

Summary

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bildes sollte in der alpinen Stufe, abgesehen von für die Sicherheit der Pistenbenützer notwendigen, inbezug auf die Umweltverträglichkeit überprüften (Kap. 5.2.2.), punktuellen Geländeanpassungen nicht geplant werden.

Aufgrund der Untersuchungsergebnisse und von Literaturangaben werden in Kap. 5.2.3. Hinweise für die von standortsgemässen Pflanzen ausgehende Rekultivierung abgeleitet und diskutiert.

SUMMARY

In the region of Davos (Eastern Swiss Alps) investigations were made on the phytosociological and ecological effects of machine-levelling of ski runs situated above 2200 m realized between 1963 and 1978. In 1978 the vegetation and sites of 241 sown and unsown plots on acidic silicate and dolomite were described. Of these 92 permanent plots were studied in 1979 and 1980. The investigations were completed by comparisons of ski runs with adjacent alpine meadows and scree slopes as well as with glacier forefields in the Val Roseg (Upper Engadine) and levelled ski runs in the Corvatsch area (Upper Engadine).

Results

1. The machine levelling of ski runs destroys most of the original plant cover. Accordingly the mean vegetation cover of the relevés with natural revegetation on silicate comes only to 4% and on dolomite to 5%. On 33% of the relevés the cover is even less than 0.05%. Deep bulldozing destroys the stratification of the soil and the humus, and fine material found in the topsoil of undisturbed areas is lost.
2. The first colonisation of the levelled ski runs on silicate and dolomite is made by a random mixture of species of surrounding alpine meadows, snowbeds, and scree slopes (compare fig. 7 with fig. 30 and fig. 14 with fig. 31). The mean plant cover of levelled ski runs (5%) corresponds rather to that of the natural scree slopes (11%) than to that of the alpine meadows (80%).
Some of the species that grow on levelled ski runs are found exclusively on silicate, others only on dolomite, and yet others on both substrates (fig. 20).
Species of snow-beds amongst others grow on areas with a relatively long lasting snow cover. Other site factors such as altitude, slope, and exposure do not clearly influence the vegetation (figs. 7 and 14).
3. During the three years of investigation some considerable differences in the changes of vegetation on the plots with natural revegetation of the silicate and the dolomite were found (figs. 8 and 15). The mean total plant cover on both rock types was most dense in 1979, and in 1980 - the last year of investigation - the least dense (fig. 21). This decrease of the vegetation is partly due to the unfavourable weather conditions.
From 1978 to 1980 the proportion of fine earth on the surface decreased noticeably on unsown permanent plots of recently levelled ski

runs, but only slightly on those that were levelled five years before, while the proportion of stones (>2 mm) increased accordingly. Thus the mean proportion of the fine earth on the surface of a one-year-old levelling (47%) was considerably higher than that of a six-year-old one with similar site factors (21%) because some of the humus and fine earth had already shifted deeper.

First only the native plants, which grew from still existing rhizomes on the recently levelled areas appeared (fig. 13). In these rather rare favourable microsites with partly unspoilt top soil a comparatively dense plant cover may develop after some time. The species spread by diaspores such as Cardamine resedifolia, Chrysanthemum alpinum, or Hutchinsia alpina appear only later.

4. The mean total plant cover comes to 30% on plots with artificial revegetation. Great variation in the density of some sown species (0.2%-90%) influences the classification (fig. 22).
With increasing altitude the sown species generally become stunted. The other site factors do not noticeably influence the sometimes poor growth of the sown species (fig. 22).
5. On the permanent plots with artificial revegetation the mean total plant cover decreased clearly from 1978 to 1980 especially on plots with a cover of more than 10% of sown plants in 1978 (figs. 23 and 24).
The proportion of stones on the soil surface generally increased from 1978 to 1980 whereas the fine soil decreased slightly (fig. 25). There is no obvious relationship between the changes of vegetation and the site factors (fig. 23).
6. The mean total plant cover was far greater on plots on siliceous substrate with artificial revegetation (30%) than on unsown ones (4%). The reason for this is also that environmentally disadvantageous levelled ski runs were not sown. On areas with artificial revegetation a few grasses such as Festuca rubra or Deschampsia flexuosa often dominate and therefore the diversity of species is smaller than on areas with revegetation by indigenous plants. Here the indigenous species generally grow slightly more densely, whereas the mosses on the soil appear less dense than on sown areas with similar site factors. Permanent plots were found with vegetation decreasing at least twice as much on levelled ski runs with artificial revegetation as on those with natural revegetation (fig. 27).
7. The levelled ski runs at Piz Corvatsch usually show soils rich in fine earth and clay particles. Therefore these soils are more prone to erosion than those in the region of Davos. Due to the higher average altitude there are more snow-bed species than near Davos (fig. 29).
8. The small changes of vegetation on the plots from 1978 to 1980 and the development of the plant cover on glacier forefields also indicate that it will probably take many decades, if not more than a century, until a closed plant cover - most likely originating from species of adjacent alpine meadows and scree slopes - can develop. Nor will there be a stable closed vegetation on areas with artificial revegetation for several decades, as the cover very often severely decreases again after relatively dense growth.

9. Because of the slow and unstable development of the vegetation, the large scale destruction of many alpine plants, some of which even protected species (table 9), and because of the damage to the scenery there should not be levelling of ski runs in the alpine zone except for small adaptations absolutely necessary for the safety of the skiers and for which an environmental impact assessment with positive result has been made.

Based on the results of the present work and of the literature, suggestions are made and discussed in chap. 5.2.3. concerning the artificial revegetation with native plant species according to the site factors.

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