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6. ENGLISCHE ZUSAMMENFASSUNGEN DER IM BERICHTS-JAHR 1988 ABGESCHLOSSENEN DISSERTATIONEN UND DIPLOMARBEITEN (Summaries of Ph D and Diploma Theses)

6.1. Dissertationen (Ph D Theses)

BINZ-REIST Hans-Rudolf. Mechanische Belastbarkeit natürlicher Schilfbestände durch Wellen, Wind und Treibzeug. Veröff. Geobot. Inst. ETH, Stiftung Rübel, Zürich 101, 536 S.

Mechanical impacts on natural reed stands by wind, waves and drift.

The present study deals with the impact of mechanical stress on reed stands. It consists of four sections:

I. The common reed (*Phragmites australis* Trin.), general overview

During the last forty years, the reed stands of most prealpine and central European lakes have been declining at an alarming rate. Causes which have been recognized thus far are direct destruction through land reclamation, and indirect destruction through environmental changes, especially water pollution by solid or liquid refuse of all kinds. The consequences of reed decline are pointed out.

II. Mechanical effects

With the aid of a mathematical model, the effect of mechanical stress factors on the reed stem, particularly wind and wave action, were simulated. All load ensues from the resistance of any obstacle (stem, resp. drift-wood and other floating matter) against the flow of air and water; it can thus be expressed by the equations of dynamic pressure. Some coefficients of these equations (drag coefficient, coefficient of inertia) were obtained by experiments. Experiments were undertaken in the wind tunnel at "Aerodynamisches Institut an der Eidgenössischen Technischen Hochschule Zürich (ETH)" and in the wave tank at "Versuchsanstalt für Wasserbau, Hydrologie und Glaziologie an der ETH" (VAW). The velocity of the air particles (wind speed) is one of the initial input data of the model, whereas the water particle velocity due to the wave motion (orbital velocity) theoretically can be derived from the wave parameters (period, height, length). Two methods of wave forecasting in function of wind speed and free water surface (fetch) are presented.

The motions of the stem and the drift (considered as a rigid body) are expressed by differential equations. To make the numerical solution of these equations possible, the stem has to be abstracted as a concatenation of rigid bars, interconnected by elastic joints ("spiral spring"). The differential equations are integrated with a modified predictor-corrector method (initial steps with Runge-Kutta method). The computed motions and hence the deformations of the stem lead to the stress factor (bending moment). According to the constellation of the input parameters viz. wave height, period, mass and form of the drift, the resulting oscillation of the stalk is more or less irregular, in spite of the wave motion being assumed strictly periodic. The question, how the calculated stress may be compared to the measured strength values is therefore discussed and illustrated by some examples of reed stems being strained by wind, waves and a piece of drift-wood. A quantitative comparison between the results of the calculation and the real behaviour of the reed stem is not possible. However, it may be assumed that the mathematical model simulates the oscillation of the stalk to the degree of accuracy normally attributed to this kind of model. This assumption can be made on the grounds of the plausibility of the results

and that they are well in agreement with qualitative field observations. The calculated examples show that the influence of drift-wood on the stress factor is strongly dependent on other input parameters. For example, at a certain wave height, which is determined by the given situation, the influence of the drift-wood almost totally disappears, i. e. the stress factor is almost the same with or without drift-wood. Above this limit, the influence of drift-wood increases steadily with increasing wave height, whereas below this level no noticeable systematic tendency is observed. It is demonstrated here in theory, that which can be observed in nature: The destructive impact of high waves on reed is compounded by the additional mechanical stress which drifting objects represent.

III. Investigation of the mechanical properties of the reed stem

This section describes laboratory and field experiments for measuring the bending stiffness and strength of reed stalks. The stiffness is an important parameter of the equations of motion, whereas the strength serves as a relative value to be compared with the calculated loads. The aim of these measurements determined in part the procedures being used; attention was paid to test the stems in a state as "natural" as possible, although for comparison and assessment of different reed stands the specimens should be dried completely prior to testing, in order to avoid the influence of differences in water content.

IV. Discussion and conclusions

Possible reed stand protection measures, especially those of a mechanical nature, are suggested and discussed. It is emphasized that most of these measures represent only a treatment of symptoms and may nevertheless be necessary in certain circumstances.

ZIMMERLI Stephan. Vegetation und Standort von Schwingrasen in der Schweiz. Veröff. Geobot. Inst. ETH, Stiftung Rübel, Zürich 102, 105 S.

Vegetation and site conditions of floating mats in Switzerland.

The present study deals with a survey of vegetation and site conditions of floating mats in Switzerland. The study area is restricted to the Swiss Alps.

The sites studied are situated between 1200 m and 2400 m a. s. l., mostly (70%) between 1450 and 2050 m a. s. l. Most of the more than 200 phytosociological relevés made show that vegetation samples in about 50 different geographical localities studied belong to the *Caricetum limosae* s.l. The front of floating mats at mesotrophic lakes may be fringed by the *Caricetum dianiae*.

Water samples were taken twice in each of the seven localities selected. About 4500 measurements of water chemistry were evaluated (pH-value, electrical conductivity, the concentrations of the cations Ca, Mg, Na, K, Fe, Mn as well as o-PO₄-P and tot-PO₄-P).

The temporal fluctuations of the measured values were analysed; a high temporal constancy was shown in particular for the pH-values, the electrical conductivity and the concentrations of Ca²⁺ and Mg²⁺.

A test of homogeneity of the total data matrix as well as their single components demonstrated that the pH-value, the electrical conductivity and the concentrations of Ca²⁺, Mg²⁺, Na⁺, K⁺ and tot-PO₄-P of the free mire water were suited to a principal component analysis, whereas the other parameters would not have a predictive influence. The primary axis associated with the pH-value, the electrical conductivity and the concentrations of Ca²⁺ and Mg²⁺ represents the alkalinity and is explaining the main part of the data structure. The second axis, intercorrelated with the first, is associated with the concentrations of K⁺ and tot-PO₄-P.

The correlations between the Ca²⁺-concentration, the pH-value, and the electrical conductivi-

ty of the free mire water were analysed; it has been shown that the electrical conductivity is a function of the Ca^{2+} - concentration and the pH-value.

The correlations of the different concentrations of ions between the free mire water and the water pressed out of the floating mat are analysed. These correlations are highly significant in the case of Ca^{2+} , Mg^{2+} and $\text{o-PO}_4\text{-P}$.

The concentrations of cations out of a peat bog floating mat were compared with those of other European peat bog waters. The differences observed cannot be explained by the gradients of precipitation proposed by ALETSEE (1967).

A phytosociological classification of the *Caricetum limosae* s.l. is proposed for the Swiss Alps.

The ecologically investigated complexes of floating mats were compared, and the correlation between the vegetation and the water chemistry was discussed.

The present study shows that the *Caricetum limosae* s.l. occurs over the whole amplitude of alkalinity. A high water level during the whole year as well as immobile (ground) water are characteristic of the sites inhabited by *Carex limosa*. The *Caricetum limosae* s.l. is not restricted to poor mire water with low pH-value. The alkalinity of the mire water as well as the water balance of the site influence the type of vegetation within the *Caricetum limosae* s.l.

In conclusion, the importance of the water flow for the differentiation of the plant cover in mire ecosystems is discussed in detail.

6.2. Diplomarbeiten (Diploma Theses)

BRAWAND Maya. Beziehungen zwischen Wasserqualität und Wasservegetation im Hänsiried (Zürich). Aktueller Zustand und Entwicklungstendenzen.
113 S. (Polykopie).

Relation between water quality and water vegetation in the fen Hänsiried (Zürich). Current conditions and tendencies of development.

The fen Hänsiried situated at the northern limit of the city of Zürich contains about 60 small ponds originated from peat cutting. Since the ponds began to become overgrown by the water vegetation it was intended to excavate the ponds again and create some new ones. In the present work an investigation of the plant species of the ponds and an analysis of the water was achieved in order to detect some relations between water quality and water vegetation.

Thirteen true water plant species and 87 shore species grow in and around the ponds. Several rare species could be found (e.g. *Potamogeton coloratus*, *Carex riparia*, *C. pseudocyperus*, *Comarum palustre*, *Myriophyllum verticillatum* and possibly *Utricularia bremii* and *U. minor* which are not identified with certainty in not flowering stage).

The peat depth varies between 1.2 m and 3.8 m. The ponds not exceeding 1 m depth never reach the mineral ground.

The ponds newly created in Winter 1988 developed already in the next Summer a dense vegetation cover. *Typha latifolia*, *Alisma plantago-aquatica*, *Potamogeton natans*, *Utricularia neglecta* and *Chara* sp. proved to be pioneer plants firstly colonizing the new ponds.

The relation between water quality and water vegetation was not always very clear. The discriminant analysis of the maximum and mean values of calcium, magnesium and conductivity and the mean value of phosphorus showed to be the best parameters to segregate the ponds in different groups.

The light might be a further factor to explain the different plant composition of the ponds.

CERLETTI Gianpietro. Experimentelle Untersuchungen zum Bodenwasserhaushalt in Trespen-Halbtrockenrasen (bei Merishausen SH). 84 S.(Polykopie).

*Soil-water regime in semi-dry *Bromus erectus* grasslands (near Merishausen SH).*

The soil-water regime in semi-dry *Bromus erectus* grasslands near Merishausen (Schaffhauser Randen) was investigated during the summer 1988. Bare gaps of 30x35 cm² on the north and the south side of a stripe with dense vegetation were prepared in autumn 1987. According to VON GUNTEN (1987) this led to the following types of microhabitats: dense "central vegetation", "gap", "south site" south of the central vegetation, "north site" north of the central vegetation. In these microhabitats soil water-content and soil-moisture tension were measured with the new Time Domain Reflectometry- (TDR) method. The results of the soil-water content led to the definition of the soil-moisture tension. The aim of these investigations was to quantify the influence of stripes of dense vegetation on soil-water regime in adjacent gaps. The results of these investigations allow the assessment of the importance of this influence for the development of seedlings and for the coexistence of different plant species in such types of grasslands.

A modified Time Domain Reflectometry (TDR) allowed the measurements of the soil-moisture in upper soil layers without damaging the plots.

The influence of the "central vegetation" on the soil-moisture regime in upper soil layers is significant, especially before mowing. Parching of the upper soil layers is significantly less in shady parts than in gaps. In the "central vegetation" the upper soil layers parch less than the uncovered surface.

Mowing strongly diminishes the influence of the "central vegetation" on soil-moisture regime in upper layers.

In lower soil layers the soil-moisture regime is virtually only influenced by the transpiration of the plant cover. Compared to upper layers the soil-moisture relations are inverted.

Concerning the soil-moisture regime, the results of the investigations suggest that not only competition but also positive interactions between plant canopy and seedlings and young plants are important factors.

FLÜELER Remo. Biologische Erosionskontrolle oberhalb der Waldgrenze: Verhalten einiger alpiner Arten in experimentellen Aussaaten auf Skipistenplanierungen. 159 S.(Polykopie)

Biological erosion control above timberline: Behaviour of some alpine taxa in experimental sowings on machine-graded ski runs.

Twenty-three species, among them 14 *Leguminosae*, from silicate and carbonate soils in the alpine area near Davos were investigated. Seed-anatomy, germination and early life phases were studied under controlled and natural conditions. Experimental test plots were established on machine-graded ski runs above the timberline.

The seed anatomy of the *Leguminosae* species turned out to be very similar. All of them had large embryos and only a little endosperm. Only seed shape and size were different. Seeds of *Alchemilla demissa*, *A. nitida*, *Epilobium alpinum*, *Potentilla dubia* and *Sibbaldia procumbens* also had large embryos. *Anthoxanthum alpinum*, *Festuca rubra*, *Ligusticum mutellina* and *L. mutellinoides*, on the contrary, had very small embryos and a well-developed endosperm.

In trials carried out under controlled conditions with untreated seeds, only *Ligusticum mutellina* and *L. mutellinoides* did not germinate at all. Four species showed a germination rate under 30%, five species a germination rate of 30-70%, the remainder had a high germination rate of over 70%. The seeds of all *Leguminosae* species harvested in 1987 germinated surprisingly well, whereas the germination of seeds of the same species harvested in 1985 was rather poor.

The mechanical scarification of the seed coat of the *Leguminosae* species produced decidedly positive results: in all cases a complete or almost complete germination was observed. The removal of the glumes improved the germination rates of the *Gramineae* species. Treatment with gibberellin resulted in increase of germination in *Alchemilla demissa*, *A. nitida* and *Potentilla dubia*; for the very first time *Ligusticum mutellinoides* germinated under controlled conditions.

Young plants developed differently under controlled conditions. Some of the *Leguminosae* and also *Epilobium alpinum* grew very fast and produced flowers in the same vegetation period. Other *Leguminosae* species as well as *Festuca rubra* grew fast but flowering was not observed. *Astragalus australis*, *A. frigidus*, *Hedysarum obscurum*, *Oxytropis campestris* and *O. jacquinii* showed exceedingly good root growth. *Anthoxanthum alpinum*, *Potentilla dubia*, *Trifolium alpinum* and *Sibbaldia procumbens* grew quite slowly. *Ligusticum mutellinoides* showed a particularly slow development.

In most field plots, much less seedlings were found than in the trials carried out under controlled conditions. Exceptions were untreated seed of *Anthoxanthum alpinum*, *Oxytropis jacquinii*, *Trifolium thalii* and above all *Ligusticum mutellina*, which were sown in autumn, 1987.

In the field trials carried out on silicate soil considerably less seedlings were counted and a higher mortality was observed than in the test plots on carbonate soil. The highest mortality rate was observed in the test plots sown in autumn (75% and 40%), whereas the mortality rate of seed sown in early summer was lower (on average 21%). The test plots which had been protected with CURLEX-blankets developed differently: in most test plots fewer seedlings emerged, but the mortality rate was low. In some of the protected plots, the seedling emergence rate and an improved mortality rate were comparable to those in unprotected plots.. A massive mortality rate with a lower seedling emergence rate was found in the plots sown in early summer with scarified seed material in carbonate soil.

The results and their significance to biological erosion control above timberline are briefly discussed.

GILGEN René. Beziehung zwischen Wasserqualität und Wasservegetation - *Lemnaceae* als Indikatorpflanzen. 122 S. (Polykopie). Siehe Beitrag in diesem Band.

Relation between water quality and water vegetation - Lemnaceae as indicator plants. See contribution in this volume.

HASLER Andreas. Biologische Erosionskontrolle oberhalb der Waldgrenze: Verwendung einiger alpiner Arten für die Bepflanzung von gefährdeten Stellen. 79 S. (Polykopie)

Biological erosion control above the timberline: use of some alpine species for the planting of endangered sites.

Nineteen native plants, mostly from the *Leguminosae* family were investigated as to their suitability for planting on sites above timberline which are endangered by erosion. The study comprises observations in the greenhouse as well as trials carried out under field conditions. The single-tiller-cloning (STC) was carried out in three series, and the resulting clonal modules were studied as to their survival, growth, and flowering. The field trials were carried out on two substrata where the modules were planted and also observed in relation to their survival, growth, and flowering.

The behaviour of the plants studied was characterized by a pronounced diversity and variability. In the single-tiller-cloning trials three different groups of behaviour were recognized; in some cases they can be further subdivided. The first group consisted of species which showed a clear growth of the ramets already after six weeks. As another characteristic of this group, no decrease of the experimental ramet populations was observed after the STC-treatment. Group II was composed of species which did not show much changes in number of ramets over the observed period of time. This pattern was either influenced by relatively great losses balanced by a high birth rate, or low losses accompanied by low birth rates. The species in group III showed a distinct or even high decrease in number of ramets. Again two strategies have been observed: On the one hand, some species showed a drastic decrease after the ramets have initially increased in number; on the other hand, some species steadily dwindled from the very beginning. The onset of flowering did not correlate with the groups (flowers were equally observed in group I and II) but with the timing of the STC-treatment.

In the field trials the survival rate was in most cases very high and growth was usually good. In the test plots planted in autumn 1987 up to 25% flowering modules were recorded, whereas the corresponding percentage in the plots planted in early summer 1988 was almost twice as high.

The results and their significance to biological erosion control above timberline are briefly discussed.

LEUTHOLD Barbara. Veränderung der Vegetation im Urner Reuss-Delta nach der Überschlickung. 86 S. (Polykopie)

Changes of the vegetation in the delta of the river Reuss in the Canton Uri after the floods.

The delta of the river Reuss in the Canton Uri is one of the last large wetlands in Central Switzerland. It was inundated by large floods in August 1987. These floods deposited a silt-layer of up to 4 cm on the right and up to 50 cm on the left side of the river Reuss. The biggest deposits were left in the *Schoenetum* south of the motorway. They were removed by a caterpillar in winter 1987/88.

In this paper, the changes in the flora were described and it was attempted to predict probable further developments. In order to get an exact analysis of how much silt has been deposited in different places, a map of the thickness of the mud layer has been made. From May to August 1988 the flood-produced changes in the flora were registered.

Result: In comparison with the previous year the population of *Phragmites communis*, *Equisetum palustre*, *Juncus articulatus*, *Juncus subnodulosus* and *Agrostis gigantea* had increased, whereas sedges, plants with rosettes and orchids, among others, had decreased. Where there was a layer of more than 10 cm of silt, the vegetation had changed very much. But different flora associations showed a different sensitivity in their reaction. The *Schoenetum* was more sensitive, whereas the *Phragmitetum* and the *Filipenduletum* were more resistent. In those fens, where the silt was thin, no major changes in vegetation are to be expected. Where there is a silt layer of between 5 and 10 cm, it can be assumed that the area concerned will have returned to its original vegetation within a few years. Areas covered with a silt layer of more than 10 cm will probably develop into more arid reeds within the next five to ten years.