6. SUMMARY

The present paper provides the results of investigations on growth and habitat occupation of common reed (*Phragmites australis* (Cav.) Trin. ex Steudel). It focuses on the aspect of space and time in the development of reed if favourable conditions for growth are given. The investigations were performed between 2000 and 2003 in carp ponds in Saxony, Germany. The results can be divided into three main units: the growth of culms, the growth of culms in stands and the habitat occupation of reed.

The growth of culms is limited by their diameter, which remains constant throughout the vegetation period. The maximum length of a culm with a given diameter can be calculated. A relative length can be determined by dividing the actual length of a culm through the length it potentially could have reached. The relative length indicates the amount, in which the culm takes advantage of the prerequisites for growth given by its diameter. Culms with large diameters emerge earlier and grow faster. At a given point at the beginning of the vegetation period they are, therefore, longer and have both more internodes and leaves than culms with small diameters. This applies as long as length growth corresponds with the apical increase in the number of nodes. The culms reach approximately 23 nodes and eleven leaves in the time period from June to August. No increase in node number by apical growth can be observed from then onwards. Thin culms stop growing, while thick culms grow exclusively by an elongation of the internodes present. Therefore, the growth rate of thin culms is bigger at the beginning, the one of thick culms at the end of the vegetation period.

The growth of culms in stands shows characteristic types of development as a result of interactions between culms with given growth conditions. Reed stands present differences of their mean diameter, which can be used as a comparing description of a developmental state. During the vegetation period, the diameter can either decrease by the appearance of thin culms or increase by their death. Over long time periods, the rhizome of reed penetrates into deeper soil layers, which also leads to increased diameters. Because the mean diameter of reed stands is subject to changes, it is not fixed within narrow boundaries by genetic conditions. The diameter limits the length of a culm. Therefore, it can be assumed that the mean diameter of culms influences upon their average length. The culms of stands with large diameters are most often longer, but the relation is vague and outweighed by local

environmental influences. The relative length reveals which stands stay short for their growth prerequisites, regardless of the actual culm length.

The density of culms in reed stands decreases with an increasing mean diameter. The long-term increase of the mean diameter leads to self-thinning in favour of fewer and larger culms. The standing crop of reed stands is constant and independent of culm density. This contradicts the -3/2 power law, which predicts an increase of the standing crop during self-thinning in dense monocultures. The constancy of the standing crop can be explained by a dependence of the biomass of single culms on their surface. Regarding their standing crop, the reed stands of carp ponds have the same growth potential, which is exploited to a similar degree.

Reed stands can be distinguished by characteristic changes of distributions, means and variances of diameter, density, length and relative length of the culms during the vegetation period. Five different types were found:

- Invasive reed is an early stage of the stands which is characterised by thin culms in diverse, sometimes very high densities.
- Central reed with stable growth was frequently found in inner regions of stands, the culms have intermediate diameters and densities.
- Reed tussocks are also characteristic for inner regions of stands. The culms are thin and grow in high densities out of sheaf-like groups of interwoven culms, rhizomes and roots.
- Steep-shore reed found at gravelled man-made shores with high slopes. The stands are characterised by thick culms and intermediate densities.
- Giant reed has striking thick culms and grows in low densities. It is found in central regions of stands with high accumulation of matter.

The types of development represent states of a long-term change of the stand structure dependent on its age and environmental influences. Basically, the development is directed from thin culms of high density towards less and thicker culms. The development is an adaptation to the accumulation of matter in the stands and can therefore be caused by the growth of reed itself. It is assumed, that the increase of culm lengths enhances the ability of reed to compete with other plants during succession. Because the standing crop remains constant, it reflects a change rather than an improvement of the stands' growth.

The habitat occupation by reed is almost exclusively a process of growth. No successful dispersal of sexual diaspores was found. Cloning was found only once and considering the amount of investigation, asexual reproduction is a rare event. Reed does hardly ever split up into ramets, which are defined as clonally originated, physically separated and living descendants of a former individual. Reed grows as an extensive individual, an organism compounded of units which are capable of living independently, but nonetheless remain connected. Therefore, the habitat occupation by reed occurs by growth of existing stands and barely includes reproduction or dispersal.

The habitat occupation of reed follows an "unstable strategy of habitat-dependant partial tactics". If growth conditions are good, the tactic is phalanx-like. Environments with less favourable conditions are occupied with a tactic showing traits of the guerrilla growth type. The physiological integration of modules guarantees the successful passage of unsuitable areas. The intra-individual combination of tactics leads to differences between parts of a single organism according to their position in a guerrilla-phalanx-gradient.

The present paper proves the high capacity of reed stands to adapt to different and changing environmental conditions. The variability of morphological properties was shown both for reed stands and parts of individuals. This variability is essential for the strategy of growth and habitat occupation of reed. Differences between stands reflect different stages of development. The results presented are an alternative or at least an additional explanation for the morphologic variability of reed, which is predominantly explained by environmental factors or genetic prerequisites.