

20/07/2015

# Overgrazing

Lielupe floodplain meadows



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20 – 07 – 2015

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## Summary

The Lielupe floodplain meadows at Jelgava are since 2005 the home of Dutch Koniks horses. This results from the European project started by the ARK Nature foundation. Currently there are a total of 62 Konik horses and various birds- and insect species on the island. Most of them protected. The koniks are most often located as one big herd, all across the island. It's been ten years since the horses first arrived in Jelgava, so some question have come up surrounding the island. Most importantly the question if the island is being overgrazed or not by the new natural grazers. To answer this question, several research questions have been established, including sub-questions. These questions are:

- What are the effects of natural grazing on the Lielupe floodplain meadows and the grazers?
- What is the current situation of the vegetation on the meadows?
- What is the health condition of the natural grazers on the meadows?
- Is there a variation in vegetation in other areas in Latvia where the koniks have been released?

In order to answer these questions, the meadows have been looked at from different perspectives. Primarily these were: the vegetation increase or decrease over a period of time, the occurrences of bare soil (patches) and the increase or decrease of them, the well-being of the herd on the meadows, scoring them on their well-being to find out if they're not underfed. Finally, there is also being looked at other areas where ARK has released Konik horses, this has been done to see if there are any significant differences between these regions and the meadows itself.

During this research, no significant signs have been found that the meadows are being overgrazed. The vegetation coverage has mostly only increased during the time of this research. The opposite happened for the bare soil, this decreased over the same period of time. Meaning that most bare soil that was found at the start of the research was regrown. At the start 0,40 % of the island was bare soil this is 0,28 ha. This amount was decreased to 0,28 % at the end of the research. In overall well-being the horses didn't show any abnormal symptoms. 90 percent of the herd felt under well-being score three, this equals good. Seven percent of the herd fell under score two, this may be due to the fact of a cold spring.

Other areas in Latvia have also been visited. This were the reserves "dviertes paliene" in Bebrene and Ķemeri National Park. There were no major differences found between vegetation, most differences came from the fact that in Dviertes, the vegetation coverage was much lower than that of the meadows. All the herds of each area were mostly in the same shape.

All these factors together point out that the Lielupe floodplain meadows are not overgrazed. At this point in time. It's still possible for the meadows to be overgrazed in the near future if there are more than 65-70 horses. To ensure that an exact number of horses could be known to overgrazing, it is recommended to do a follow-up study on the meadows. This way, a clearer and stronger image of the meadows will be established with each passing year.

## Preface

The research report that lies before you is the culmination of a 10-week internship at ARK Nature. This internship is part of the third year of the study of applied biology at the CAH Vilentum, Almere NL. It is used to remove the student from his comfort zone and become acquainted with an international field. The purpose of this internship was to conduct a research in Latvia, Jelgava. To investigate the situation of natural grazing on the Lielupe Floodplain Meadows. And to find out if the meadows were being overgrazing or not.

I also want to offer a special word of thanks to my supervisor Einārs Nordmanis for his valuable guidance, friendly welcome and enthusiasm. I also thank him for the fact that he has involved me in the ins and outs of the Latvian culture. In addition, I would like to take the opportunity to thank Frank Zanderink of ARK Nature, for enabling this internship. I also want to thank Jan van der Veen of ARK for making it possible to visit other areas in Latvia. Finally, I want to thank Robbert Boink for the guidance from the school and for the feedback on the training plans and interim reports.

In closing, I therefore want to wish a pleasant reading.

Lex van Drongelen

Jelgava, July 2015.

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## 1. Introduction

In 1999 ARK Nature and WWF started a large natural grazing project to counter the overgrowth of various open fields in Latvia with bushes, reeds and forest. So preventing losing a part of Latvia's biodiversity. Konik horses from ARK Nature were driven from Holland to Latvia and were set loose in Papa nature reserve. The project resulted in a great success and more Koniks and other natural grazing project were set up in nature reserves all over Latvia (van der Veen, J. 2015).

One of the project that followed out of this was Lielupe floodplain meadows at Jelgava. Since 2004 the meadows are a Nature2000 site because of its amount of endangered birds. Of the 135 bird species which occur there are 27 specially protected (Latvijas Dabas fonds. 2003). The natural grazing project started in 2005 when the first sixteen Koniks were brought from the Netherland to Jelgava. This did not go unnoticed as the Koniks were released on the nature island situated in the center of Jelgava. Quickly becoming a tourist attraction. After the release, the horses live on the island free from predators and with minimal human intervention.



Figure 1. The Lielupe floodplain meadows located in the center of Jelgava.

Currently there are a total of 62 Konik horses and various birds- and insect species on the island. Most of them protected. The Koniks are most often located as one big herd, all across the island.

After ten years since the Koniks were brought here, there is a need for a review of the island. The question has come up whether the island is overgrazed or not. The island is also the home for protected plant and bird species. When there are too many grazers, in this case Koniks, there could be a detrimental effect on the environment and it can even upset the ecological balance of the island. This could mean loss of biodiversity, irreversible loss of topsoil, increase of turbidity in surface waters and even increased flooding frequency/intensity.

## 1.1 Objective

The objective of the research is: To find out if the current population of Koniks is overgrazing the Lielupe floodplain meadows, so as to analyse what the support base is for this amount of Konik horses on the island.

## 1.2 Research- & sub-questions

The main research question is as follows: What are the effects of natural grazing on the Lielupe floodplain meadows and the grazers?

The following sub-questions have been formulated to assist in answering the main research question:

- What is the current situation of the vegetation on the meadows?
- What is the health condition of the natural grazers on the meadows?
- Is there a variation in vegetation in other areas in Latvia where the koniks have been released?

## 1.3 Reading guide

Chapter 2, "Materials and Methods" will describe the methods that were used in this study. It will also describe the analysis methods that have been conducted on the obtained data. Chapter 3 concerns the outcomes of these analyses and will include further results of the research. In the subsequent chapter (4), the results are set out. In addition, the limitations of the results, and this study will be discussed in this section. Chapter 5 will show the conclusions from the research and Chapter 6 will have recommendations based on the conclusions found in the previous chapter. Lastly, in chapter 7, the literature that has been used for this research is mentioned.

## 2. Material and methods

During this research there will be investigated whether the Lielupe floodplain meadows are being overgrazed. There are a number of factors that play a role when speaking of overgrazing. The most common causes leading to overgrazing are (Hogan, C. 2012):

- Excessive animal density on the land. This means that there are too many animals living off the land of a certain size. Furthermore the vegetation won't have time to recover itself and the land will be eaten bare, eventually leading to desertification.
- Lack of rotation or residence time of grazers on a sub-plot of the landscape unit.
- Grazing at inappropriate times relative to the flora productivity cycle.

To research this, the island will have been looked at from multiple perspectives. The island has been checked twice in total, once at the start of the research (11-05-'15 till 27-05-'15) and near the end (22-06-'15 till 06-07-'15). As it's not possible to see the entire island at once. The island has been divided into six clusters (A till F), this gives each area enough time to be fully explored. In the figure below there is an overview of the island divided into six clusters.



Figure 2. The Floodplain Meadows divided into clusters

During these rounds of inspections the vegetation of the meadows has been mapped out and observed, looking for any signs of vegetation loss or regression of certain (protected) species. To analyse and document the vegetation the Braun-Blanquet method has been used. This method has certain factors that need to be elucidated, such as the surface; this implies the extent of the count plane, generally the rule is to extend the count plane until there are no more new plant species in and around the area. Furthermore the method uses a certain coding system, this has been enclosed in a blank copy of the method format, including a blank copy of the used Braun-Blanquet form. (Appendix 1.).

Additionally the soil has also been checked in the same period, looking for an increase in bare soil. The circumference of each bare soil patch will be measured twice. This has been



Figure 3. Bare soil patch in the meadows.

done in the same periods as the vegetation research. After both periods the data has been compared to see if an existing patch has increased or decreased in size or if new patches have emerged or existing ones have disappeared. GPS location of the patches have also been documented, this has been done using the app Galileo pro.

Furthermore, in Latvia there are more nature reserves where Koniks are being used as natural grazers. Some of these reserves have been visited and compared with the Lielupe floodplain meadows, also some of the living conditions of the Koniks in the other reserves were observed. The reserves that were visited are the “dviētes paliene” in Bebrene and Ķemeri National Park. It should be noted that of these visits, only observations have been made, no researches.

There will also be looked at the well-being of the natural grazers. If this show that the health condition of the herd is lower than it should be during the months of May-July. Than this could point to a food shortage, which is characteristic of overgrazing. To achieve this, there will be made use of the “Welfare Monitoring System” designed by the Livestock Research department of the University of Wageningen. This protocol is based on research of Carrol and Huntington (Body Condition Score system, 1988). Of this protocol only the “Good Feeding, Appropriate behaviour” sections have been looked at, seeing how the other indicators are not related to overgrazing or the meadows in general. A copy of this protocol has been enclosed in appendix two.

All these different factors together can be used to create an overview of the current state of the island. Furthermore, in the discussion there will be a disquisition of the results in order to explain the possible signs of overgrazing that could be found. In addition, possible complication regarding the research will also be explained in the discussion. Finally an overall conclusions will be drawn from the findings of the discussion. The conclusion in turn is used to formulate a recommendation for the future.

### 3. Results

In this chapter the results of the research have been covered. Paragraph 3.1 will cover the vegetation aspects of the investigation, this includes the found plant species and the coverage ratio of the vegetation. This will be displayed on cluster and overall level. Then in paragraph 3.2 there will be look at the bare soil patches that were found in the various clusters and the increase / decrease thereof. This will also be displayed on cluster and overall level. Paragraph 3.3 will show the condition of the koniks in the meadows, this is displayed in well-being and situations scores as shown in the welfare protocol of the Wageningen University (appendix 2). And last in paragraph 3.4 the differences found between other areas in Latvia and the meadows are listed there.

#### 3.1 Vegetation

A total of six clusters has been observed, looking at the vegetation and plant species across the island. The possible increase of vegetation layer growth has been measured, across five count planes for each cluster. Making it a total of thirty count planes of three by three meters. Furthermore of each count plane the plant species that were found have been included. This is documented in a plant species list in 3.1.8

The observation has been done in two periods, once at the start of the research and once at the end. Of each cluster there will be twee tables showing each the total coverage of vegetation of a count plane and the layers of which a plane is constructed. These layers have been predetermined by the Braun-Blanquet method (Appendix 1.). Further is there also a table showing the difference for an overview of the increase or decrease for the cluster.

##### 3.1.1 Cluster A

Cluster A has a size of 8,52 Ha. There is an average increase of 0,4 % of the total vegetation coverage between the two periods. In the shrub layer there was an average increase of 16 %. In the Herb layer there was an average decrease of 12 %. In the moss layer there was an average decrease of 2 %.

| Period 1.                          | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | 95 %           | 70 %          | 90 %          | 98 %          | 100 %         |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Herb Layer (10 cm till 135 cm)     | 100 %          | 80 %          | 100 %         | 90 %          | 100 %         |
| Moss Layer (<10 cm)                | 0 %            | 20 %          | 0 %           | 10 %          | 0 %           |

Table 1. Vegetation observed period 1. Cluster A.

| Period 2.                          | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | 100 %          | 60 %          | 95 %          | 100 %         | 100 %         |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | 0 %            | 0 %           | 10%           | 30 %          | 50 %          |
| Herb Layer (10 cm till 135 cm)     | 100 %          | 100 %         | 90 %          | 70 %          | 50 %          |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |

Table 2. Vegetation observed period 2. Cluster A.

| Difference between periods         | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | + 5 %          | - 10 %        | + 5 %         | + 2 %         | 0 %           |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | 0 %            | 0 %           | + 10%         | +30 %         | +50 %         |
| Herb Layer (10 cm till 135 cm)     | 0 %            | + 20 %        | - 10 %        | -20 %         | -50 %         |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 0 %           | -10 %         | 0 %           |

Table 3. Difference between period 1 & 2 Cluster A.

### 3.1.2 Cluster B

Cluster B has a size of 8,69 Ha. There is an average increase of 21 % of the total vegetation coverage between the two periods. In the shrub layer there was an average increase of 40 %. In the Herb layer there was an average decrease of 36 %.

| Period 1.                          | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | 100 %          | 65 %          | 35 %          | 100 %         | 95 %          |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Herb Layer (10 cm till 135 cm)     | 100 %          | 100 %         | 100 %         | 100 %         | 100 %         |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |

Table 4. Vegetation observed period 1. Cluster B.

| Period 2.                          | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | 100 %          | 100 %         | 100 %         | 100 %         | 100 %         |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | 20 %           | 0 %           | 90%           | 30 %          | 60 %          |
| Herb Layer (10 cm till 135 cm)     | 80 %           | 100 %         | 10 %          | 70 %          | 40 %          |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |

Table 5. Vegetation observed period 2. Cluster B.

| Difference between periods         | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | 0 %            | + 35 %        | + 65 %        | 0 %           | + 5 %         |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | +20 %          | 0 %           | + 90%         | +30 %         | +60 %         |
| Herb Layer (10 cm till 135 cm)     | -20 %          | 0 %           | - 90 %        | -30 %         | -40 %         |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |

Table 6. Difference between period 1 & 2 Cluster B.

### 3.1.3 Cluster C

Cluster C has a size of 24,5 Ha. There is an average increase of 8 % of the total vegetation coverage between the two periods. In the shrub layer there was an average increase of 5 %. In the Herb layer there was an average decrease of 5 %.

| Period 1.                          | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | 95 %           | 80 %          | 100 %         | 85 %          | 100 %         |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 20 %          | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Herb Layer (10 cm till 135 cm)     | 100 %          | 100 %         | 100 %         | 80 %          | 100 %         |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |

Table 7. Vegetation observed period 1. Cluster C.

| Period 2.                          | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | 100 %          | 100 %         | 100 %         | 100 %         | 100 %         |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 20 %          | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | 10 %           | 0 %           | 0 %           | 15 %          | 0 %           |
| Herb Layer (10 cm till 135 cm)     | 90 %           | 100 %         | 100 %         | 65 %          | 100 %         |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |

Table 8. Vegetation observed period 2. Cluster C.

| Difference between periods         | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | +5 %           | + 20 %        | 0 %           | +15 %         | 0 %           |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | +10 %          | 0 %           | 0 %           | +15 %         | 0 %           |
| Herb Layer (10 cm till 135 cm)     | -10 %          | 0 %           | 0 %           | -15 %         | 0 %           |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |

Table 9. Difference between period 1 & 2 Cluster C.

### 3.1.4 Cluster D

Cluster D has a size of 10,6 Ha. There is an average increase of 6 % of the total vegetation coverage between the two periods. In the shrub layer there was an average increase of 4 %. In the Herb layer there was an average decrease of 4 %.

| Period 1.                          | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | 60 %           | 100 %         | 100 %         | 100 %         | 100 %         |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 10 %          | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | 10 %           | 0 %           | 0 %           | 0 %           | 0 %           |
| Herb Layer (10 cm till 135 cm)     | 90 %           | 100 %         | 100 %         | 90 %          | 100 %         |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |

Table 10. Vegetation observed period 1. Cluster D.

| Period 2.                          | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | 90 %           | 100 %         | 100 %         | 100 %         | 100 %         |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 10 %          | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | 20 %           | 0 %           | 0 %           | 10 %          | 0 %           |
| Herb Layer (10 cm till 135 cm)     | 80 %           | 100 %         | 100 %         | 80 %          | 100 %         |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |

Table 11. Vegetation observed period 2. Cluster D.

| Difference between periods         | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | +30 %          | 0 %           | 0 %           | 0 %           | 0 %           |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | +10 %          | 0 %           | 0 %           | +10 %         | 0 %           |
| Herb Layer (10 cm till 135 cm)     | -10 %          | 0 %           | 0 %           | -10 %         | 0 %           |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |

Table 12. Difference between period 1 & 2 Cluster D.

### 3.1.5 Cluster E

Cluster E has a size of 20,1 Ha. There is no average increase or decrease of the total vegetation coverage between the two periods. In the shrub layer there was an average increase of 26 %. In the Herb layer there was an average decrease of 26 %.

| Period 1.                          | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | 70 %           | 95 %          | 95 %          | 95 %          | 95 %          |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Herb Layer (10 cm till 135 cm)     | 100 %          | 100 %         | 100 %         | 100 %         | 100 %         |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |

Table 13. Vegetation observed period 1. Cluster E.

| Period 2.                          | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | 80 %           | 100 %         | 100 %         | 70 %          | 100 %         |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | 50 %           | 0 %           | 80 %          | 0 %           | 0 %           |
| Herb Layer (10 cm till 135 cm)     | 50 %           | 100 %         | 20 %          | 100 %         | 100 %         |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |

Table 14. Vegetation observed period 2. Cluster E.

| Difference between periods         | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | +10 %          | +5 %          | +5 %          | -25 %         | +5 %          |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | +50 %          | 0 %           | +80 %         | 0 %           | 0 %           |
| Herb Layer (10 cm till 135 cm)     | -50 %          | 0 %           | -80 %         | 0 %           | 0 %           |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |

Table 15. Difference between period 1 & 2 Cluster E.

### 3.1.6 Cluster F

Cluster F has a size of 7,66 Ha. There is an average increase of 5 % of the total vegetation coverage between the two periods. In the shrub layer there was an average increase of 3 %. In the Herb layer there was an average decrease of 4 %. In the moss layer there was an average decrease of 1 %.

| Period 1.                          | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | 80 %           | 90 %          | 95 %          | 90 %          | 100 %         |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 30 %          | 0 %           | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Herb Layer (10 cm till 135 cm)     | 100 %          | 100 %         | 70 %          | 100 %         | 100 %         |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |

Table 16. Vegetation observed period 1. Cluster F.

| Period 2.                          | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | 100 %          | 100 %         | 100 %         | 95 %          | 100 %         |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 30 %          | 0 %           | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | 10 %           | 0 %           | 5 %           | 0 %           | 0 %           |
| Herb Layer (10 cm till 135 cm)     | 90 %           | 100 %         | 60 %          | 100 %         | 100 %         |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | 5 %           | 0 %           | 0 %           |

Table 17. Vegetation observed period 2. Cluster F.

| Difference between periods         | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------------------------|----------------|---------------|---------------|---------------|---------------|
| Total vegetation coverage          | +10 %          | +5 %          | +5 %          | +5 %          | 0 %           |
| Consisting of the following layers |                |               |               |               |               |
| Tree Layer (>800 cm)               | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Shrub Layer (135 cm till 800 cm)   | +10 %          | 0 %           | +5 %          | 0 %           | 0 %           |
| Herb Layer (10 cm till 135 cm)     | -10 %          | 0 %           | -10 %         | 0 %           | 0 %           |
| Moss Layer (<10 cm)                | 0 %            | 0 %           | +5 %          | 0 %           | 0 %           |

Table 18. Difference between period 1 & 2 Cluster F.

### 3.1.7 Overview

From all the clusters, there is a determined average of the difference between the two periods, shown in the tables below. This is done for each layer and the total vegetation coverage.

| Total vegetation | Count plane 1. | Count plane 2 | Count plane 3  | Count plane 4 | Count plane 5 |
|------------------|----------------|---------------|----------------|---------------|---------------|
| Cluster A.       | + 5 %          | - 10 %        | + 5 %          | + 2 %         | 0 %           |
| Cluster B.       | 0 %            | + 35 %        | + 65 %         | 0 %           | + 5 %         |
| Cluster C.       | +5 %           | + 20 %        | 0 %            | +15 %         | 0 %           |
| Cluster D.       | +30 %          | 0 %           | 0 %            | 0 %           | 0 %           |
| Cluster E.       | +10 %          | +5 %          | +5 %           | -25 %         | +5 %          |
| Cluster F.       | +10 %          | +5 %          | +5 %           | +5 %          | 0 %           |
| <b>Average</b>   | <b>+10,00%</b> | <b>+9,17%</b> | <b>+13,33%</b> | <b>-0,50%</b> | <b>+1,67%</b> |

Table 19. Overview of the total vegetation coverage

| Total tree layer | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------|----------------|---------------|---------------|---------------|---------------|
| Cluster A.       | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Cluster B.       | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Cluster C.       | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Cluster D.       | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Cluster E.       | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Cluster F.       | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| <b>Average</b>   | <b>0 %</b>     | <b>0 %</b>    | <b>0 %</b>    | <b>0 %</b>    | <b>0 %</b>    |

Table 20. Overview of all the tree layers

| Total shrub layer | Count plane 1.  | Count plane 2 | Count plane 3  | Count plane 4   | Count plane 5   |
|-------------------|-----------------|---------------|----------------|-----------------|-----------------|
| Cluster A.        | 0 %             | 0 %           | + 10%          | +30 %           | +50 %           |
| Cluster B.        | +20 %           | 0 %           | + 90%          | +30 %           | +60 %           |
| Cluster C.        | +10 %           | 0 %           | 0 %            | +15 %           | 0 %             |
| Cluster D.        | +10 %           | 0 %           | 0 %            | 0 %             | 0 %             |
| Cluster E.        | +50 %           | 0 %           | +80 %          | 0 %             | 0 %             |
| Cluster F.        | +10 %           | 0 %           | +5 %           | 0 %             | 0 %             |
| <b>Average</b>    | <b>+16,67 %</b> | <b>0 %</b>    | <b>+30,83%</b> | <b>+12,50 %</b> | <b>+18,33 %</b> |

Table 21. Overview of all the shrub layers

| Total herb layer | Count plane 1.  | Count plane 2  | Count plane 3   | Count plane 4   | Count plane 5   |
|------------------|-----------------|----------------|-----------------|-----------------|-----------------|
| Cluster A.       | 0 %             | + 20 %         | - 10 %          | -20 %           | -50 %           |
| Cluster B.       | -20 %           | 0 %            | - 90 %          | -30 %           | -40 %           |
| Cluster C.       | -10 %           | 0 %            | 0 %             | -15 %           | 0 %             |
| Cluster D.       | -10 %           | 0 %            | 0 %             | -10 %           | 0 %             |
| Cluster E.       | -50 %           | 0 %            | -80 %           | 0 %             | 0 %             |
| Cluster F.       | -10 %           | 0 %            | -10 %           | 0 %             | 0 %             |
| <b>Average</b>   | <b>-16,67 %</b> | <b>+3,33 %</b> | <b>-31,67 %</b> | <b>-12,50 %</b> | <b>-15,00 %</b> |

Table 22. Overview of all the herb layers

| Total moss layer | Count plane 1. | Count plane 2 | Count plane 3 | Count plane 4 | Count plane 5 |
|------------------|----------------|---------------|---------------|---------------|---------------|
| Cluster A.       | 0 %            | 0 %           | 0 %           | -10 %         | 0 %           |
| Cluster B.       | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Cluster C.       | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Cluster D.       | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Cluster E.       | 0 %            | 0 %           | 0 %           | 0 %           | 0 %           |
| Cluster F.       | 0 %            | 0 %           | +5 %          | 0 %           | 0 %           |
| <b>Average</b>   | 0 %            | 0 %           | +0,83 %       | -1,67 %       | 0 %           |

Table 23. Overview of all the moss layers

### 3.1.8 Plant species list

During the two periods the found plant species in the count planes have been noted in this section. Given from each species is its scientific name. Any comments concerning a species are found behind the scientific name in the table.

| Plant scientific name               | Comments                                                                                                            |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------|
| <b><i>Anthriscus sylvestris</i></b> |                                                                                                                     |
| <b><i>Glechoma hederacea</i></b>    |                                                                                                                     |
| <b><i>Primula veris</i></b>         | This plant has about 500 species (Wikipedia, 2015), the suspicion goes to the <i>veris</i> but it may be incorrect. |
| <b><i>Taraxacum officinale</i></b>  |                                                                                                                     |
| <b><i>Urtica dioica</i></b>         |                                                                                                                     |
| <b><i>Phragmites australis</i></b>  |                                                                                                                     |
| <b><i>Plantago</i></b>              | Of this plant no exact species could be determined.                                                                 |
| <b><i>Juncus</i></b>                | Of this plant no exact species could be determined.                                                                 |
| <b><i>Filipendula ulmaria</i></b>   |                                                                                                                     |
| <b><i>Trifolium repens</i></b>      |                                                                                                                     |
| <b><i>Trifolium pratense</i></b>    |                                                                                                                     |
| <b><i>Bellis perennis</i></b>       |                                                                                                                     |
| <b><i>Lamium album</i></b>          |                                                                                                                     |
| <b><i>Lamium</i></b>                | Possible species are: <i>purpureum</i> , <i>maculatum</i> , <i>amplexicaul.</i>                                     |
| <b><i>Salix alba</i></b>            |                                                                                                                     |
| <b><i>Geranium columbinum</i></b>   |                                                                                                                     |
| <b><i>Geum rivale</i></b>           |                                                                                                                     |
| <b><i>Tulipa sylvestris</i></b>     |                                                                                                                     |
| <b><i>Marsh Helleborine</i></b>     |                                                                                                                     |
| <b><i>Dactylorhiza maculata</i></b> |                                                                                                                     |

Table 24. All of the found plant species

### 3.2 Bare Soil

A total of six clusters have been mapped out looking for bare soil patches. This has been done in two periods, once at the start of the research and once at the end. Of each cluster there will be an overview of the increase or decrease of a patch. Also there will be a map of each cluster with GPS locations of the patches. The percentages have been calculated by using the following equations:

$$\text{Circumference} = 2 * R * \pi \rightarrow R = \text{Circumference} / 2 * \pi$$

$$\text{Surface} = \pi * (1/2 * \pi)^2 * \text{Circumference}^2 \rightarrow \text{Surface} = \pi * 1/4 * \pi^2 * \text{Circumference}^2$$

$$\text{Surface} = \text{Circumference}^2 / 4 * \pi$$

Using this equation the total surface of bare soil per period could be calculated. Then using google maps of each cluster the size could be measured in hectares. Then with those hectares being set to m<sup>2</sup> the total surface of each cluster could be calculated. With both surfaces the percentage could be calculated with the following equation:

$$\text{Total bare soil surface} * 100 / \text{Total surface cluster} = \text{Percentage bare soil}$$

#### 3.2.1 Cluster A

In Cluster A a total of four bare soil patches were found. Cluster A has a size of 8,52 Ha. Most of the bare soil patches found in this cluster, were used by the horses as spots to roll around in. Some coastal patches were also being used by local fisherman.

In total between the two periods a decrease of 2,14 meters has been measured. Further of the 85.200 m<sup>2</sup> in period one only 0,15 percent of it is bare soil. In period two only 0,13 percent of area was bare soil. The exact findings are documented in table 25.



Figure 4. Bare soil patch locations. Cluster A.

| Bare Soil Patches - GPS     | Period 1 - Circumference | Period 2 - Circumference | Difference       |
|-----------------------------|--------------------------|--------------------------|------------------|
| 1. +56.663056, +23.725556   | 8,54 (m)                 | 7,00 (m)                 | -1,54 (m)        |
| 2. +56.660833, +23.725556   | 9,50 (m)                 | 9,21 (m)                 | -0,29 (m)        |
| 3. +56.660556, +23.726111   | 10,95 (m)                | 11,23 (m)                | +0,28 (m)        |
| 4. +56.661111, +23.728611   | 11,20 (m)                | 10,61 (m)                | -0,59 (m)        |
| <b>Total bare soil area</b> | <b>40,19 (m)</b>         | <b>38,05 (m)</b>         | <b>-2,14 (m)</b> |

Table 25. Cluster A. Bare soil patches

### 3.2.2 Cluster B

In Cluster B a total of five bare soil patches were found. Cluster B has a size of 8,69 Ha. Most of the bare soil patches found at the south side of this cluster, were completely overgrown by vegetation during period 2. This has been measured as a 100 % decrease.

In total between the two periods a decrease of 12,08 meters has been measured. Further of the 86.900 m<sup>2</sup> in period one only 0.077 percent of it is bare soil. In period two only 0.026 percent of area was bare soil. The exact finding are documented in table 26.



Figure 5. Bare soil patch locations. Cluster B

| Bare Soil Patches - GPS     | Period 1 - Circumference | Period 2 - Circumference | Difference        |
|-----------------------------|--------------------------|--------------------------|-------------------|
| 1. +56.665278, +23.720278   | 3,90 (m)                 | 1,12 (m)                 | -2,78 (m)         |
| 2. +56.663889, +23.723056   | 4,61 (m)                 | 0,00 (m)                 | -4,61 (m)         |
| 3. +56.663889, +23.723333   | 5,12 (m)                 | 0,00 (m)                 | -5,12 (m)         |
| 4. +56.665833, +23.721111   | 7,55 (m)                 | 7,42 (m)                 | -0,13 (m)         |
| 5. +56.666309, +23.720341   | 7,83 (m)                 | 8,39 (m)                 | +0,56 (m)         |
| <b>Total bare soil area</b> | <b>29,01 (m)</b>         | <b>16,93 (m)</b>         | <b>-12,08 (m)</b> |

Table 26. Cluster B. Bare soil patches

### 3.2.3 Cluster C

In Cluster C a total of seven bare soil patches were found. Cluster C has a size of 24,5 Ha. The bare soil patch found in the middle of this cluster, were completely overgrown by vegetation during period 2. This has been measured as a 100 % decrease. The other bare soil patches were found mostly around the coast or the paths leading across the island. The coastal areas were also frequently used by local fisherman.

In total between the two periods a decrease of 24,88 meters has been measured. Further of the 245.000 m<sup>2</sup> in period one only 0,092 percent of it is bare soil. In period two only 0,026 percent of area was bare soil. The exact finding are documented in table 27.

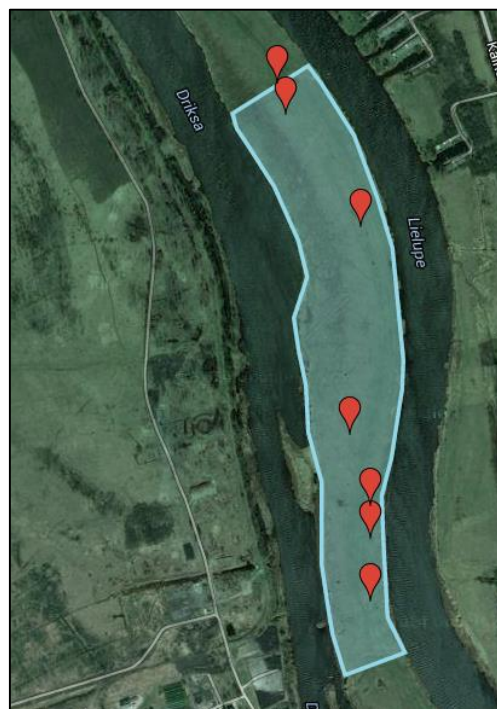


Figure 6. Bare soil patch locations. Cluster C

| Bare Soil Patches - GPS     | Period 1 - Circumference | Period 2 - Circumference | Difference        |
|-----------------------------|--------------------------|--------------------------|-------------------|
| 1. +56.668312 , +23.718817  | 9,32 (m)                 | 3,73 (m)                 | -5,59 (m)         |
| 2. +56.669518 , +23.718817  | 6,90 (m)                 | 5,25 (m)                 | -1,65 (m)         |
| 3. +56.670155 , +23.718796  | 10,21 (m)                | 3,46 (m)                 | -6,75 (m)         |
| 4. +56.671555 , +23.718053  | 6,30 (m)                 | 0,00 (m)                 | -6,30 (m)         |
| 5. +56.675613 , +23.718473  | 4,26 (m)                 | 2,23 (m)                 | -2,03 (m)         |
| 6. +56.677795 , +23.715771  | 10,75 (m)                | 9,81 (m)                 | -0,94 (m)         |
| 7. +56.678570 , +23.715492  | 5,62 (m)                 | 4,00 (m)                 | -1,62 (m)         |
| <b>Total bare soil area</b> | <b>53,36 (m)</b>         | <b>28,48 (m)</b>         | <b>-24,88 (m)</b> |

Table 27. Cluster C. Bare soil patches

### 3.2.4 Cluster D

In Cluster D a total of four bare soil patches were found. Cluster D has a size of 10,6 Ha. Most of the bare soil patches found at the south side of this cluster.

In total between the two periods a decrease of 0,78 meters has been measured. Further of the 106.000 m<sup>2</sup> in period one only 0,043 percent of it is bare soil. In period two only 0,041 percent of area was bare soil. The exact findings are documented in table 28.



Figure 7. Bare soil patch locations. Cluster D

| Bare Soil Patches - GPS     | Period 1 - Circumference | Period 2 - Circumference | Difference       |
|-----------------------------|--------------------------|--------------------------|------------------|
| 1. +56.678513 , +23.715492  | 5,81 (m)                 | 4,80 (m)                 | -1,01 (m)        |
| 2. +56.678745 , +23.715857  | 11,69 (m)                | 10,21 (m)                | -1,48 (m)        |
| 3. +56.679420 , +23.714119  | 3,13 (m)                 | 3,73 (m)                 | +0,60 (m)        |
| 4. +56.679737 , +23.713539  | 3,60 (m)                 | 4,61 (m)                 | +1,01 (m)        |
| <b>Total bare soil area</b> | <b>24,13 (m)</b>         | <b>23,35 (m)</b>         | <b>-0,78 (m)</b> |

Table 28. Cluster D. Bare soil patches

### 3.2.5 Cluster E

In Cluster E a total of three bare soil patches were found. Cluster E has a size of 20,1 Ha. This cluster unlike the other clusters consisted out of 2 biotopes. Most of the bare soil patches were found at the south side of this cluster, in a grassland.

In total between the two periods an increase of 1,54 meters has been measured. Further of the 201.000 m<sup>2</sup> in period one only 0,015 percent of it is bare soil. In period two only 0,017 percent of area was bare soil. The exact findings are documented in table 29.



Figure 8. Bare soil patch locations. Cluster E

| Bare Soil Patches - GPS     | Period 1 - Circumference | Period 2 - Circumference | Difference       |
|-----------------------------|--------------------------|--------------------------|------------------|
| 1. +56.659599 , +23.724976  | 6,64 (m)                 | 5,54 (m)                 | -1,10 (m)        |
| 2. +56.658466 , +23.726391  | 10,11 (m)                | 11,80 (m)                | +1,69 (m)        |
| 3. +56.662596 , +23.722704  | 2,47 (m)                 | 3,42 (m)                 | +0,95 (m)        |
| <b>Total bare soil area</b> | <b>19,22 (m)</b>         | <b>20,76 (m)</b>         | <b>+1,54 (m)</b> |

Table 29. Cluster E. Bare soil patches

### 3.2.6 Cluster F

In Cluster F a total of three bare soil patches were found. Cluster F has a size of 7,66 Ha. This cluster unlike the other clusters consisted out of 2 biotopes. Most of the bare soil patches were found at the south side of this cluster, in a grassland.

In total between the two periods an increase of 7,76 meters has been measured. Further of the 76.600 m<sup>2</sup> in period one only 0,019 percent of it is bare soil. In period two only  $3,52 \cdot 10^{-3}$  percent of area was bare soil. The exact findings are documented in table 30.

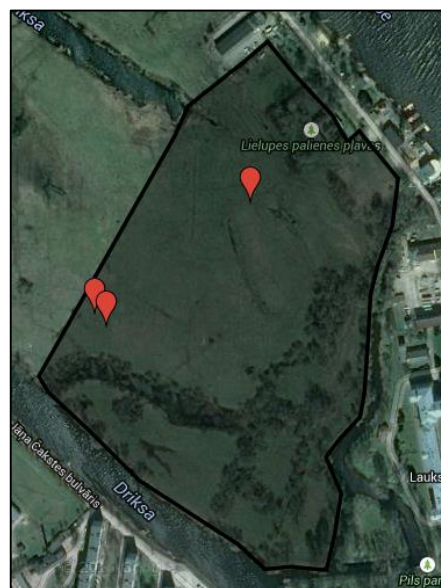


Figure 9. Bare soil patch locations. Cluster F

| Bare Soil Patches - GPS     | Period 1 - Circumference | Period 2 - Circumference | Difference       |
|-----------------------------|--------------------------|--------------------------|------------------|
| 1. +56.658241 , +23.729005  | 5,52 (m)                 | 2,51 (m)                 | -3,01 (m)        |
| 2. +56.657108 , +23.726145  | 4,39 (m)                 | 1,94 (m)                 | -2,45 (m)        |
| 3. +56.656982 , +23.726355  | 3,67 (m)                 | 1,37 (m)                 | -2,30 (m)        |
| <b>Total bare soil area</b> | <b>13,58 (m)</b>         | <b>5,82 (m)</b>          | <b>-7,76 (m)</b> |

Table 30. Cluster F. Bare soil patches

### 3.2.7 Overview

Of all the clusters the totals have been taken and determined the total decrease over the entire island.

| Cluster                     | Period 1 - Circumference | Period 2 - Circumference | Difference |
|-----------------------------|--------------------------|--------------------------|------------|
| A                           | 40,19 (m)                | 38,05 (m)                | -2,14 (m)  |
| B                           | 29,01 (m)                | 16,93 (m)                | -12,08 (m) |
| C                           | 53,36 (m)                | 28,48 (m)                | -24,88 (m) |
| D                           | 24,13 (m)                | 23,35 (m)                | -0,78 (m)  |
| E                           | 19,22 (m)                | 20,76 (m)                | +1,54 (m)  |
| F                           | 13,58 (m)                | 5,82 (m)                 | -7,76 (m)  |
|                             |                          |                          |            |
| <b>Total bare soil area</b> | 179,49 (m)               | 133,39 (m)               | -46,10 (m) |

Table 31. Total overview of all the clusters

Furthermore all the percentage per period have been calculated. Using these percentage there can be calculated how much percent of bare soil there is on the Island.

| Cluster                 | Period 1 - Percentage | Period 2 - Percentage   |
|-------------------------|-----------------------|-------------------------|
| A                       | 0,150 %               | 0,130 %                 |
| B                       | 0,077 %               | 0,026 %                 |
| C                       | 0,092 %               | 0,026 %                 |
| D                       | 0,043 %               | 0,041 %                 |
| E                       | 0,015 %               | 0,017 %                 |
| F                       | 0,019 %               | $3,52 \cdot 10^{-3} \%$ |
|                         |                       |                         |
| <b>Total percentage</b> | 0,40%                 | 0,24%                   |

Table 32. Total overview of all the clusters in percentage.

### 3.3 Horse condition

Of the 62 examined Konik horses there are seven young foals excluded. This is because determining the well-being of a young foal is very difficult because the foal still has to grow a lot and the fact that newly born foals are always weaker than older foals and adult horses. So only 55 horses, their well-being has been determined. The information below shows various well-being scores & well-being situations by taking the number of horses that were found with the appropriate score based on the well-being protocol of the Wageningen University (appendix 2). The feeding scores have been determined by the criteria of absence of prolonged hunger & absence of prolonged thirst.

#### 3.3.1 Feeding scores

The hunger situation has been measured by giving every horse a body condition score. With 0 as very poor and 5 with very fat.

| Score         | Amount of horses | Percentage of herd |
|---------------|------------------|--------------------|
| 0 – Very poor | 0                | 0 %                |
| 1 – poor      | 0                | 0 %                |
| 2 – Moderate  | 4                | 7,27 %             |
| 3 – Good      | 49               | 89,10 %            |
| 4 – Fat       | 2                | 3,63 %             |
| 5 – Very fat  | 0                | 0 %                |

Table 33. Body condition scores and percentage

Then there is also the feed intake of the herd. The herd has availability ad libitum (24 hours a day) of only grass and roughage without supplements. This puts the herd in situation A of the protocol.

#### 3.3.2 Thirst Score

The herd has free access to the entire meadows including the water provision. They have the availability of clean drinkable water 24 hours a day. Meaning that the herd falls under situation F.

### 3.4 Other areas in Latvia

During this research other nature park around Latvia have been visited. All these parks make use of the natural grazing with Konik horses. The parks that have been visited are Dvīetes palīne in Bebrene (3.4.1) and Ķemeri National Park (3.4.2).

*Disclaimer: the information in this section is based on observations alone. Most of the following found patterns haven't been researched or analysed. But are important to include in the conclusion and consideration of this research. Because it has value on a national level and on natural grazing as a whole.*

### 3.4.1 Bebrene - Dvietes paliene

Dvietes paliene in Bebrene (3.4.1) and Ķemeri National Park (3.4.2). Dvietes paliene in Bebrene (3.4.1) and Ķemeri National Park (3.4.2). Dvietes paliene in Bebrene (3.4.1) and Ķemeri National Park (3.4.2). The Nature Park is around 5000 ha of which 600 ha is intended for natural grazing. Of this area 300 ha is actual graze able (communication: J. van der Veen, 2015). In this area live around 150 Konik horses this means that there is 1.5 per ha graze able land per horse available is. Also living in this nature park is a cattle, around 120 cows.

Regarding the well-being of the horses in this park, there are no irregularities discovered or major differences with the herd. The well-being is around the same as the herd of the meadows. One exception are the foals. The foals in Bebrene show much stronger than the foals of the meadows. Presumably the foals here have been born earlier than those of the meadows.



Figure 10. A herd from Dvietes paliene.

Vegetation in Dvietes paliene is similar to the floodplain meadows, the vegetation coverage on the other hand is a lot thinner than the meadows.

### 3.4.2 Ķemeri National Park

The nature park is around 40.000 ha of which only the meadows in the park are intended for natural grazing (Dabas aizsardzības pārvalde, 2015) which is around 300 ha. In this area live around 70 Konik horses, this means that there is 4,2 per graze able land per horse available. Also living in this nature park is cattle. An exact number of cattle in this moment of time is unknown but 2013 the amount of cattle was 40 (V. Korpa , I. Strazdina, 2013).

Regarding the well-being of the horses in this park, there are no irregularities discovered or major differences with the herd. The well-being is around the same as the herd of the meadows. The foals were looking the same as the foals of the meadows. Presumably these foals have been born around the same time as the ones of the meadows.

Vegetation in Ķemeri is slightly different than that of the floodplain meadows. The meadows of Ķemeri have on first sight more aquatic plant species than meadows of Jelgava. The vegetation coverage is around the same.

## 4. Discussion

This chapter discusses various aspects of the research. In paragraph 4.1 the result have been compared with results & analysis from literature and previous researches. Paragraph 4.2 will answer the research the sub-questions of 1.2. Furthermore paragraph 4.3 will discuss the limits and constraints of this research.

### 4.1 Exposition of the results

In this section each of the aspect of the research will be analysed and studied to achieve an answer for the research questions.

#### 4.1.1 Vegetation

The results of table 19 till 23 show that the overall vegetation coverage has increased over all the count planes per each cluster. One exception is count plane 4 but this is mostly because of cluster E. the reason behind this occurrence will be addressed in a later chapter. Another thing that's noticeable, is the fact that there is an increase in the shrub layer and a decrease in the herb layer. This means that overall there is an increase in vegetation, but the existing vegetation from period 1 has grown so much that around period 2, it fell under the shrub layer.

#### 4.1.2 Bare Soil

The results of table 31 & 32 show that of the 70 ha of the meadows only 0,40 % was bare soil during period 1. This even decrease around period 2 to 0,24 %. thus a decrease of 0,16 % . This was a difference of roughly 46,10 meters of bare soil. This also means that there isn't an increase in bare soil or bare soil patches during the two periods. This is a sign that there is no overgrazing, if it was then the bare soil should increase instead of decreasing.

It should be noted that in Cluster E. an increase was detected. This can be explained by the fact that this early spring it rained a lot and the water levels were high. Around the time summer began, most of the water retreated, leaving behind some bare areas. It is to be expected that over time these areas will regrow.

#### 4.1.3 Well-being

What is above all clear when looking at tables 33 is the fact that 90% of the herd have a good well-being. Regarding the 7 %, that's below that, can be explained due to the fact that it was a cold spring, meaning that a lot of vegetation wasn't growing till the end of May 2015. Furthermore the herd falls into a good situation regarding their food coverage and availability to quench their thirst. However, it should be noted that this well-being is only representative of this time of writing, more information regarding this can be read in chapter 4.3.2.

### 4.2 Sub-questions

#### **What is the current situation of the vegetation on the meadows?**

The current situation of the meadows is good, there are little signs of overgrazing and only increases in vegetation and decreases in bare soil have been measured. This means the amount of horses as of now (62 horses) are not the threshold of the meadows. It is possible to make an approximation for the number of possible horses, which the area can sustain. Most of the time there needs to be 3ha graze able land per horse, this way the horse can survive the entire year without extra feeding. However, when considering extra feeding in winters, which is almost a given in Latvia (communication: van der Veen. J, 2015), the amount of graze able land per horse lowers to 1 ha / 1,5 ha depending on the land and grazing rotation(FREE Nature, 2013). This means without winter feeding around 24 horses can live on the island. With winter feeding around 70-65 horses can live on

the island. It should be noted that the horses are being fed extra feeding in winters (communication: Nordmanis. E, 2015).

This amount is only based on literature, and can always differ in practice. In reality, there can be more or less horses possible, this depends on the situation in the meadows.

#### **What is the health condition of the natural grazers on the meadows?**

The condition of the horses is to be considered good. They are not overfed or underfed. There are no signs that there is a shortage in food. The horses that are now to fight will presumably lose this during the winter. The two horses that were found with score two, were two females who just had there foals, this could be the reason why these two horses were slightly in a rougher state.

#### **Is there a variation in vegetation in other areas in Latvia where the koniks have been released?**

Two other places then, the Floodplain meadows have been visited. The Dvietes paliene in Bebrene and Kemeru National Park. Most of the vegetation species are the same in these areas. Regarding the vegetation coverage on the hand, there are more changes. In Dvietes is the vegetation much lower. Where on the Floodplain meadows, most of the vegetation reaches the shrub layer. In Dvietes most vegetation only reaches the herb layer. One thing should be noted in both areas (Kemeru & Dvietes), the tree layer is significantly more present than on Jelgava. This is explained by the fact that in both areas are close to forests and bigger places to roam around in.

### **4.3 Impediments and limitations**

This paragraph discusses the limits and constraints of this research. This involves problems which counteracted the progress of the research. These Impediments and limitations have affected the quality of this research.

#### **4.3.1 Time / Timeframe**

Time is within this research an important factor. Mainly for the implementation of the research, but also for the time in which this research takes place. An example for this is the time that was used on visiting other areas in Latvia. There was not enough time to research these areas more in-depth than how it's done now.

Regarding the time to conduct this research refers to the fact of what kind of research this is. As this is a snapshot of the state of the meadows. To make sure what the precise state of the meadows is and whether overgrazing can occur there should actually be a research where the meadows would be observed for several years, in the same time periods. This way, a more representative image of the state of the meadows can be determined and whether it is or is not overgrazed can also be determined more accurately.

#### **4.3.2 Animal Well-being**

The monitoring for the well-being of the horses that has been done for this research should be considered a snapshot. Further assumed in this protocol is the fact of a homogeneous group of mares and geldings only because animals that are kept often are held in sex and age classes, and not in family groups like in the wild. An example of how this can be avoided is from the Dutch Oostvaardersplassen. Oostvaardersplassen selects individuals to monitor by dividing the area into a certain amount of count planes and measure all the animals in these planes at random. This way a certain amount of individuals would be chosen instead of determining a number by age or sex. (Beheeradviescommissie Oostvaardersplassen, 2014)

So to measure a precise scientific assessment of animal welfare a much bigger research should be considered. It might be preferable to monitor individuals over time and over the years to be able to say something about their well-being throughout their lives, but these kind of researches are often too expensive and time-consuming.

## 5. Conclusion

During this research is investigated what the effects are of natural grazing on the Lielupe floodplain meadows and the grazers. Furthermore, there has also been looked at the support base for the amount of Konik horses that the island can sustain.

From this research it has been found that the meadows are not overgrazed. During two time periods (May-July) there was only an increase in vegetation. Furthermore, there was not an increase in bare soil found in the same period. The total bare soil area decreased by 0,16 percent. Further, there are no irregularities discovered with regard to the well-being and the situation of the herd. 90 percent of the herd is in good health, just a mere 10 percent of the herd is slightly fat. This is not a problem, seeing as most of the horses lose a lot of weight during winters.

Regarding the support base of the amount of Konik horses, it should be taken into account that the herd of the floodplain meadows receives extra feeding in winters. This affects the amount of graze able ha per horse that is needed. With winter feeding the amount of ha per horse is one ha or one and a half ha. This difference depends on certain factors, namely: The fertility of the soil and the feeding rotation of the herd (this means that the vegetation has time to regrow). Knowing this and the amount of land available for the herd, it could be determined how many horses should be considered for the island. That amount is around 65-70 depending on the factors as named above.

## 6. Recommendations

Based on the exposition of the results and overall observations some recommendations have been made. In providing these recommendations the potential costs and benefits have been taken into account.

### 6.1 Further research

It will be a good thing for the meadows to be examined each year within the same period as this study. This will create an even clearer picture for the support of the area with each passing year. Furthermore, will this root some of the problems of this research because instead of a snapshot you will create an image over a certain time course. This will give a more detailed image of the horse well-being, plant species and the distribution of the different types of plants.

Another possible research which could assist with overgrazing. Is a research dedicated to the habitat use of the Konik horses. This kind of studies have been done in other areas with konik horses and proved very successful. This gives a lot of insight into how horses behave within an area and how they interact with the area. This can be fed back to overgrazing. If there is more knowledge about the herds you can use this to influence the herd making the support base more flexible.

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### Images, figures and tables

- Cover Image, Latvijas Ornitoloģijas biedrība, 2013
- Figure 1,2,4,5,6,7,8,9: Google Maps engine,2014
- Rest of the figures and image by auteur.

## 8. Appendix

**I. Braun-Blanquet Method.**

|                                 |           |                               |
|---------------------------------|-----------|-------------------------------|
|                                 | Record.nr |                               |
| Place:                          | GPS:      |                               |
| Surface                         |           |                               |
| Description of the count plane: | code      | aantal individuen             |
|                                 | R         | (1-2)                         |
|                                 | +         | Little (tot. 20)              |
|                                 | 1         | Numerous (20 - 100),          |
|                                 | 2m        | Very numerous (more than 100) |
|                                 | 2a        | Very numerous (more than 100) |
|                                 | 2b        | Very numerous (more than 100) |
|                                 | 3         | Random                        |
|                                 | 4         | Random                        |
|                                 | 5         | Random                        |
|                                 | coverage  |                               |
|                                 |           |                               |
| Total Coverage                  |           | %                             |
| Tree layer                      |           | %                             |
| Shrub layer                     |           | %                             |
| Herb layer                      |           | %                             |
| Moss layer                      |           | %                             |
| Species                         | Code      | Possible remarks              |
|                                 |           |                               |
|                                 |           |                               |
|                                 |           |                               |
|                                 |           |                               |

## II. Well-being Protocol – University of Wageningen.

### PART A

### Measures that fit into the Welfare Quality® classification

Table 1. Classification of animal- and environment based parameters for horses according to the Welfare Quality® system

| Principle                    |    | Welfare criteria                                | Animal-based measure                                                                                                                                                                                 | Management/resource -based measure                                                                                                               |
|------------------------------|----|-------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Good feeding</b>          | 1  | Absence of prolonged hunger                     | Body Condition Score, wear pattern incisors                                                                                                                                                          | Feed intake (roughage/concentrates, interval (time) forage/roughage intake, height concentrates trough, order roughage-concentrates), inspection |
|                              | 2  | Absence of prolonged thirst                     | <i>As yet, no animal based measure has been developed</i>                                                                                                                                            | Water provision (cleanliness, functioning, availability)                                                                                         |
| <b>Good housing</b>          | 3  | Comfort around resting                          | <i>As yet, no animal based measure has been developed</i>                                                                                                                                            | Comfort around resting (noise around box, clean and dry lying area, bedding)                                                                     |
|                              | 4  | Thermal comfort                                 | <i>As yet, no animal based measure has been developed</i>                                                                                                                                            | Climate (temperature, humidity, ventilation, ammonia in the box; shelter)                                                                        |
|                              | 5  | Ease of movement                                | <i>As yet, no animal based measure has been developed</i>                                                                                                                                            | Ease of movement (area per horse in relation to its withers' height, space in paddock/pasture)                                                   |
| <b>Good health</b>           | 6  | Absence of skin lesions and wounds              | Patches of white hairs, wounds, swollen legs, length whiskers, hoof condition, lameness                                                                                                              | Safety (public and horse area) in terms of risk of slipping, sprain/stumbling/ tripping, injuring at protrusions or crevices, bumping.           |
|                              | 7  | Absence of disease                              | Breathing, coughing, nasal discharge, skin irritation lower legs, generalized skin problem, rubbed and broken hairs mane and tail, coat condition, itchiness, ocular discharge, Body Condition Score | <i>As yet, no environment based measure has been developed</i>                                                                                   |
|                              | 8  | Absence of discomfort caused by use             | Back muscles, mouth corners, bars                                                                                                                                                                    | <i>As yet, no environment based measure has been developed</i>                                                                                   |
| <b>Appropriate behaviour</b> | 9  | Expression of social behaviours                 | <i>As yet, no animal based measure has been developed</i>                                                                                                                                            | Possibilities for social contact                                                                                                                 |
|                              | 10 | Expression of other, species-specific behaviour | Wear incisors, abnormal behaviour                                                                                                                                                                    | <i>As yet, no environment based measure has been developed</i>                                                                                   |
|                              | 11 | Good human-animal relationship                  | <i>As yet, no animal based measure has been developed</i>                                                                                                                                            | <i>As yet, no environment based measure has been developed</i>                                                                                   |
|                              | 12 | Positive emotional state                        | <i>As yet, no animal based measure has been developed</i>                                                                                                                                            | Possibilities for providing visual horizon                                                                                                       |

## 1. Good Feeding

### 1.1. Absence of prolonged hunger

| Title              | Poor Body Condition                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Scope              | Animal based parameter                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Method description | <p>Assess the horse without a rug, at a sufficiently lit space, where it is safe to walk around the horse.</p> <ol style="list-style-type: none"><li>1. Approach the horse quietly from the front, comfort the horse and start with a general inspection from the side of the horse</li><li>2. Visually assess the fat/muscle covering the ribs, neck, shoulder, back, abdomen and hindquarters</li><li>3. If the ribs are not visible approach the horse and palpate the ribs</li><li>4. Stand at a safe distance behind the horse and assess the fat reservoirs/deposits around the tail bone/caudal vertebra of the horse, assess the shape of the croup, the visibility of the spine and hip bone</li></ol> <p>Use the Body Condition Score system of Carrol and Huntington (1988) with a scale from 0 (very poor) to 5 (very fat). This system is used for all breeds and all purposes of use. Only for broodmares use the custom made system (Carol and Huntington, 1988).</p> <p><i>Exception</i><br/>For this measure only assess horses that are (too) poor or moderate (score 0, 1, 2) and/or normal (score 3). Horses that are (too) thick/fat/overweight (score 4 and 5) are scored at a separate measure.</p> |
| Classification     | <p><b>0</b> – Very poor<br/><b>1</b> – Poor<br/><b>2</b> – Moderate<br/><b>3</b> – Good</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |



Score 1



Score 2

**BCS system for all horses, exception broodmares**

## 0 Very poor

### ***Pelvis***

Angular, skin tight  
Very sunken rump  
Deep cavity under tail

### ***Back and ribs***

Skin tight over ribs  
Very prominent and sharp backbone

### ***Neck***

Marked ewe neck  
Narrow and slack at base

## 1 Poor

### ***Pelvis***

Prominent pelvis and croup  
Sunken rump but skin supple  
Deep cavity under tail

### ***Back and ribs***

Ribs easily visible  
Prominent backbone with skin sunken on either side

### ***Neck***

Ewe neck, narrow and slack at base

## 2 Moderate

### ***Pelvis***

Rump flat either side of backbone  
Croup well-defined, some fat  
Slight cavity under tail

### ***Back and ribs***

Ribs just visible  
Backbone covered but spines can be felt

### ***Neck***

Narrow but firm

## 3 Good

### ***Pelvis***

Covered by fat and rounded  
No gutter  
Pelvis easily felt

### ***Back and ribs***

Ribs just covered and easily felt  
No gutter along back  
Backbone well covered but spines can be felt

### ***Neck***

No crest (except for stallions) firm neck

## 4 Fat

### ***Pelvis***

Gutter to root of tail  
Pelvis covered by soft fat  
Need firm pressure to feel

### ***Back and ribs***

Ribs well covered – need pressure to feel

### ***Neck***

Slight crest  
Wide and firm

## 5 Very fat

### ***Pelvis***

Deep gutter to root of tail  
Skin dispended  
Pelvis buried, cannot be felt

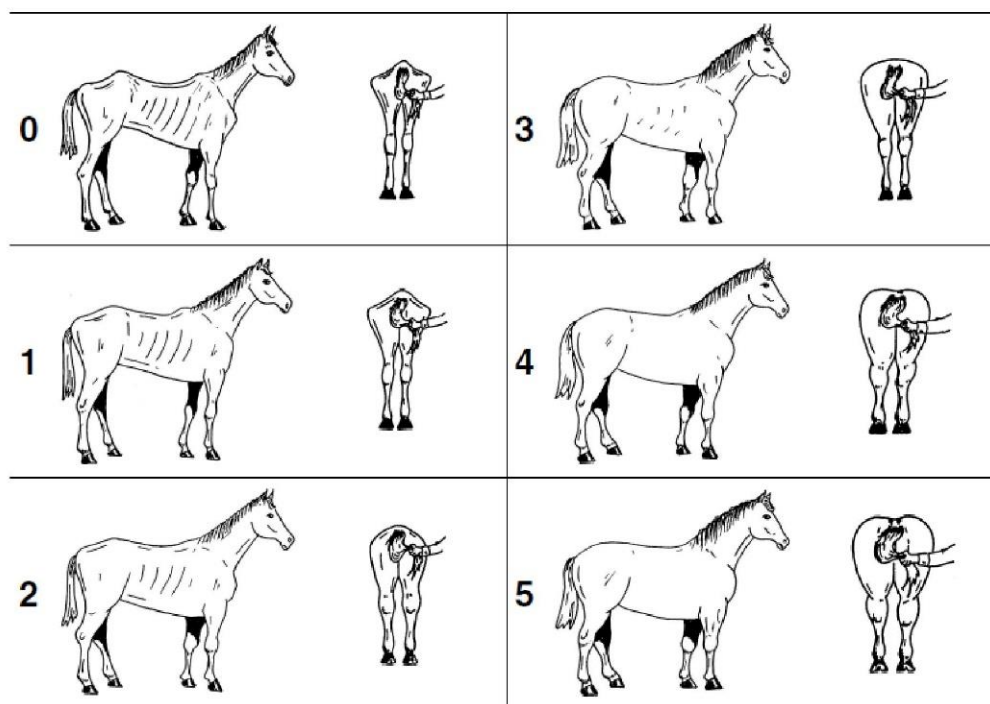
### ***Back and ribs***

Ribs buried, cannot be felt  
Deep gutter along back  
Back broad and flat

### ***Neck***

Marked crest  
Very wide and firm  
Folds of fat

### BCS system broodmares



| <b>Condition</b>   | <b>Neck</b>                                                             | <b>Withers</b>                                      | <b>Back &amp; Loin</b>                                                              | <b>Ribs</b>                                | <b>Hind Quarters</b>              |
|--------------------|-------------------------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------|-----------------------------------|
| <b>0 very poor</b> | Bone structure easily felt<br>no muscle shelf where neck meets shoulder | bone structure easily felt                          | 3 points of vertebrae easily felt                                                   | each rib can be easily felt                | tailhead and hip bones projecting |
| <b>1 poor</b>      | can feel bone structure<br>slight shelf where neck meets shoulder       | can feel bone structure                             | spinous process can be easily felt<br>transverse processes have slight fat covering | slight fat covering, but can still be felt | can feel hip bones                |
| <b>2 moderate</b>  | fat covering over bone structure                                        | fat deposits over withers dependent on conformation | fat over spinous processes                                                          | can't see ribs, but ribs can still be felt | hip bones covered with fat        |
| <b>3 good</b>      | neck flows smoothly into shoulder                                       | neck rounds over withers                            | back is level                                                                       | layer of fat over ribs                     | can't feel hip bones              |
| <b>4 fat</b>       | fat deposited along neck                                                | fat padded around withers                           | positive crease along back                                                          | fat spongy over and between ribs           | can't feel hip bones              |
| <b>5 very fat</b>  | bulging fat                                                             | bulging fat                                         | deep positive crease                                                                | pockets of fat                             | pockets of fat                    |

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Title</b>              | <b>Wear pattern incisors: feed intake</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Scope</b>              | Animal based measure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Method description</b> | <p>Check for abnormal wear of the incisors possibly negatively affecting feed intake.</p> <ul style="list-style-type: none"> <li>• Comfort the horse</li> <li>• Gently spread the upper and lower lips from each other</li> <li>• Assess the position of the incisors relative to each other</li> </ul> <p>Indicate for each of the following types of irregularities and/or abnormalities if there is evidence for it or not.</p> <ol style="list-style-type: none"> <li>1. overbite (parrot mouth) or underbite (sow mouth) where grinding surfaces do not make contact</li> <li>2. smile, smirk, diagonal curvature</li> </ol> <p><i>Exception</i><br/>The abnormal wear of incisors that is characteristic for crib-biting (from outside to inside; 'from lips to cavity') should be recorded at another measure.</p> |
| <b>Classification</b>     | <p><b>0</b> — No evidence of abnormal wear pattern of this type</p> <p><b>1</b> — Evidence of abnormal wear pattern of this type</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |



Type 1, score 1



Type 2, score 1



Type 2, score 1

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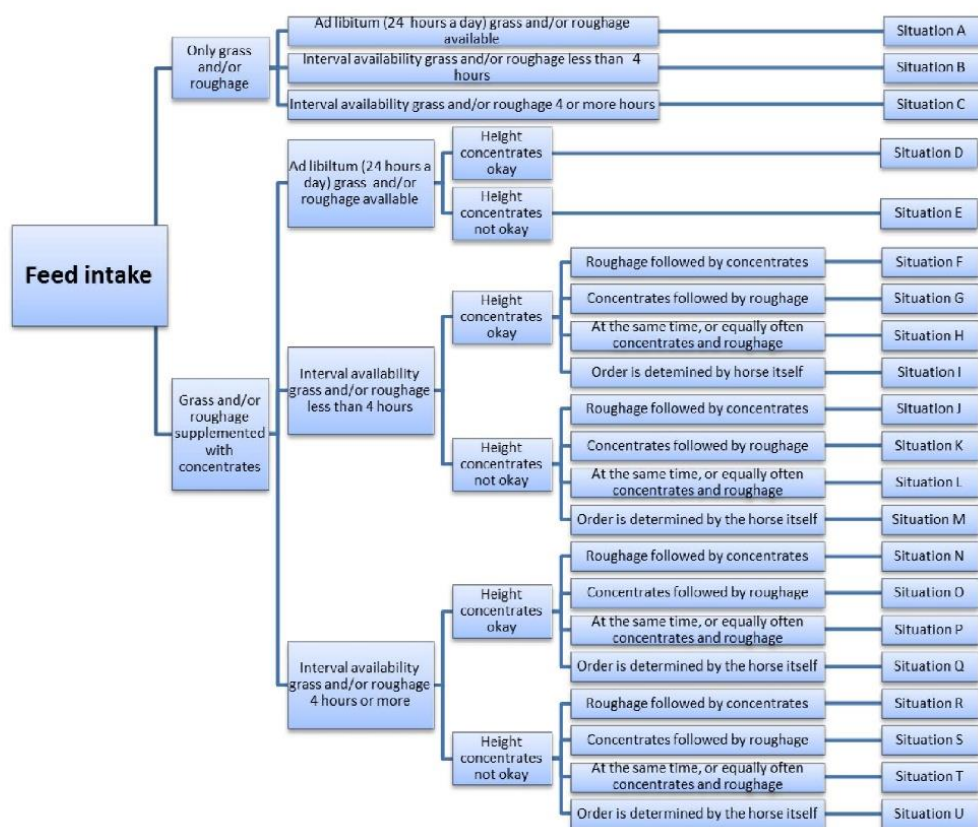
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|                           |                                                                                                                                                            |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Title</b>              | <b>Inspection horse teeth</b>                                                                                                                              |
| <b>Scope</b>              | Environment based measure                                                                                                                                  |
| <b>Description method</b> | Ask if, and if so, with what frequency the horse teeth are being inspected by an equine dental technician or veterinarian.                                 |
| <b>Classification</b>     | <p><b>0</b> — At least once a year</p> <p><b>1</b> — Less than once a year</p> <p><b>2</b> — No inspection by equine dental technician or veterinarian</p> |

|                           |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Title</b>              | <b>Feed intake</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Scope</b>              | Environment based measure                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <b>Description method</b> | <p>Follow the decision tree feed intake taking into account the following points and determine which situation is most applicable for this horse</p> <ol style="list-style-type: none"> <li>1. Determine if the horse is fed only roughage or roughage and concentrates</li> <li>2. Determine if roughage (exclusive straw bedding) or grass is available ad libitum (24 hours a day) or if there is an interval (more or less than 4 hours) between the availability to eat roughage or grass</li> </ol> |

3. If the horse is fed concentrates assess the height of the feed trough (the height is okay if the highest point of the feed trough is equal or lower in relation to the horse's onset of the neck).
4. If the horse is fed both roughage and concentrates determine the order in which roughage and concentrates are given:
  - a. First roughage, followed by concentrates
  - b. First concentrates, followed by roughage
  - c. Simultaneously fed roughage and concentrates or equally often fed roughage followed by concentrates and vice versa
  - d. Horse determines the order itself (for example hit active stables).

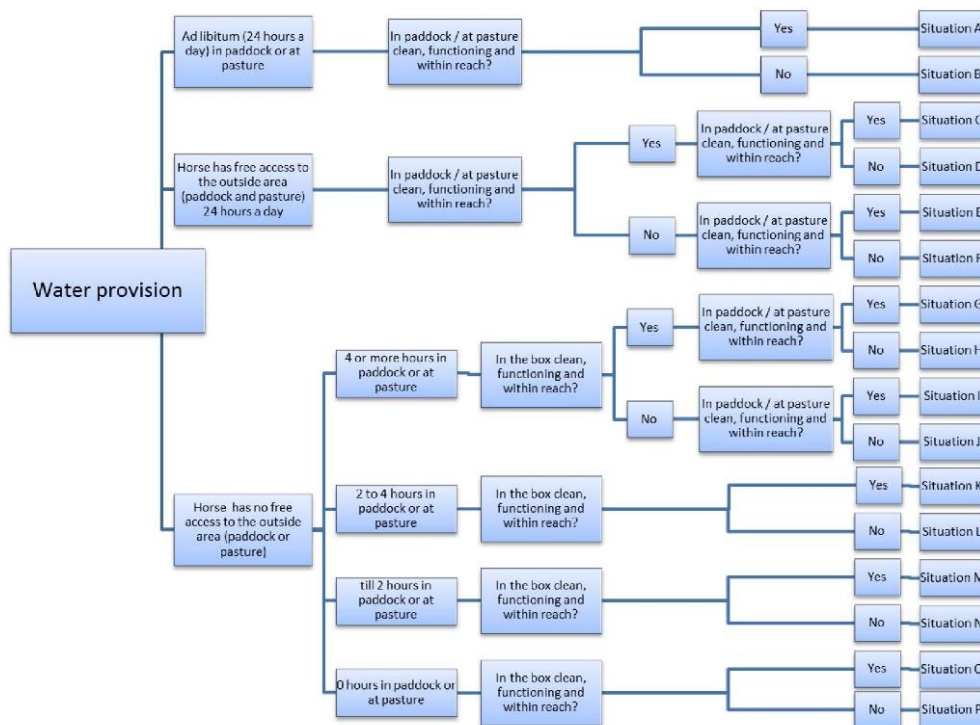


|                |                                                                 |
|----------------|-----------------------------------------------------------------|
| Classification | Classify the horse in one of the 21 possible (A – U) situations |
|----------------|-----------------------------------------------------------------|

## 1.2. Absence of prolonged thirst

| Title              | Water provision                                                                                                                                                                                                                                                                                                                                                                                                            |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Scope              | Environment based measure                                                                                                                                                                                                                                                                                                                                                                                                  |
| Description method | <p>Follow the decision tree water provision taking into account the following points and determine which situation is most applicable for this horse</p> <ol style="list-style-type: none"> <li>1. Determine the possibilities of access to pasture/paddock</li> <li>2. If the horse is not free to move inside and outside ask how many hours a day the horse is put outside (pasture/paddock) at this moment:</li> </ol> |

- 0 hours
  - up to 2 hours
  - 2 to 4 hours
  - over 4 hours
3. For the horses which stay not outside 24 hours a day determine if the water provision in the box
- is functioning
  - is within reach (highest point not higher than the onset of the neck)
  - if the water is clean (clear and does not smell)
- If one of these points can be answered with *no*, choose *no* in the decision tree
4. For the horses which are put outside for more than 4 hours a day determine if the water provision at pasture/paddock is:
- is functioning
  - is within reach (highest point not higher than the onset of the neck, not too steep, not frozen etc.)
  - if the water is clean (clear and does not smell)
- If one of these points can be answered with *no*, choose *no* in the decision tree.



Classification

Classify the horse in one of the 16 (A – P) possible situations