# Pastures in South and Central Tibet (China)
## I. Methods for a rapid assessment of pasture conditions

W. Holzner and M. Kriechbaum

# Der Zustand des Weidelandes in Süd- und Zentral-Tibet (China)
## I. Methodik für eine rasche Einschätzung des Weidezustandes

## 1. Introduction

This paper presents the ecological parts of the results of a pilot project that has been carried out to survey the situation and conditions of the Tibetan pastures, to determine the methodology and feasibility of future, more detailed research, as well as to develop initial recommendations for possible countermeasures for the preservation or improvement of pasture ecosystems and nomadic communities. As we were already engaged in studying problems of human impact on vegetation and landscape in adjacent areas in India (Ladakh, Zanksar, Lahul, Spiti), Nepal and Qinghai, we were invited to carry out this survey in the Tibet Autonomous Region (TAR) together with TARA (Tibetan Assistance to the Remote Areas), an organisation affiliated with the Department of the Industry and Commerce Federation of the Tibet Autonomous Region, Lhasa.

Within the scope of this project an expedition through a vast range of nomadic areas in southern and central Xizang was carried out in summer 1998. The first part of the expedition took us through the pasture areas of Sangsang and Tsome (Xigaze Prefecture) and from there to the pastures around Tangra Yum Tso (Nacqu Prefecture) and finally across the Changtang to Nacqu. Finally, we investigated in the surroundings of Porong (Xigaze Prefecture), directly to the north of Mt. Xixapangma. The other participants in the expedition were Hilde Diemberger, Charles Ramble, two anthropologists and experts in Tibetan language and affairs and Trinley Namgyal, the representative of TARA. For parts of our trips we were accompanied and advised by native pasture experts. Without their assistance and the information we obtained from them directly or through their interpretation, our efforts would not have been nearly as successful.

## 2. HAPIE – Integrative Ecology of High Altitude Pastures

For projects in "applied ecology" science is not an end in itself but has to subordinate itself to the practical aspect and

**Zusammenfassung**

Katastrophale Winterverluste an Weidetieren und Berichte über großflächige Degradation des Weidelandes in Tibet waren Anlass zu einem Pilotprojekt mit dem Ziel, einen Überblick über den Zustand der Weiden und Vorstellungen über die Ursachen der Probleme zu erhalten, um Möglichkeiten für weitere Maßnahmen entwickeln zu können. Wegen der rein praktischen Zielsetzung wurde ein Ansatz entworfen, der rasch brauchbare Resultate versprach. Für diesen Zweck erschien es zunächst notwendig, viel gebrauchte aber unscharfe Begriffe, wie „Nachhaltigkeit", „Überweidung", „Desertifikation" oder „irreversibel", gleichsam aus der Sichtweise der Hirtennomaden zu definieren. Mittels eines Systems einfacher Indikatoren war eine rasche Beurteilung des Zustandes und der Entwicklungstendenz von Weideland möglich. Etwa ein Drittel des Weidelandes der bereisten Gebiete ist in gutem Zustand, zwei Drittel tragen Zeichen von Überweidung und Degradation, die sowohl uralt als auch rezenten Ursprungs sein kann. Die möglichen Ursachen rezenter Übernutzung, die auf etwa einem Fünftel der Weideflächen festgestellt wurde, sowie einige Aspekte des Komplexes von Problemen der Weidewirtschaft in Tibet werden in Teil II dieser Arbeit diskutiert.

**Schlagworte:** Weidewirtschaft, Weideökologie, Degradation, Weideindikatoren, Tibet.

## Summary

The preliminary results of a pilot project on the conditions of pastureland in Tibet are presented. Part I of this paper deals with the particular approach, integrative ecology, and methodology which was developed for this task which demanded relatively rough but fast and reliable results and suggestions for solutions. For that purpose, frequently but imprecisely used terms, such as sustainability, overgrazing, desertification and irreversible, have been defined from the viewpoint of the pastoralists. The evaluation of the pastures was based on a system of simple indicators. The results were:

1. With this "instant evaluation" it was possible to assess the conditions of pastures and the trend of pasture development.
2. About one third of the vast pastureland investigated proofed to be in an optimal state, while 50 % show signs of overgrazing and even degradation of ancient origin. 20 % of overgrazing seemed to be of recent origin. The possible causes of this recent pasture destruction, but also some aspects of the whole complex of "pasture problems" and animal losses will be discussed in part II.


**Key words:** Pastoralism, Rangeland Ecology, Degradation, Pasture Indicators, Tibetan Plateau.

the methods have to be chosen from a pragmatic point of view. If the main concern is the well-being of human societies, the laws of human economy, psychology and sociology, as well as human traditions and culture have to be regarded as well. This approach is called "integrative ecology" (HOLLING, 1998) a very wide-ranging and complex field. The difference to mere sociology or economics is that humans are treated as part of ecosystems.

For the purpose of this report and the project that will follow it we have designed an approach that we call "high altitude pasture integrative ecology" (HAPIE) as a special aspect of "integrative ecology" combining traditional pastoral know-how with modern ecological, economic and social considerations, the goal being to achieve an optimal (= sustainable) utilisation of high-altitude pastureland and the welfare of nomadic society.

For this purpose it seemed to be necessary to specify the semantic content of the most important terms used, because it will often be narrower than in general use. We tried to see the pastures and the problems around them from the point of view of nomads or yaks and to define the terms according to that.

An ecologist calls a pasture a "biocoenosis" of plants and animals and treats the whole as an "ecosystem". The livestock breeders are an integrated and essential part of the pasture ecosystem. The crucial point is whether or not they are aware of this inevitable law. If understanding the interdependence of man and nature has led to the development of cultural or religious systems, which helped the people to control and protect their natural resources, i.e. the pastures, we call this *"pastoral tradition"*.

*"Sustainable pasture utilisation"* means utilisation of a pasture in a way that preserves the quality and yield of a pasture over a long span of time. If this is not the case, we speak of *"exploitation"*. The results are degradation and desertification (see below).

A important feature of the Tibetan pastoral tradition is its *flexibility*. In terms of rangeland science, the mainstream view implicates a state of equilibrium which can be reached by applying the proper management. However, "equilibrial grazing systems" in humid regions are contrasted with so-called "non-equilibrial" ones in arid and semi-arid regions (e.g. ELLIS and SWIFT, 1988). Here, populations of plants and animals fluctuate within a broad amplitude as the environmental conditions are rather variable and unpredictable. A pasture management that tries to keep the same standard of productivity from year to year must fail in such cases. "In disequilibrium grazing systems, because the grazier has little influence on system dynamics, the appropriate management strategy is to exploit the spatio-temporal variation in forage availability in a flexible, opportunistic manner, rather than attempting to manipulate the system to suit the grazier's requirements" (TAINTON et al., 1996). It is precisely in this way that the traditional nomadic systems in Tibet have worked (see GOLDSTEIN and BEALL, 1990).

An *optimal pasture state* (OP) is the state of maximum possible density and productivity of edible vegetation (or domestic animals) that can be achieved at a certain place by sustainable utilisation (see also chapter 5).

*"Overgrazing"*[1] is a type and degree of utilisation of a pasture which prevents the complete regeneration of the palat-

able plants (e.g. because they have no chance to accumulate and store nutrients for regrowth). Overgrazing is the mode of utilisation, a change of vegetation is its indicator, reduction of the productivity is its short-term effect, and "desertification" is the long-term effect.

*"Desert"* we define only from a pastoral point of view as land that is practically devoid of edible plants. *"Desertification"*[2] means that the process of degradation quite probably will lead to a (pastoral) desert. This process will be usually "irreversible", which means that a return to the former state seems to be either impossible (e.g. because the soil has been eroded) or will at least take many years, which means that it is theoretically reversible, but practically irreversible. As regeneration will only take place when the pastures are not grazed at all any more or with very low intensity, the reversibility of the pasture is only a theoretical one from the viewpoint of the pastoralists. For them, desertification is a dead-end road, because any regeneration of the pastures, if at all possible, will take too much time to be worth waiting for. The herders will have to look for another source of sustenance or they will have to emigrate.

*"Semideserts"* we call the intermediate states between degraded pastures and pastoral deserts, and we define them simply as "poor to very poor pastures".

## 3. Indicators

Because of the special goal of this project and the vast area covered in a limited time[3], particular methods had to be designed. A set of simple indicators for pasture condition was developed, making it possible to evaluate (1) the productivity (quantity) and (2) the quality of the pasture, (3) whether the utilisation has been adequate and sustainable or (4) whether the pasture has been overgrazed for a short or long period; they also make it possible to assess (5) whether the pasture is in a relatively stable state or whether it is on the slope of degradation and desertification, and (6) whether the degradation is of ancient or recent origin. This indicator system is in a test phase and may be refined in the course of further investigations.

### 3.1 *Indicator:* relative abundance of unpalatable plants

From the viewpoint of a yak, goat or sheep or its owner, a pasture should consist only of palatable plants with high regeneration ability. However, species that are adapted to avoid the lips, tongues or teeth of herbivores (the "shirkers") or protected species (the "armed plants") are unavoidable, because they are promoted by the very circumstance of grazing. They belong to the pasture ecosystem and the pastoralists and their livestock have to coexist with them. But their relative coverage, abundance and share of the productivity of the whole vegetation should be as low as possible. With increasing grazing pressure, however, the percentage of these plants increases and they are consequently labelled "pasture weeds".

As this process takes time, ancient overgrazing may be distinguished from recent overgrazing by the proportion of palatable plants/unpalatable plants in the vegetation. The vegetation of areas with ancient ("traditional") heavy grazing or overgrazing is dominated by fully protected "pasture weed" species, which may even be the only components of the pasture. Livestock is still grazing but in very low densities and the animals have to migrate over huge areas to collect the sparse food. Wild herbivores are widely hunted or practically extinct.

According to a hypothesis developed during the project ancient overgrazing is found in areas where the livestock herders had some other livelihood, such as agriculture or trading, and/or in areas which had a higher density of human population in former times. Ancient overgrazing can be found in other dry areas of western and central Asia with ancient cultural centres, like in southwestern Iran (own observations). A human population of pastoralists shifted its means of sustenance from herding to agriculture or trade, war and robbery. The old rules of pastoralism were not important any more and became neglected.

### 3.2 *Indicator:* condition of palatable species

The amount of plants or plant parts of palatable species that are untouched at the end of the grazing season may be used as an indicator for the grazing intensity. Consequently, the best time for an evaluation is autumn for summer pastures and spring for winter pastures. Undergrazing can be detected during the rest of the year by dead remains from the last season.

### 3.3 *Indicator:* coverage of vegetation, relative degree of erosion

Grazing animals always cause some disturbance of the soil surface. The amount and degree depend on many factors,

such as animal weight, sharpness of the claws or hooves, mobility, soil conditions and climate. Within a pasture type the degree of overgrazing can be judged by the percentage of open soil, animal tracks and other types of erosion.

### 3.4 *Indicator:* relative abundance of colonising species

Plants that are specialised in the colonisation of open soil patches prevail in areas with frequent or heavy soil disturbance. A high amount and coverage of certain pioneer species indicates recent or regularly occurring opening or disturbance of the vegetation.

If a pasture is overgrazed or grazed with much higher intensity than in former times, vegetation and soil are consequently damaged. Colonisers are the first to invade the freshly open space and bare soil patches. With increasing overgrazing the number and coverage of colonisers increases. If periods of stable pasture regime follow (which may be an overgrazing regime as well), they are slowly replaced by perennial pasture plants – in the case of continuous overgrazing by the typical pasture weeds. Recent overgrazing can be distinguished from ancient one by means of that indicator.

## 4. Evaluation of the pasture condition

### 4.1 Class I: optimal pastures (OP)

OPs are pastures in the optimal state, which means that they deliver the possible maximum productivity of edible plants (fodder) year after year, practically without input. The criterion for this judgement is not the absolute quantity of yield, which is rather low on most Tibetan pastures, but rather the sustainability of utilisation. If sustainability is the underlying philosophy of utilisation, OPs will be the result.

### 4.2 Class II: degraded pastures – recent overgrazing (RDP 1–5)

In some parts of Tibet the pastures show the marks of rather recent overgrazing (low coverage of vegetation, low percentage of pasture weeds but abundance of colonising plants), which means that they must have been OPs until about the middle of this century. RDPs are therefore defined as pastures that still allow moderate pastoralism, but have been overgrazed to a certain degree during the last few decades. The degradation towards desertification goes on if the exploitation is continued.

RDP 1: Somewhat overgrazed, but desertification still far away. Regeneration seems to be possible after improved utilisation; estimated recovery phase within about 10 years.

RDP 3: Overgrazed, desertification can be expected within one human generation. Regeneration seems to be possible, necessary time span difficult to judge, but probably within one generation.

RDP 5: Severely overgrazed, degree of vegetation destruction close to desertification. Regeneration theoretically possible, but only within a long time span.

The grades 2 and 4 can be used for intermediate states.

### 4.3 Class III: degraded pastures – ancient degradation (ADP 1–5)

As mentioned above in some areas of Tibet the prevailing vegetation, mostly semideserts, seems to be the result of a certain degree of overgrazing for centuries or even longer. Though the grazing pressure might have been reduced in the meantime, the vegetation could not recover to OP, because grazing continued without a pause (or the pause was too short even if it lasted for hundreds of years – ecological processes like soil formation and vegetation succession are very slow in Tibet).

The distinction between RDP and ADP is still a rather hypothetical one (see Table 1). It is one of the scientific goals of our future research to test and refine the indicator system, with the help of which it may be possible to confirm or detect the range and boundaries of ancient population centres.

### 4.4 Class IV: desertified area – anthropogenic (pastoral) desert (D)

Desert-like areas where the vegetation is not scarce because of natural (climatic, edaphic) reasons – in this case it would be an OP, even though it is a semidesert – but because it has been destroyed by long and/or intensive overgrazing or by peat-cutting or eventually by other factors such as burning, shrub-digging, etc., have been classified as D. A recovery is very unlikely and if it were to come about would require many human generations if not millennia.

### 4.5 Estimation of productivity (P 0/1–5)

The exact measurement of the productivity of an area and the translation of the data into values that are meaningful for HAPIE are complicated and unreliable. For the purposes of this project, a rough relative estimation method seemed to be the right solution. To represent the two ends of the spectrum, the giant *Kobresia* pasture was chosen as the most productive type (value 5) and the Edelweiss semidesert as an example of that with the lowest value (1). Therefore, the estimated productivity is indicated by values ranging from P 5 to P 1. As intermediate numbers, P 3–4, P 3.5, are possible and desert areas will be classified as P 0. Thus, productivity (P) can be estimated using 10 grades or values.

### 4.6 Estimation of Fodder Quality (Q 1–5)

The same simple and rough but effective method has been applied for the estimation of the palatability, the nutritive value and the percentage of poisonous plants in the vegetation: 5 means "excellent" and 1 "very poor".

The high nutritional value of high altitude Cyperaceae is well known from studies of the European Alps. Investigations conducted on the Tibetan Plateau (CINCOTTA et al., 1991; ZHOU and SIMON, 1995) confirm the great importance of sedges as fodder plants. Therefore, pasture types dominated by *Kobresia* and *Carex* species have been assigned the highest values, pastures dominated by weeds, like the ill-famed *Oxytropis* (duk – poisonous), received the lowest ones.

## 5. Pasture Types

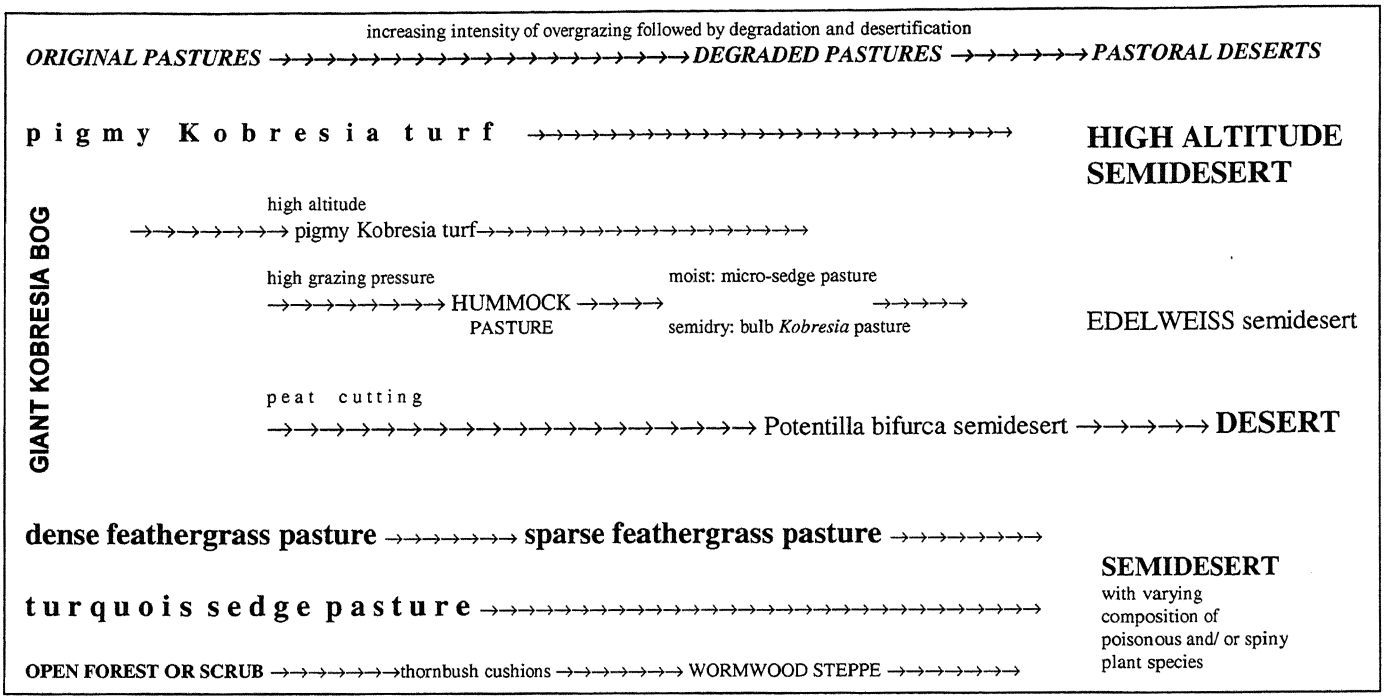
To prevent confusion of the terms used here: *Pasture classes* show the position of a particular pasture on the gradient between optimal and completely degraded state. *Pasture types* have been defined according to their plant composition and categorised according to their dominant plant

Table 1: Common pasture types of southern and central Xizang
Tabelle 1: Weit verbreitete Weidetypen in Süd- und Zentral-Xizang

| Pasture type | Dominant plants | Tib. Name[1] | Class | P | Q |
|---|---|---|---|---|---|
| Pygmy *Kobresia* turf[2] | *Kobresia pygmaea* | pang tsa | OP<br>ADP 1 | 2 | 5 |
| Feathergrass steppe[3] | *Stipa* spp. and other (small) tussock grasses | chema | OP | 1-3 | 4 |
| Turquois sedge pasture[4] | *Carex moorcroftii* | long tsa | OP | 1-3 | 3 |
| Giant *Kobresia* bog[5] | *Kobresia schoenoides* | na tsa | OP | 5 | 4 |
| Dwarf shrub pasture[6] | *Dasiphora, Juniperus, Myricaria, Hippophae* | | OP | 1-3 | 2 |
| Micro-sedge pasture[7] | *Carex microglochin* | | RDP 1-2 | 2 | 5 |
| Bulb *Kobresia* pasture[8] | *Kobresia royleana* | | RDP 3 | 2 | 4 |
| Wormwood steppe | *Artemisia* spp. | yog mo | ADP 4 | 2-3 | 4 |
| Semidesert pasture[9] | *Astragalus* spp., *Stellera chamaejasme, Incarvillea, Cryptothladia, Tanacetum, Iris* | | RDP 6<br>ADP 4-5 | 2-1 | 1-3 |
| High altitude semidesert | *Androsace* | | ADP 4-5 | 1 | 2 |
| Edelweiss semidesert[10] | *Leontopodium nanum* | | ADP 5 | 1 | 1 |
| Duk tsa pasture[11] | *Oxytropis tatarica, Thermopsis lanceolata* | duk tsema | RDP5 | 2-3 | 1 |
| Stinging nettle pasture[12] | *Urtica hyperborea* | | RDP5 | 2 | 2 |

[1] The Tibetan names of the dominant plants given by the local people are rendered in phonetic approximation.
[2] Widespread at high altitudes, covering huge areas (except for the driest parts); particularly important for yak; 4000-5300 m; replaces giant *Kobresia* bog in high altitudes after constant overgrazing.
[3] Widespread in dry areas and altitudes between 4000-5000 m; covering huge areas.
[4] Widespread on sandy soil in dry areas.
[5] Widespread in water-surplus habitats (e.g. around lakes, along rivers, lower part of slopes).
[6] Locally on special ecological situations; *Myricaria* and *Hippophae* on river gravel.
[7] Result of ancient, moderate overgrazing of giant *Kobresia* bog; often as moist "hummock pasture".
[8] Result of severe overgrazing of giant *Kobresia* bog; often as dry "hummock pasture".
[9] Result of overgrazing of feathergrass steppe; dominant species poisonous or spiny.
[10] Perhaps a result of ancient degradation (peat cutting?) of pygmy *Kobresia* turf.
[11] Dominant species poisonous; nowadays widespread.
[12] Along passes and travel roads.

Table 2: Important pasture types of southern and central Xizang along a gradient of degradation
Tabelle 2: Wichtige Weidetypen in Süd- und Zentral-Xizang entlang eines Degradationsgradienten




species. Table 1 contains only the most important pasture types the team came across on this trip, but omits others that have been described in literature (e.g. in CHANG, 1981; MIEHE, 1988, 1990; WANG, 1988.)

## 6. Results: the condition of Tibetan pastures

The results of pasture evaluation (pasture classes) and classification (pasture types) are presented in a concise form in Tables 1 and 2.

Contradictory statements are found in literature concerning the condition of the pastures and the evidence for overgrazing in Tibet. Widespread overgrazing is reported, for instance, by IVES (1981) and LI (1990) (both cited in MILLER et al., 1992). On the other hand, MILLER et al. (1992) found much of the rangeland on the Tibetan Plateau to be in surprisingly good condition. According to GOLDSTEIN et al. (1990), the Chinese government's perception of a grassland crisis in Tibet is derived from assumptions and inferences obtained from inaccurate livestock census data and not from proper monitoring of the rangeland.

In any event, it is very difficult to judge information about the change in livestock numbers. Official statistics show an increase in livestock numbers since 1981, when the "household responsibility system" was established in Tibet (CLARKE, 1988). However, GOLDSTEIN et al. (1990) found that total livestock has not increased in Western Tibet. During our trip, in different places we heard different statements concerning changes in livestock numbers. However, animal figures only make sense if they refer to a certain area (acreage), a rule that seems to be logical, but is often neglected.

The different views of the situation may be partly caused by the reasons mentioned above, partly by the manifold natural conditions and partly by the different effects of the recent political and socio-economic changes. There is, however, no doubt that in some areas the condition and productivity of the pastures is getting worse, but this is true not only for Tibet, but also for many areas of High Asia.

On the other hand, our investigations (as well as the judgement of other experts cited above) have shown that it is not wise to generalise. Summarising the experience gained from our expedition, we can confirm that huge areas of the pastures are in good condition, as the summarised estimation for southern and central Tibet displays the following picture: About 30 % of the pastures investigated on our trip were in optimal condition (OP), about 20 % showed recent complete devastation (RDP 5) and about 20 % were heavily overgrazed (ADP 3,4). The rest fall somewhere between the optimal state and heavy overgrazing, and it is difficult to judge whether the degradation is of ancient (ADP) or recent origin (RDP).

The fact that the pastureland has been kept in optimal condition (optimal from an ecological as well as an economic point of view) in large areas, for centuries of pastoralism can be taken as evidence that the Tibetan pastoral system is a sustainable one. Our main concern, however, was the areas with recent pasture devastation, because we were looking for clues to the causes of the catastrophes mentioned in the introduction. They will be discussed in part II of this publication.

## Notes

[1] "Overgrazing" is often used in a very broad context, which is not compatible to the view of a pastoralist and we generally agree with WILSON and MCLEOD (1991), who state that the extent of "overgrazing" is frequently overestimated by experts, (particularly by ecologists).

[2] For a general discussion of the complex phenomenon see MÜLLER-HOHENSTEIN (1993) and THOMAS and MIDDLETON (1995).

[3] 5.000 km within four weeks by land cruiser and on horseback.

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## Address of authors

**Univ.-Prof. Dr. Wolfgang Holzner** and **Dr. Monika Kriechbaum**, Centre for Environmental Studies and Nature Conservation, University of Agricultural Sciences, Vienna, Gregor Mendel Straße 33, A-1180 Wien; e-mail: kriechba@edv1.boku. ac.at

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