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Chances and Risks for the Development of the Danube with Regards to the Hydropower Plant of Gabcikovo

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Zusammenfassung

Umweltgruppen haben schon 1990 aufgrund der günstigen Bedingungen eine ökologisch orientierte, nachhaltige Wirtschaftsentwicklung der Grenzregion an der Mittleren Donau gefordert. Zentrum wäre ein effektiv geschütztes Auengebiet und die Einbeziehung der lokalen Bevölkerung. Konträr dazu stehen neu angekündigte, intensive Nutzungsvorhaben sowie das Gabcikovo-Projekt, welches europaweiten Modellcharakter für veraltete Großvorhaben besitzt, welche wertvolle Natur- und Kulturräume nachhaltig zerstören. Gabcikovo verursacht zunächst einen schweren Eingriff in den regionalen Wasserhaushalt, durch den nicht nur essentielle Umweltfaktoren für die Aulandschaft, sondern auch für den umliegenden Wirtschaftsraum verändert werden. Obwohl frühere, großteils hausgemachte Flußprobleme existieren, wird Gabcikovo diese nicht nur nicht lösen, sondern vielmehr eine Reihe neuer, meist schwerwiegenderer Umweltprobleme auslösen. Diese werden am Beispiel der Erfahrungen ähnlicher Ingenieur-Projekte an Oberrhein und österreichischer Donau skizziert. Die ersten hydrologischen und Wasserqualitäts-Beobachtungen vom Herbst 1992 und die Begrenzheit der Ausgleichsmaßnahmen legen den Schluß nahe, daß entgegen offiziellen Äußerungen sehr wohl größere negative Prozesse - wenn auch häufig erst mit jahrelanger Verzögerung - nicht zu verhindern sein werden. Nach der Frage, wer die Gesamtverantwortung auch für zukünftige Auswirkungen von Gabcikovo tragen wird, wird angeregt, daß die Slowakei bis zur Lösung wichtiger politischer und wissenschaftlicher Fragen auf den EG-Kompromißvorschlag eingehen sollte.

Slovak summary

(will be sent separately!)

WWF and the Gabcikovo project

WWF is a private, international and non-profit NGO working on a scientic and professional base. It is the world's largest conservation organisation with over 4 mio. supporters and 28 national organisations.

The floodplain ecosystem between Bratislava and Györ as well as the drinking water reservoir in the underground rank among the most valuable natural resources all over Europe (u.a. WENGER, ZINKE & GUTZWEILER 1990). Its longterm preservation is important

for its possible economic use by future generations (especially for drinking water), its genetic and ecological diversity, its nature-historical and cultural importance and its balancing values for the landscape, the climate and the people living there and near-by.
International engineers consider Gabcikovo as an oldfashioned, technocrat river project whose large-scale impacts on economy, hydrology/ecology and personal security of local people far outweigh its small benefits in electricity, navigation and river-bed stabilisation (including flood protection).
WWF considers Gabcikovo as a model project for the international discrepancy between the political goal of a sustainable use of natural resources and today's reality where man still acts to tame and exploit nature. WWF is involved in the Gabcikovo debate since 1986 and has published several studies (WWF 1987, WWF 1989, WWF 1992a, WWF 1992b).

Chances of the Central Danube border region

The Citny Ostrov and Szigetköz region have a big potential for an environmentally sound economic development which can be a perspective both for the local people and their respective state. This was recognised and demanded by NGOs from Austria, CSFR and Hungary when formulating the "Danube Charter" on 8 April 1990 declared for the Central Danube border regions along Dyje, Morava and Danube rivers (the so-called "Trilateral park area") as well as along the rivers Raab, Vah, Hron, Mosonduna, Maly Dunaj and Ipoly. The whole Central Danube region is described as one of the most interesting European border zones which can serve the idea of a reconciliation of Europeans along the former Iron Curtain. However, such an "Ecological Brick" in the "Common House of Europe" must be developed on a sustainable base and should not follow onesided, exploiting and destructive user concepts (LANGER, ZINKE, Golub & HAHN 1990).
Such a sustainable development should be based on an effective protection of the valuable floodplain ecosystem and a stabilisation of the river bed by alternative, small-scale engineering measures (e.g. river bed fortification by large gravel). It should include sound economic activities like biological agriculture, moderate forestry, traditional handcraft together with sound recreation and ecotourism in the surroundings of the transboundary protected floodplain park. The concept of this protected zone (e.g. in form of a biosphere reserve) could include various zones with different goals (core zones for intensive protection of endangered species/biotopes, sectors for wetland rehabilitation, nature education and information as well as for tourism/recreation). It is designed at long-term perspective maintaining the balance of natural resources with man's use.

A major factor of this concept is the permanent involvement of local people both in the preparation, planning and implementation stages allowing them to co-decide on the forming and creation of their working and living environment.

Recently announced economic developments aiming at industrialising and further exploiting this region, at building big tourist and recreation facilities, at intensifiying the use and "deve-

lopment" of the wetland and at enhancing the number of daily visitors both in- and outside the protected area will at long run inevitably lead to overuse, degradation and destruction of the natural and cultural resources. It must be questioned by what experiences can it be promised that "millions of people will visit and bring long-term profit to this region"? Beside the Gabcikovo scheme the already started building of weekend houses in- and outside the wetland, the upcoming construction of recreation ports and lakes and of an industry park will have the well-known detrimental impacts on the wetland ecology and stability as much as on the social and cultural climate.

On the other hand it should be compared with similar Slovak border regions now facing international investments in form of "biodiversity protection projects" which will soon be started in three other Slovakian regions (High Tatra, East Carpathians and Morava floodplains), financed by GEF funds through the World Bank. It is mainly due to the Gabcikovo project and entailed economic politics that such a project could yet not (and most likely will never) be initiated in the Slovakian Danube zone.

Risks and Problems

The present and future development of the Danube region, as it can be overseen at present under the impact of the Gabcikovo project, bears many risks and problems. This is mainly due to the fact that crucially needed studies, calculations and analyses were either not finished or ignored or even not started before the Gabcikovo operation. Even when looking at the many ongoing efforts of scientists and the investor company to "optimize" and reshape the present technical system it must be expected that a number of negative effects on the environment cannot be prevented or fully controlled. It also can be guessed that one day the investor will stop his investments to correct, mitigate or recompensate such damages. However, it must be reiterated that such longterm costs are in fact part of the cost-benefit analysis and cannot be left over as a endless burden to the state budget.
This paper will concentrate on wetland ecology, surface and groundwater effects:

a) The continuous destruction of the floodplain ecosystem

A floodplain ecosystem is characterised by its multiple dynamics and the following crucial factors:

* periodic fluctuations of the river and groundwater bodies (in horizontal and vertical directions)
* permanent erosion and sedimentation processes
* inflow of nutrients
* migration of organisms between river and side-arm system.

These environment conditions allow only especially adapted, today in Europe mostly extinct or endangered organisms to find long-term favourable conditions while other large-spread "ordinary" organisms can only realise non-permanent existence. On a European scale such large and dynamic floodplain zones with limited or no human interference do exist only in a very few

locations; the only major European river with such ecocenters is the Danube with its floodplains between Vienna and Györ, in the Kopacki Rit (mouth of river Drava) and in the Danube delta.

However, it is a concerning fact that over the last decades, a significant erosion of the river bed was observed which also led to a floodplain deterioration downstream of Bratislava. The causes are threefold:

- river development activities starting in the 1960s cutting off many side-arms especially at low-water periods from the Danube and inducing a bed erosion which then was further aggravated by
- large-scale gravel exploitations downstream of Devin and especially of Bratislava and
- upstream river sediment retentions by the Austrian Danube dams.

This shows that the main causes are actually "home-made". Their progress and intensity did certainly promote the need for a major engineering activity to stop this process.

Even though the creation of a storage lake, the controlling of local erosion and flood forces or the lifting of the groundwater table will have locally beneficial effects, it must be said that the Gabcikovo system will not really cure all problems or even "save the ecosystem", as stated by Slovak politicians, but will partly shift them downstream and partly provoque other problems and damages both on Slovak and Hungarian side which yet are only partially detected or even quantified. This is what is concluded by experts when looking, discussing or checking various problems of Gabcikovo (e.g. WWF 1989).

When looking at the floodplain it can be stated that suggested recompensation measures such as underwater weirs aiming to lift the Danube water table, or artificial water inflow trying to imitate floodplain inundations have limited ecological but more optical effects for uninformed visitors. Alone the comparison of the 0-50 m^3/sec inflow into the wetland with the natural 700-11.000 m^3/sec fluctuations (equals 6-9 m difference between lowest and highest water marks) makes it evident that the existing ecosystem will face big changes over the years. Except for a short time and limited space, these measures will bring little ecological or hydrological benefits and will not stop the further ecosystem's deterioration. Even MUCHA (1993) considers this artificial inflow only as a "complement measure" and pleads for an opening of the side-arm system towards the Danube. This, however, only makes sense if there is enough water which can flow between river bed and side-arm system.
The large-scale water fluctuations are the driving engine for the entire hydrological, geomorphological, physico-chemical and biological processes (HÜGIN 1981, DISTER 1985). This machine cannot be replaced by weirs, canals and small-scale input of water. Based on the experience gained with other side-canal and hydro-dam systems e.g. on the Rhine and the Upper Danube it can be predicted that these technical measures near Gabcikovo will not prevent large-scale and probable irreversible alterations of

the huge surface and groundwater system and, by consequence, of the rare plant and animal communities as well as of the water-dependant economic activities like especially agriculture and forestry. However, it is a another well-known scientific fact that these changes will come only months and years after the damming and river diversion.
HÜGIN (1981) has investigated the inter-relation of floodplain phytocenoses with surface and groundwater fluctuations on the Upper Rhine before and after the river development in the 1960s and 1970s. There, the disconnection of the side-arms from the multiple, surface and underground in- and outflow of Rhine water into the forests, bringing suspended nutrients in form of natural fertilizer, resulted in a loss of decisive physical conditions, damages in all biocenoses and a reduction of wood and agricultural production (figure 1).
Consequent efforts to artificially fill in water into forest sectors and to create cross dikes did not lead to the needed large-scale inundation flow but only to limited inundation and ground-water fluctuation effects. Figure 2 shows that such artificial inundations cannot reach large parts of the phytocenoses and lead to a change of species composition. By consequence, the overall groundwater fluctuations become levelled (figure 3). Underwater weirs were found to have bifold effects: upstream they increased the sedimentation of suspended matter which led to colmation; downstream the increased off-flow had draining effect. After the river engineering measures on the Upper Rhine, the hydrological and ecological system was completely altered (see also DISTER 1985, ZINKE & GUTZWEILER 1990 etc.). It therefore can be guessed that the technical measures intended and realised to replace the Danube system along the Gabcikovo scheme will barely prevent the replacement of the unique plant, animal and water system.

The ÖKO-SYSTEMSTUDIE DONAUSTAU ALTENWÖRTH (1989) similar activities were investigated at the Altenwörth dam on the Austrian Danube which came to similar conclusions. Over there, even longer and more frequent artifical input of water into the arm system did not improve the ecology but led to a levelling of biotopes and groundwater profiles: both the soil water and the vegetation changed, the drainage developed into a single direction and the nutrient input ceased. The reduced oxygen level and soil ventilation also changed the biology.

Expected effects like eutrophication, colmation and unfavourable chemical processes in the storage lake, contamination of near-by drinking water wells, water-logged zones along the storage lake, dried out areas along the emptied Danube bed, losses in timber and farmland productivity, losses in self-purification processes, (indirect) destruction of floodplain biotopes etc. will be part of the Gabcikovo consequences and illustrate after several years how these human impacts slowly destroy the ecological and hydrological system.

Also, it can be expected that the Gabcikovo project for a long time will not be "completed". Beside further investments e.g. for the planned power plant and lock system in the Cunvo weir, it is most likely the Slovak national budget which will have to cover all "needed" activities to prevent the worst effects,

which includes permanent monitoring, "optimising" of technical installations, mitigating and repairing works as the other daily business beside power production, navigation and sightseeing. The series of technical problems in fall and winter 1992 and the poor condition of some parts (e.g. rost and cracks at Gabcikovo station) support such pessimistic view. We also learned that preparations to purify drinking water and to optimise the water flow and sedimentation in the storage lake are important tasks. Is there already a designated location for the disposal site to which daily hundreds of trucks will have to bring the masses of lake mud which independant experts have calculated to sediment in the lake? In the summer, it is expected that the lack of groundwater fluctuations will lead to degradation of soil productivity while in the winter the stronger formation of ice and winds on the lake and canal will affect navigation.

b) The threats to the groundwater system

Most, including Slovak, scientists, stress that the maintenance of the groundwater fluctuations in the riparian zone is one of the crucial demands regarding the groundwater quality. However at present, both the horizontal and the vertical groundwater movements are changed and very much reduced: former disconnections between river and side-arms were recently even fortified on Slovak side, while the infiltration of Danube water into the groundwater body will remain very small because the river is to receive only max. 600 m^3/sec (at present only ca. 400 m^3/sec). After the river diversion in October 1992, the groundwater levels fell by 0,5 to 2 m (especially along the canal and wetland) below the already reduced level. However, in the summer the impact of the very low water level poses much severe stresses for wetland organisms. As both floodplain forests and the farmland (especially maize, sugarbeet) depend on high and fluctuating groundwater levels, large detrimental effects must be expected in the next months and years.
One example for the major hydrological changes is the expected observation that the present general groundwater flow is now rerouted towards to Danube which acts as a drainage while before the Gabcikovo operation the flow was running parallel to or even away from the river: this excludes the crucial horizontal infiltration of oxygen-rich river water into the adjacent underground.

Beside this, the groundwater quality is perhaps the most important task because this region is to serve several million people with drinking water. Many of them rely on bank-filtered drinking water (WWF 1987). It is known that numerous point and non-point contamination sources (industrial waste deposits, oil leakages of Slovnaft, non- or insufficiently treated sewage, agricultural products etc.) contribute to a permanently high pollution risk of the hydrological system. With the operation of Gabcikovo, important self-purification processes in the side-arm system were significantly reduced, while the filling of the storage lake is expected to result in unfavourable physico-chemical processes (quick consumption of oxygen) (e.g. WWF 1989).
The first groundwater monitoring data collected by SHMU (Slovak Hydrometeorological Institute Bratislava) between 26 October and 31 December 1992 show first negative trends and confirm previous prognoses even though it then was premature to speak already of

an upcoming drinking water pollution. However, the fact and range of the contamination is very concerning:
Similarly to measurements near the Austrian dam at Altenwörth (ÖKO-SYSTEMSTUDIE DONAUSTAU ALTENWÖRTH 1989), oxygen contents in observation wells along the Gabcikovo scheme went down to 0-0,5 mg/l while NH4, NO2 and H2S exceeded the standards CSN 757111 in observation wells near Gabcikovo, Kalinkovo and mainly near Rusovce-Ostrovne lucky. The non-polar extractable substances (oil products) exceeded in 14 % (113 of 809 measurements) the drinking water standards. Even worse, the few measurements of cancerogenic organic pollutants were too high in most samples: in 3 out of 3 samples for 1,1-Dichloroethen, 7 out of 7 for 1,2-Dichlorobenzene, 2 out of 2 for Pentachlorophenol, 2 out of 5 for Benz(a)pyrene, 2 out of 2 for Hexachlorobenzene and 1 out of 13 for Lindan). It is very important to closely observe the quantity and behaviour of these substances in the next years.

These facts are also contradicting to the official Slovak statements in spring 1993 concluding that there would be "no" or "no more" pollution and that the groundwater quality would generally have "improved". Negative suspicion is further emphasized by the fact that these data are not accessible to the public and by the public announcement that the new data from the sampling period January to March 1993 will be ready and commented only in August 1993.

Question of future responsibility
Different to the engineering works of the 50ies and 60ies, the Gabcikovo project was built and finished in a period where the knowledge and experience on the impacts of such large-scale river works existed already. It is known today that many scientists already in the 70ies and 80ies described problems and warned of the consequences of this project. However, this was obviously not included into the project. Until today experts and even state officials which are critical to Gabcikovo and its connected activities are publicly attacked by polemic statements and learn that they risk their job and existence if they continue their critique. This also applies to foreign critique which is rejected as being an undesired interference in Slovak matters.
Beside the fact that this reflects anything but sovereign, democratic and fair proceeding, a sometimes even "dictatorial behaviour" (a term used in Slovak media) of the Gabcikovo investor company emphasizes public doubts, mistrust and even the suspicion that sometimes the unfavourable truth is hidden.
In case that the prognosed negative effects will come true only to a limited extend it today must also be asked who will pay recompensation for all detrimental effects e.g. in agriculture, forestry, private house construction? Is there an insurance which covers e.g. income losses in case of technical problems at the Cunovo weir, the power plant or the locks system? Is there a warning and evacuation plan for local villages in case of a major accident?

There is a democratic right of every Slovak and even European citizen to get comprehensive information on the state of Gabcikovo, of their environment and of possible economic risks. And

a compromise for a interim period, at least 66% of the Danube water should be left in the river bed in order to maintain to some extend the previous balance of the ecosystem and of the groundwater reservoir. Also the European Parliament asked the Slovak delegation to be more open for a respective agreement. Possible Slovak losses in power production must and can be recompensated, e.g. by Hungary or EC Commission.

It seems that this is the last chance for the Danube system before irreversible facts become reality. And this is economically and ecologically cheaper than running an 1:1-experiment in a situation when competent experts are still trying to understand the environment situation prior to the technical experiment which they actually need to design their prognoses on the impacts of the experiment. The risk of major damages is too high for such a fragile system.

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Appendix:
The Danube Charter (from LANGER, ZINKE, GOLUB and HAHN 1990)

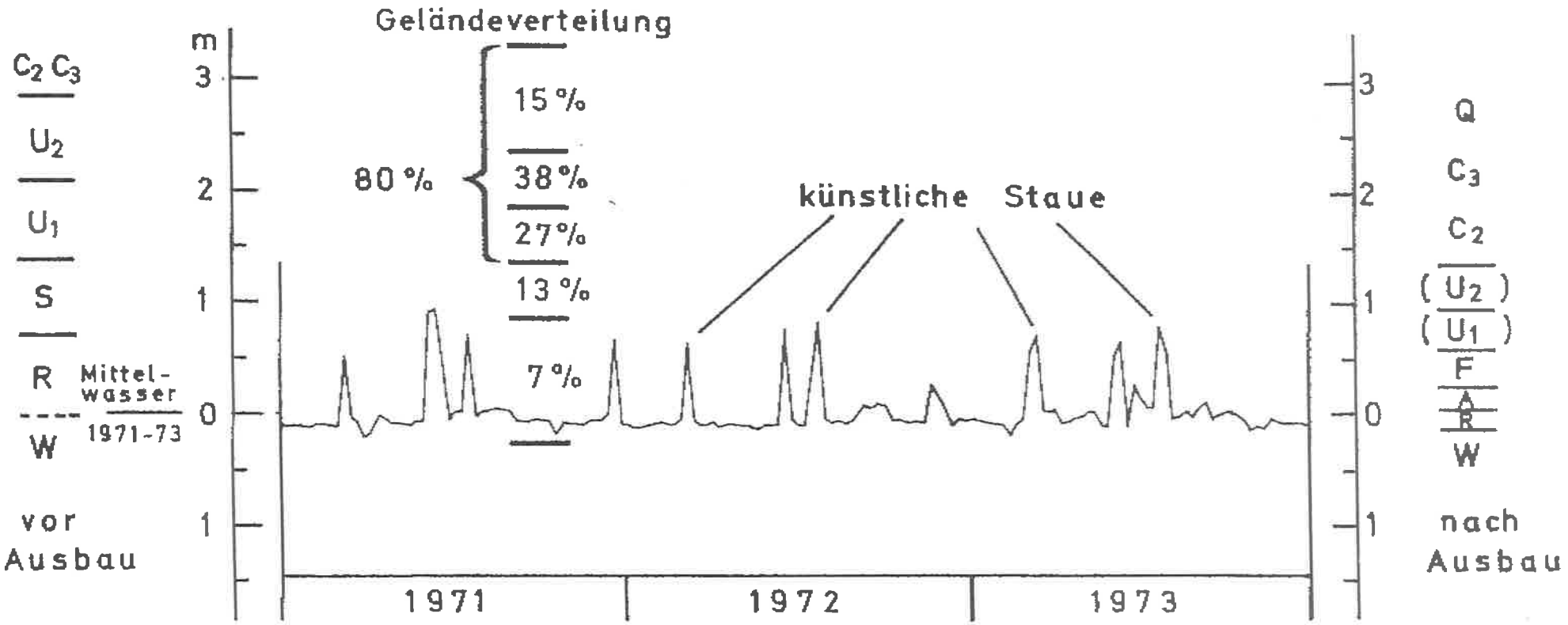

Abb. 2 - Die Wirkung von Wässerungen im nicht mehr überschwemmten Altrheingebiet bei Weisweil (Stauhaltung Rheinau).

Figure 2: The effect of artificial water input systems in the Old rhine area no longer inundated by the river floods (dam at Rheinau) before (left) and after river development. Abbreviations: W = areas permanently under water, R = reed belts; all other vegetation types see fig. 1

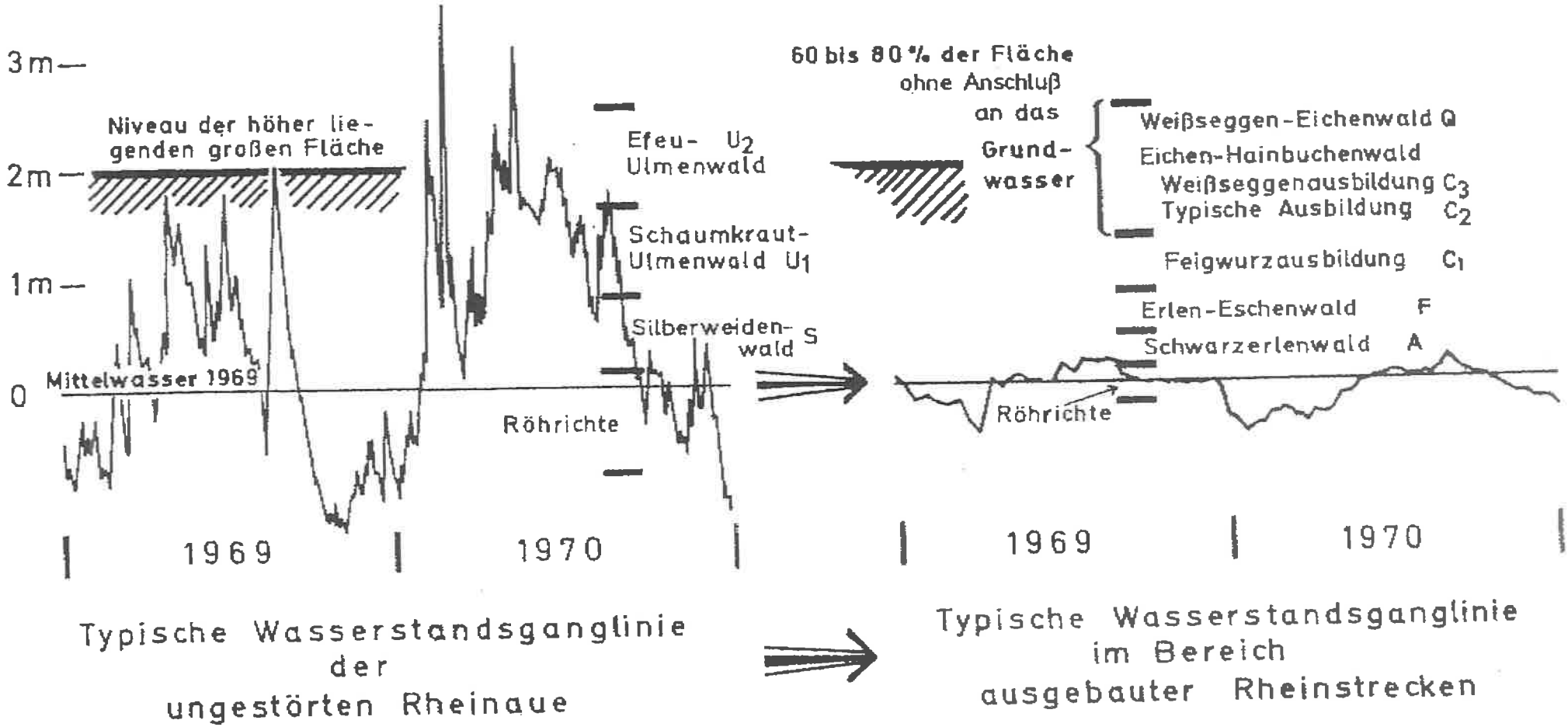

Abb. 4 - Veränderung der Auenvegetation durch Änderung der Wasserstände. Die Folgevegetation ist dargestellt als potentielle natürliche Vegetation.

Figure 1: Change of floodplain vegetation by modification of water levels. The subsequent vegetation is shown as potential natural vegetation (example: Southern Upper Rhine).

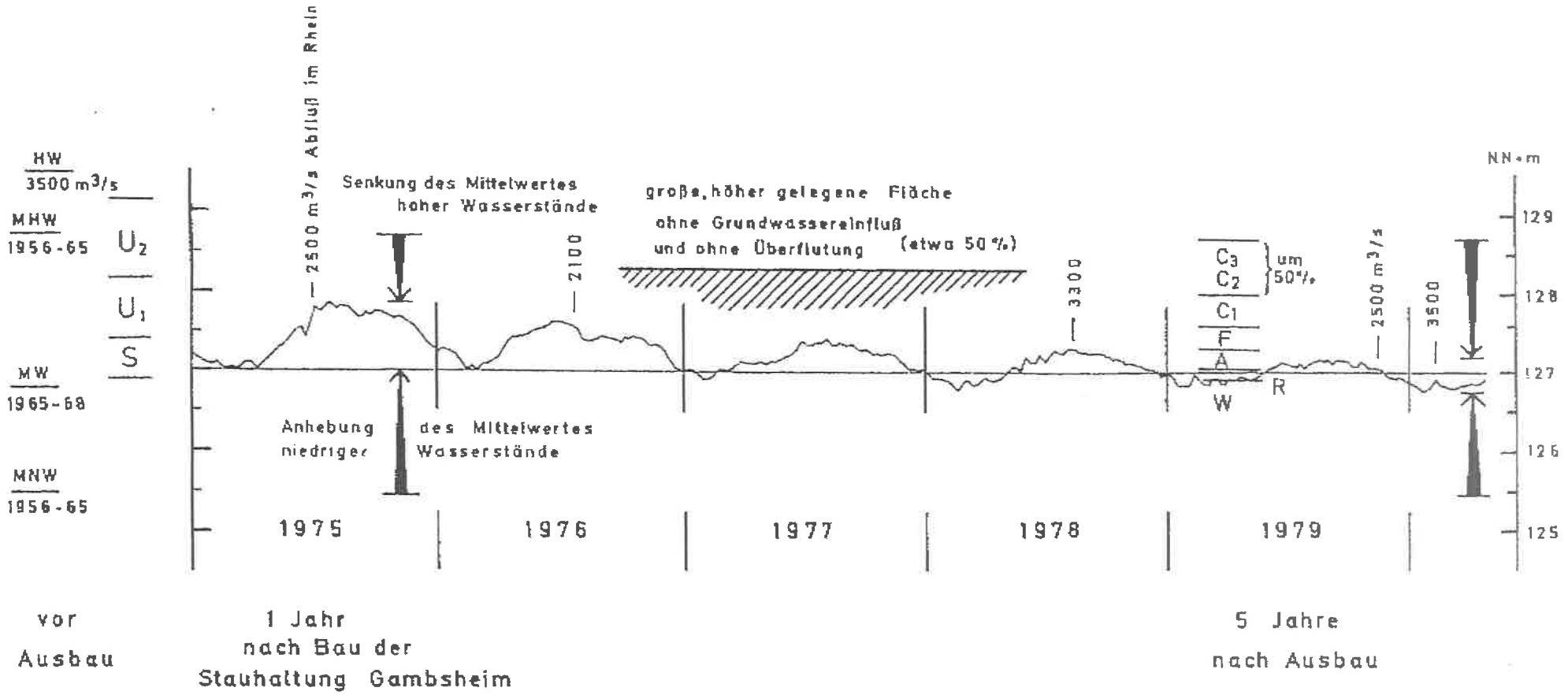

Abb. 3 - Veränderung der Grundwasserstände im Altrheingebiet westlich von Freistett seit dem Ausbau (Meßstelle 139 a).

Figure 3: Changes of groundwater levels in the Old Rhine area west of Freistett 1 to 5 years after the river development.
Abbreviations: see figure 1 and 2.