Projected and chaotic changes in forest and grassland plant communities. Preliminary notes and theses (*)

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A. INTRODUCTION

It is quite compulsory to install permanent plots to get the necessary information on stability and/or successional trends on any given site of plant community. But only very long time scales, 20 years or more, can give an idea which species are actually showing successional trends and which species are appearing constantly, may be with varying abundancy, any time we control a given plot, or then, in the case of stable sites, which species are behaving like in a succession and which species are belonging to a basic, more or less unchanging stock of species in a given plant community (valid for forest and grassland sites; compare e.g. Dierschke, 1993, 1994).

B.1. Examples for more or less undirected successions

The following examples on table 1 were evaluated in 1994, one in 1990 (references on table 1). Each example has a number of permanent plots, and each permanent plot has a distinct tendency, but also the whole set of data given by these permant plots shows certain distinct tendencies. Erratic or rarely appearing species have been obliterated (relevés were never done by a single person except by some of the older authors).

B.2. Example 1: Lüneburger Heide

The first example, incorporating a set of different wetland communities depicts the fact that such data not only need a considerable laps of time (as mentioned above) but also a whole set of permanent plots in a given area. Only the evaluation of whole sets with common successional trends on all plots give relevant results, and species with a normal or high persistance are more easily detectable.

(*) More details to appear in: Verh. Ges. Ökol., **25**, Dresden 1995.

TABLE 1

EXAMPLE

locality	investigation years	veget. mapping and perm. plots	examples	reference
Lüneburger Heide special view on wetlands	(1975-) 1983-94	30 □ + vm	3 ex. & generalisations	KLÖTZLI 1993
Reussebene, w Zürich old river system	1973 & 1978-94	vm period each year	5 ex. dep. on precip. & nutrient flux	KLÖTZLI 1995
Mkwaja Ranch/Tanzania savanna system	1975-80 1992 + 94	vm ca. 100 □	1 ex. & generalisations	KLÖTZLI 1995
Transect through Swiss forests (Schaffhausen - Chiasso) lowland and montane deciduous forest	1940-70 vs 1994	vm & ca. 300 □	4 ex. from North & South Switzerland	preliminary statements & KLÖTLZI et al. in print

TABLE 2

AVERAGE VALUES FOR ("CONSTANT") PERSISTENT SPECIES AND FLUCTUATING SPECIES IN THE "LÜNEBURGER HEIDE"

	persistent species	fluctuating species 75-94	fluctuating species 93/94
B			
Carr	~20	4	6
for compa. 1001*:	20	13	14
Q	13	8	4
Source			
M	6	5	3
Mire			
WW			
Pastures & Meadows	13	8	5
For comparison			
1017	12	14	7
1018	23	8	3
1019	10	12	8

* 1001: change in damming (?)
1017: change in management
1018: dammed
1019: partly drained

Thus, for different wetlands there is a variable amount of "persistent" species, further, there is a variable amount of species appearing or disappearing in a given period.

Each type of wetland has a typical ratio between persistent and non-persistent species. The successions (e.g. hydrarch succession, drainage, inundation etc.) are coupled with more newly appearing and disappearing species. However, in no case, it is predictable, which species is truly persistent and which one is for certain not persistent. But for some species there is a higher probability than for others: the namegiving species of the plant communities are mostly highly persistent (preliminary statement).

There is no correlation between highly constant and abundant species and their persistence.

B.3. Example 2: "Stilli Rüss"

For about 30 years and since 1973 in a regular way a wetland complex has been mapped phytosociologically on the basis of relevés of the same area (references in Klötzli, 1995). Although controlled each year by the same persons the picture of the map is never constant.

By assessing the surface of each plant community and by discriminating into wet(ter) and dry(er) or nutrient rich(er) and poor(er) communities a clear correlation with the fore-going year incl. the first five months of the mapping year (mapping time between mid May and beginning of June) was calculated. The following findings may be cited:

— The wetter the years the more plant communities of wetter sites

— The wetter the years the more plant communities of poorer sites are formed (farmers extensifying the wettest meadows in wet years; however, during the wettest years more nutrients are washed out into the wetland complex)

— The limits between plant communities vary considerably from year to year, i.e. reactions of "cryptically" occurring plants are quick, probably partly deriving from seedbanks, partly from rhizomes and the like (compare e.g. Van der Valk, 1981)

— Changes occurring from year to year are not predictable

— The map of a given date may not be representative for the following years

— Fixed surfaces are only in true depressions and on flat hills. All limits between communities in a given year are freely fluctuating (details in Klötzli, 1995).

B.4. Example 3: Shifts in forest communities

To evaluate vegetation shifts which might be due to global change (climate shifts) old relevé plots, mainly undisturbed by man, have been revisited from Northern and Southern Switzerland in a 30 km wide corridor

from Schaffhausen via Zürich and the Reuss and Ticino valleys to Locarno, using mostly plots with examples of climax (near) vegetation and resting below about 800 m in the north and 1000 m a.s.l. in the south (insubrian climate, summer warm and moist, winter cool and moist, little temperature extremes, but often high precipitations and longer sunny periods).
Preliminary results may be stated as follows:

— There is not much floristic similarity between "plot-couples" of the forties to the seventies and 1994

— On an average around 25-50% (N) resp. 50-75% (S) of the former species are missing and around 30-80% (N) resp. 0-30% (S) are replaced by "new" species, often species of the immediate surroundings (partly noted in brackets in the old relevés). If site conditions have slightly changed, due to silvicultural activities, floristic changes may depass 100%.

— Changes are in no way predictable

— Due to the combination of "persistent" species a given plant community can be redetermined, or then a replacing community assessed. But, normally, a given plant community is not converted

— Giving a picture of the events on such plots, we may say that populations of all these different species are moving across a given plot like clouds driving with varying winds. Again, it is not predictable which "population cloud" will touch the surface of the plot and which one will be driving past and away

— Some thermophilous species are more frequent than before. In the south some exotic (mostly Eastern Asian) species have been propagating and thus marking the arrival of a new biome: the shifts showing a clear change of purely summergreen to partly evergreen broadleaved forest (on northern slopes up to 400 m, on southern slopes up to about 1000 m a.s.l.).

A full evaluation of all the data will be published separately.

B.5. Example 4: Coastal Savannas on Mkwaja Ranch

Since 1955 coastal savanna grasslands in NE Tanzania are managed by the same firm in the way of a cattle ranch, partly as a wildlife sanctuary. 10 years later a thorough survey has been done on 500 km^2 incl. 10 km^2 of an intensively inventarised special investigation area.

Changes have been observed due to prolonged drought (74-76) and due to more rainy conditions (77-80). A new inventory incl. relevés on old plots (marked by pieces of railway iron) and remapping the special investigation areas has been elaborated in 92 and parts of it in 94 again (full description in Klötzli, in print).

The findings are similar to those sub cipher 3, 4 and 5 and may be summarized as follows:

— While the mapping keys (based on about 300 relevés) of the first investigation period (74-80) have shown no definite changes, the changes in 92 are considerable and non-predictable:

- 13 species (of a total of about 60) of the old mapping key are no longer valid as differentiating species
- 14 species (of a total of 55) of the new mapping key are "new" species compared with the old key
- 18 species only are persistent, 3 species are completely new
- some species (7) occurring generally have become differential species
- some differential species have turned to species occurring generally (> 10 species, and generally spoken)
- some rare species have been spreading
- some common species have become rare
- some new (for the area) species have shown up
- some species have more or less disappeared, all facts valid for the more and the less pastured areas
- finally: persistent species enable us to evaluate the plant communities now showing a new characteristic species combination

Again, the vegetation maps are comparable but the limits between plant communities are not fixed and have changed in an impredictable way. Nowadays, the trend is clearly pointed to moister conditions: the ratio between drier and moister grasslands having changed from 42: 36% (75) to 45: 20% (92), i.e. from 1.2 to 2.3.

C. Conclusions

1. Summing up all findings from the four areas we may conclude that:

— plant communities are floristically stable regarding persistent species but not in taking the other species into account

— changes are unforeseeable and (so far known) chaotic, i.e. in no way directed

— limits between plant communities are flexible in all situations, seed banks and subterranean parts being responsible for minor fluctuations

— dynamics of species may be truly "persistent", fluctuating, rising from and dipping to an unknown cryptic state (see above) or then fluctuating, rising or dipping occasionally

2. Species may change their function, i.e. generalists becoming specialists (= differential species) and vice-versa. Rare species may turn into common ones and vice-versa.

3. There are a couple of open questions, viz.:

— are there really totally persistent species in a given system?

— are there fluctuations in a population due to undeterminate fluctuations in site conditions incl. parasites (e.g. viral effects) or then due to changes in environmental conditions?

Populations of many species behave like clouds moving deliberately and in many ways over a given surface. In true successions a "species rain" is pouring over a given site changing in a directed way.

4. Final questions touch the importance of a given relevé, the picture of a plant community and the stability of an ecosystem:

— a relevé, is it just a "sheet of a calender" of events, species composition changing from year to year?

— a plant community and its characteristic species combination is it just a flash in the existence of a fluctuating ecosystem?

— an ecosystem and its fluctuations are they normally "chaotic" or is it an entity under stochastic laws (e.g. as the chaotic movement anywhere in nature, in micro- and in macrocosm sensu Prigogine)?

Further investigations and succession research will put more light on a given, so far undetectable, order or a chaos.

D. Summary

The evaluation of data sets of 4 longterm (25 up to 50 years) permanent plots in more or less stable plant communities of

— different wetlands (North Germany, Lüneburger Heide)
— a wetland complex (North Switzerland, Stilli Rüss)
— different forests through North to South Switzerland
— different savanna grasslands (Tanzania, South Pangani, Mkwaja Ranch)

showed no predictability regarding

— development and fluctuations of species
— rapidity of change
— limits between plant communities
— function of species (e.g. generalists vs specialists, common vs rare species)
— the way species behave:
- persistent
- highly or irregularly fluctuating
- disappearing (dipping) or appearing

depending on water and nutrient regime, weather conditions, but also as far as is known of unknown (intrinsic) factors touching the ecosystem. Dry and moister periods were not that much decisive in species composition.

"Persistent" species enable us to determine a given plant community, be it on a wetland, forest or savanna site. However, there is not much floristic similarity between relevés of different years. From year to year species move over a given plot like clouds over the earth.

State and role of a relevé, a plant community and an ecosystem is questioned under the heading of these findings.

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