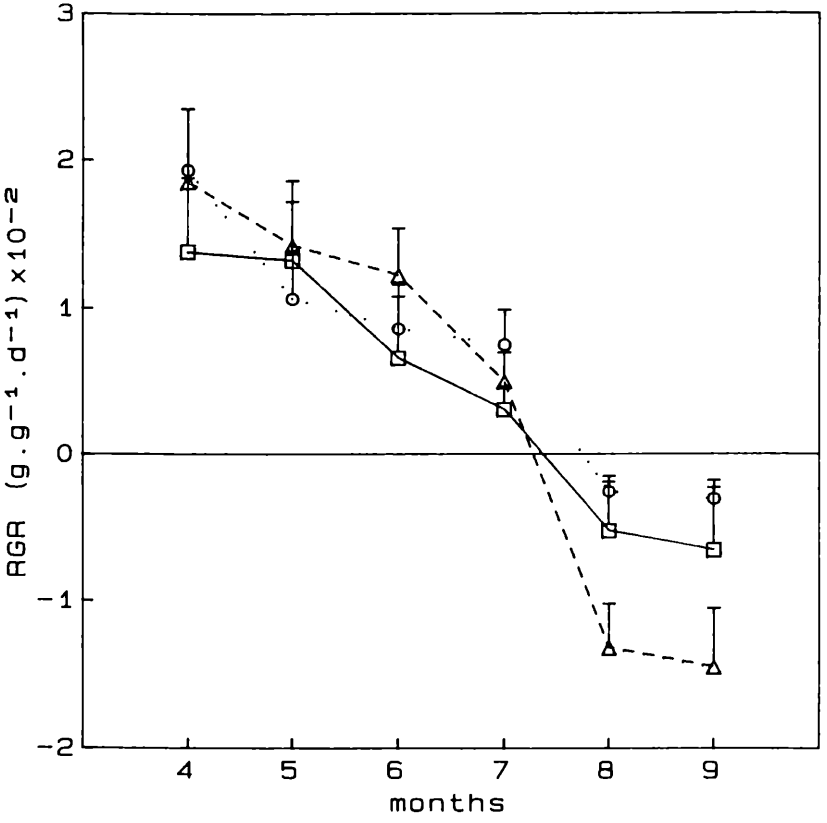

Fig. 2c: *Phragmites australis.* Seasonal changes in the relative growth rate (RGR). (For symbol parameter see Fig. 2b)

marginal area of the reed belt. The constantly flooded central zone of the *Scirpo-Phragmitetum utricularietosum* with its high proportion of old stems is less productive (cf. Fig. 2a). The seeming "advantage" in production is offset by a great morphological "disadvantage": As BORNKAMM and RAGHI-ATRI (1986) have shown, a high proportion of phosphorus and nitrogen makes the reeds more susceptible to mechanical damage; it results in the formation of thick, but soft stems with a large leaf area (cf. Fig. 2b). However, as experiments by SUKOPP and MARKSTEIN (1981) have demonstrated, the sklerenchyma is less strong. When exposed to mechanical stress, the stems will break and later there may even be a decrease in the shoot biomass. The extent to which these results can be transferred to the reed belt along Neusiedlersee still needs to be assessed by further detailed studies. These observations show that with a continuously high influx of nutrients a noticeable decline in the mechanical strength of reed stems is to be expected.

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