# Open-space Cultivation and Mowing Techniques at Stuttgart Airport – A Field Report

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**Summary:** The 182 ha meadow area at Stuttgart Airport was established between 1992 and 1995. Meadow development and with it, bird-food supply and bird numbers were strongly dependent on the management method. It was the goal to arrive at the management method that supported the highest possible flight safety. In combination with the results of a habitat report, the experiences with different management methods led to three central recommendations for the future management of the meadows at Stuttgart Airport.

## 1. Framework Conditions

### 1.1. Green areas

Stuttgart Airport covers a total area of about 402 hectares, with green areas accounting for about half of this area (200 hectares). About 182 hectares of those green areas are air-side meadows. When the runway of Stuttgart Airport was extended, those meadows were newly established. First the ground was leveled by soil being cleared away / filled up, and seed beds were prepared appropriately. The green areas are characterized by clear differences in terms of the variety of plants growing there, of growth and of the vegetation structure.

In terms of layout and management, the development of the green area all in all complies with the airport-specific objective of a relatively high growing, biodiverse meadow requiring a maximum of two mowings.

### 1.2. Cultivation: internal organization, positive / negative experiences

Meadow cultivation is in the responsibility of the airport gardening section which belongs to the General Operations Branch of the Construction and Facility Management Department. The gardening section has special equipment for meadow cultivation and its skillful staff has undergone specialist training. Cultivation is organized and carried out in close coordination with the chief of the General Operations Branch, the bird strike officer of the airport and the chief of the gardening section.

On the basis of comprehensive experiences and differentiated information gained from the habitat report (HILD et al. 1991), it was also possible to continuously optimize the cultivation system.

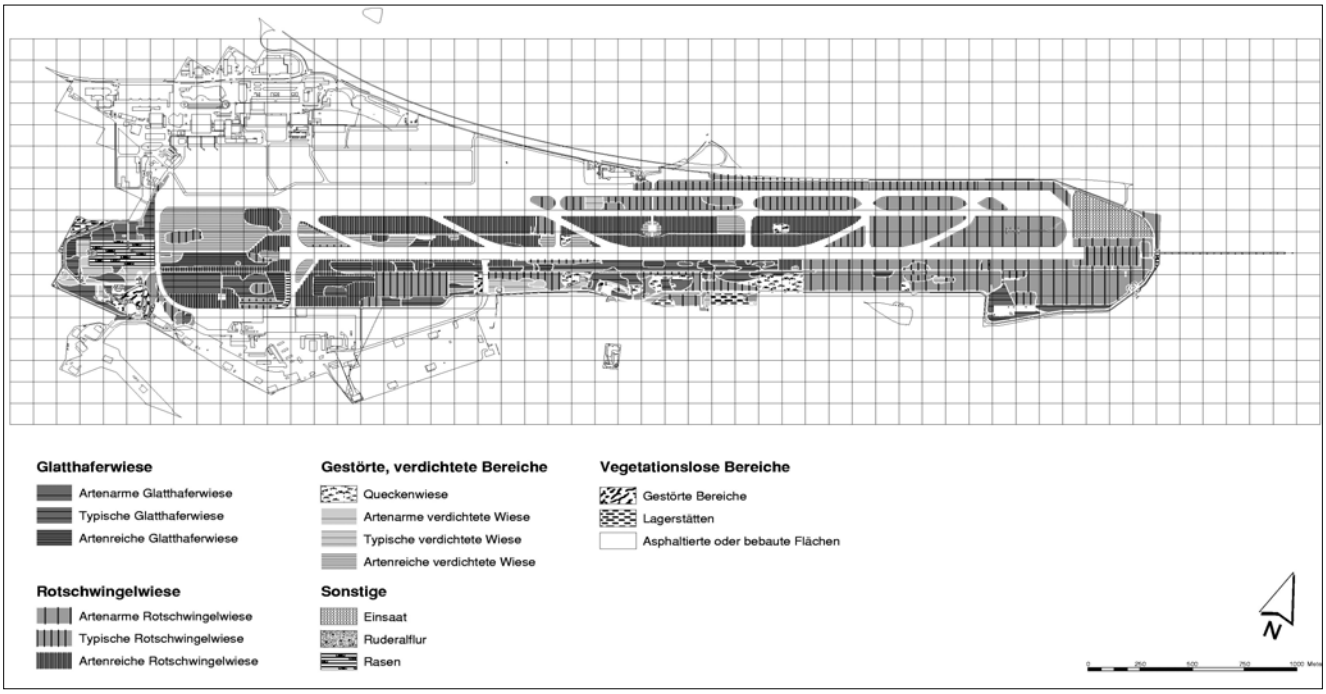


**Fig. 1: Map of the vegetation at Stuttgart Airport, 2001**

### 1.3. Reference – Habitat report

One of the central issues addressed in the habitat report is the dependency of meadow development on cultivation. The parameters of vegetation development, bird occurrence, and availability of food for the birds are always associated with the achievement of maximum flight safety. Thus, from the positive correlation of a specific cultivation method and the resultant vegetation structure with a low occurrence of birds, goals and recommendations for meadow cultivation have been defined.

## 2. Green areas

### 2.1. Characteristics

When mapping the vegetation within the airport area (see Fig. 1), 13 types of green areas / vegetation were distinguished.

Larger meadows of the tall oat-grass type are only to be found in the western, i.e. the oldest section of the airport. Depending on the cultivation and the nutrient content, we differentiate between species-poor, typical and biodiverse tall oat-grass meadows (see Fig. 2).

All areas showing compacted and disturbed soil or an increased nutrient content were portrayed accordingly.

Under the category "lawn", we combined all frequently mowed areas along the runway and roads, around lighting installations and in part of the transmitter area.

### 2.2. Cultivation Influence to Vegetation Development

If we compare different forms of cultivation implemented on test areas, we see some obvious differences between mulched and mowed sections. Contrary to mowed areas (where the swath was cleared away), mulched areas have a higher degree of humidity and nitrogen and a lower biodiversity for the same area size. Mulching leads to the monotonous and dominating occurrence of couch grass (*Elymus repens*), only a small percentage of other types of vegetation are represented in the overall vegetation cover of these areas. Mowed areas have a higher biodiversity and the same coverage as areas that have not been mown. Repeated mowing on compacted areas may, however, result in the development of dominating occurrences of creeping cinquefoil (*Potentilla reptans*) and silverweed *(Potentilla anserina*). They have a relatively poor root penetration.

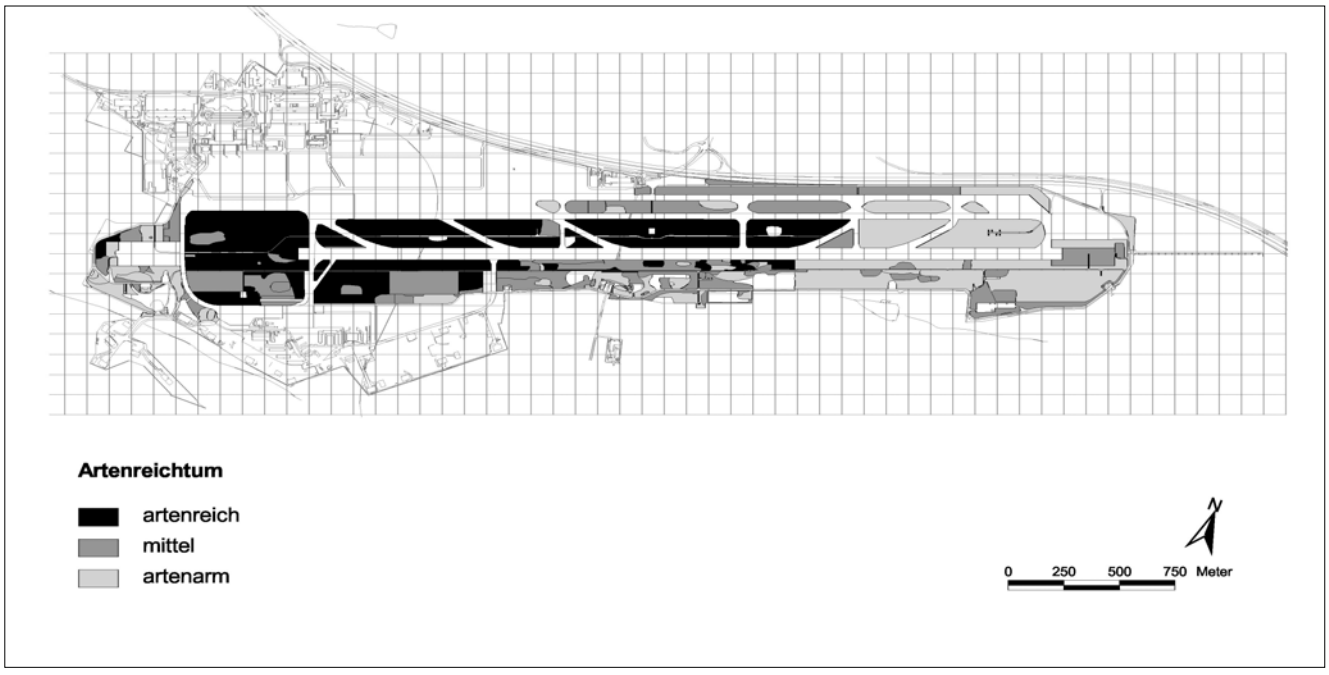


**Fig. 2: Biodiversity of meadows**

The red fescue meadows are dominated by the red fescue (*Festuca rubra*) in the grass layer; mostly there are no tall grasses. Consequently the grass cover is often patchy, with a rather low height. Depending on the biodiversity, we differentiated here, too, between species-poor, typical and biodiverse red fescue meadows (see Fig. 2).

### 2.3. Occurrence of birds in relation to vegetation development and mowing

In the area of Stuttgart Airport, the following birds were observed:

a) All-year birds: common buzzard, carrion crow, gray heron, common kestrel, domestic pigeon, small birds

(pied wagtail, yellowhammer, house sparrow, tree sparrow, goldfinch, greenfinch)

b) summer birds: lapwing, red kite, black kite

c) winter guests: rook, sporadically gray partridge and magpie, temporarily flocks of more than 1000 starlings

The annual variation of the entire bird population is low. Only in March there is a distinct maximum due to massive occurrences of starlings. The birds most frequently observed at the airport are starlings, followed by small birds, rooks, common buzzards and common kestrels.

The spatial distribution of the entire bird population shows that all green areas are used as a habitat. However, the birds prefer the larger green areas south of the runway. Further concentrations are observed west and east of the airport area.

If we take a look at the differently cultivated and constantly observed areas, we may deduce the following correlations (see Table 1)[1]:

**Table 1: Cultivation of the permanently observed areas and number of birds**

| | Total | Starling | Crow (carrion cr. + rook) | Common kestrel | Common buzzard | Lapwing |
|---|---|---|---|---|---|---|
| **Test area 1** | | | | | | |
| **Mowing 0** | 31.1 | 18.5 | 1.5 | 2.9 | 0.0 | 0.5 |
| **Mowing 1** | 30.1 | 16.8 | 1.5 | 3.1 | 0.0 | 0.5 |
| **Mowing 2** | 46.8 | 13.5 | 6.8 | 3.9 | 1.8 | 0.1 |
| **Test area 2** | | | | | | |
| **Mowing 0** | 17.9 | 3.9 | 6.8 | 4.2 | 1.2 | 0.0 |
| **Mowing 1** | 103.9 | 76.9 | 5.9 | 3.4 | 4.5 | 0.0 |
| **Mowing 2** | 147.8 | 128.2 | 5.6 | 5.9 | 4.6 | 0.0 |
| **Test area 3b** | | | | | | |
| **Mowing** | 8.7 | 0.0 | 4.3 | 1.5 | 2.5 | 0.3 |
| **Mulching** | 32.0 | 12.6 | 14.8 | 1.5 | 2.5 | 0.1 |
| **Test area 3a** | | | | | | |
| **Mowing** | 19.4 | 1.7 | 5.9 | 0.8 | 3.5 | 2.6 |

Areas mowed twice increase the attractiveness of the areas to rooks and common kestrels as compared with areas that are mowed only once or not at all.

- For test area 2, mowing (both one-time and two-time) had a positive effect on the attractiveness of the area, especially to starlings and common buzzards.
- The mowed areas accommodate a larger number of species that are significant from a nature protection point of view and are therefore ecologically more important.
- Mulching also increases the habitat quality of the areas for starlings and rooks.

[1] The information on bird numbers refers to the number of birds per 10,000 square meters (= one grid square) observed during the study period

These correlations are based on the food offered in the different areas and its availability as well as on the spatial structure of the vegetation. Starlings, for example, will never be seen in the higher growing meadows, while birds of prey regularly hunt for food in those areas, too.

### 2.4. Meadow Mowing: Dates, Cycle, Mowing Equipment, Use of Technical Equipment

How often and when the meadows are mown significantly depends on the growth. Since 2003 they have been mown relatively late in the year, and a second mowing has only taken place where there is an excessive growth (see Table 2).

The signposts at runway 07/25, the marginal strips of the taxiways, the lighting systems as well as the four antenna faces for the ILS are cut clear in short intervals in accordance with the requirements.

Mowing equipment to be procured for open-space cultivation at Stuttgart Airport will have to meet the following requirements:

**Fig. 3: Mowing and chaffing machine John Deere 6750 with swath container**

- The equipment must be sophisticated and well tried in agricultural and/or municipal applications and must provide for the required modification potential.
- Taking into account the permissible total weight, the maximum contact pressure of the wheels must not exceed 3 kp/square centimeter.
- The equipment must be able to execute the operations of mowing, chopping and loading in one and the same process.
- The equipment must be able to completely ingest the swath.
- It must be possible anytime to install and de-install different harvesting units for field grass cutting, full

plant silage, swath ingestion, corn and grass harvesting.

- Equipment that does not ingest the swath will not be appropriate, because it would lead to turf felting.

In the runway, taxiway and ILS areas two automotive mowing and chopping machines (John Deere 6750, year of construction 2002, and John Deere 5830, year of construction 1988) including swath containers are used (see Figure 3). In the area of the signposts and the lighting systems, two rotary mowers (John Deere F 1145) with driver's cab are employed (see Figure 4). The technical data are shown in Table 3.

**Table 2: Mowing in 2002 - 2004**

| Year | Month | April | | | May | | | | | June | | | | July | | | | | August | | | | | September | | | | October | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Calendar week (approx.) | 16 | 17 | 1 | 8 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 3 | 1 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 |
| 2002 | Run- and taxiway | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Signposts and lighting systems | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ILS areas | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2003 | Run- and taxiway | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Signposts and lighting systems | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ILS areas | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2004 | Run- and taxiway | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Signposts and lighting systems | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ILS areas | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

**Fig. 4: Rotary mower John Deere F 1145 cutting clear a signpost**


**Table 3: Technical Data and Characteristics of the mowers**

**Technical data of the mowing and chopping machine John Deere 6750**

- 6-cylinder John Deere motor with 290 kW (395 PS) at 1900 rpm
- Cubic capacity 12500 ccm, turbo charger and intercooling
- 700 l fuel tank 2 x 12 V 120 Ah
- Drive, hydrostatic drive
- Heeling, precompression rollers, metal detector and contact pressure control
- Chopping organ, 56-cutter drum, manual sharpening when cutters are in reverse mode, counter cutter blade
- Transportation of chaff, segmented discharge blower, hydraulic rotation by 200 degrees possible, total height up to 515 cm
- weight 11,000 kg approx.
- Harvesting adapter, field grass cutter with a working width of 420 cm, double-cutter drive, supported by the wheels

**Technical data of the swath container**

- JF scraper floor tumbril ST 12000/40 Unimaster with chaffing platform and discharge conveyor
- Total weight < 16,000 kg
- tandem axles
- scraper floor chains and conveyor chains running on support tracks
- hydraulic scraper floor power train with forward and return movements
- adjustable discharge conveyor for chaff
- cross-axle loading height 430 cm

- Platform: Elevated drop side with large greenstuff box
- holding capacity 36 m³
- Discharge time of swath container about 5 to 8 minutes

**Performance of the mowing and chopping machine John Deere 6750**

- Mowing, chopping and storing in one operation
- Driving speed 20 km/h
- Working speed variable, 0-10 km/h at a constant speed of the mowing and chopping system
- Mowed area about 3-10 ha/h

**Technical data of the rotary mowers**

- John Deere F 1145 with driver's cabin and heating
- 20 KW three-cylinder motor, diesel
- hydrostatic drive, 0-17.7 km/h
- hydraulic clutch
- front drive without belt
- power-steering
- Dimensions excl. cutting unit width 1.09 m, length 2.29 m, height about 2.02 m
- weight incl. cutting unit and driver's cabin: about 1250 kg
- Ground pressure about 0.93 kp/cm²
- 1.53 m 3-blade siccle cutting units with side or rear discharge, hydraulic drive
- Lights compliant with German Road Licensing Regulation, 2 additional halogen headlights

### 2.5 Handling of swath: Disposal, composting

The whole swath is taken up and carried away. It is currently disposed in a commercial composting facility, which involves a logistically justifiable effort. Composting in the airport area is deliberately avoided so not to offer food sources to birds such as crows and gulls.

The signpost and lighting areas are mulched with the rotary mowers so that no swath is taken up there or has to be disposed of.

## 3. Experiences

### 3.1 Technical handling/equipment and workflows

Since May 1977, self-propelled mowing and chopping machines have been used for mowing at Stuttgart Airport. The mowing and chopping machines function well and without any failures both when mowing dry and wet grass. The performance of the mowing and chopping machines has also been outstanding when used in the night. The excellent view on the harvesting unit allow precise mowing to the centimeter, especially in the area of signposts and lights. The grass is immediately and completely taken up from the cutter bar without touching the ground again. In order to minimize transport in the airport area, the grass is blast into the swath container. From the swath container the grass is discharged onto transport vehicles with container platforms; they carry away the grass without the work having to be interrupted. No major failures have been experienced with the mowing and chopping machines until now. Over the years the swivelling wheels of the harvesting unit have continuously been improved, so that nowadays the cutting height may be varied from 0 to 35 cm.

## 4. Recommendations/Prospects

In combination with the results of a habitat report, the experiences with the cultivation methods described above result in the following central recommendations for the future management of the meadows at Stuttgart Airport:

The goal to be aimed at in the development of the green areas should be the establishment of tall oat-grass meadows or biodiverse vegetation areas. Biodiverse meadows and tall oat-grass meadows in the airport area are typically not attractive to species that are a risk to flight safety. Due to the high vegetation cover, there are only a few small mammals living there, which makes the meadows unattractive as a food habitat for birds of prey.

Wherever flight safety allows, the mowing frequency is reduced. A high mowing intensity (twice or more often during the year for fast growing areas) enhances the development of low growing vegetation covers which are more attractive to common kestrels.

Mulching of larger areas is refrained from, as it enhances the development of a monotonous vegetation (couch grass, in particular) which seem to be especially attractive to starlings and crows.

## 5. Reference

HILD, Jochen et al.: Biotopgutachten für den Flughafen Stuttgart - Vorschläge zur Verhütung von Vogelschlägen. Traben-Trarbach, 1991. - Im Auftrag der Flughafen Stuttgart GmbH

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**Tall grass cultivation with 25 cm after mowing**

**Rotary mower with 1.53-m 3-blade-siccle cutter units with side discharge**

**The swivelling wheels of the harvesting unit for the variation of the cutting height from 0 to 35 cm**

**Swath container being emptied**

**Harvesting unit (field grass cutting unit) with a working width of 420 cm and duplicate cutters**

**Swath transferred to transport vehicles with container platforms**