



RESEARCH REPORT REV 8.1

PROJECT APPLICATION DEVELOPMENT - Inholland
University of Applied Science

Abstract

This research report explores the development of an application that results from a possible solution, to a problem taken from an existing ecological system, by using a mathematical model to show the predicted effects of the proposed measure on the ecosystem.

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1. Introduction

Mathematical engineering is based on developing application models for making predictions and find desirable solutions to real-life problematic situations. While working towards the development of an application, one comes across several challenges which fluctuates the approach of development. Challenges can be encountered when determining the model of the application, due to the observation and collection of data which is relevant to use as variables in a mathematical formula. Thus, parameters are going to be divided into categories such as the essential and trivial factors, then later implemented to improve the model. Therefore, due to the level of complexity that the model may hold it is mandatory to not only implement an application which gives as an output statistical numbers but visuals as well, such as graphs.

1.1. Context

Oostvaardersplassen, a persevered ecological system, which has many animals living there including the main three large herbivores: wild horses, wild cattle, and deer; and other foremost species such as geese and birds of prey. Conjecting that no major predators are present in the ecological system and the herbivores prohibited migration, unbalance has been settled in the Oostvaardersplassen preservation.

Complicating the situation is the fact that there are a lot of geese, particularly during winter, and they consume the same type of food as the large herbivores do. The competition and interact between the herbivores and the geese for food can be quite severe, leading some to extreme situations such as death.

1.2. Purpose

The purpose of this project is to work towards a possible solution of a problem taken from an existing ecological system, Oostvaardersplassen. Based on a mathematical model for the system and an application doing the number crunching to graphically illustrate the predicted effects of the proposed measures on the ecosystem.

2. Central research question and sub-questions

2.1. Research question

Main Research Question of the project:

What will happen to the populations of deer, cattle, horse and geese if releasing a number of foxes in the preserve (with the number of foxes being the free variable).

Main Research Question for this research paper:

How do the herbivores and the geese compete for the grass in an enclosed area?

2.2. Research sub-questions

Sub-Research Questions for this research paper:

1. What is the rate of grass consumption of each animal?
2. How do animal populations change as a result of grass availability?
3. What are the populations of each animal?
4. What is the start data and what do we know from historical data?
5. Which existing mathematical models can fit to our problem?
6. How can we implement what is being asked?

3. Research Methodology

The methodology explored in this project reflects the competition for food, taking place between herbivores and geese, in an enclosed ecosystem, Oostvaardersplassen. By means of collecting data and modeling equation based on the data, the research will then attempt to provide an accurate prediction based on fluctuating data. The **Data collection** is based on the information found on the Website of Oostvaardersplassen^{1,1}, which is related to the numbers of herbivores and geese during different seasons, the amount of grass they eat, death rate and any other related data.

The **Equation research** is mostly focused on the equations of the grass growth. The research conducted to find equations is based on literature^{2,2}. Transforming grass amount into actual weight so comparison can be made to the amount of food the herbivores and geese are eating.

Once the data collection process and equation research will be finalized, the creation of the application model will begin. By creating class models of UML ¹will help to visualize how the application will look like and what it should do. As soon as, the UML model for the application will be completed the focus then turns to the back-end work, implemented using Java. After having the engine and the whole map of the Oostvaardersplassen in program, the application will then display in a GUI², by JavaFX³.

During the project development several limitations may occur, that could harm the final result of the application. Some of those **Limitations** for this research are the time frame which project needs to be finished. The information availability constraints which might be lacking data or not accurate at all. Another challenge is the interdependence on the other group that is investigating relating variable. This research is limited scope to Oostvaardersplassen.

¹UML – Unified Modeling Language is a general-purpose, developmental, modeling language in the field of software engineering, which intends to provide a standard way to visualize the design of a system.

² GUI – Graphical User Interface is a type of user interface that allows users to interact with electronic devices through graphical icons and visual indicators such as secondary notation, instead of text-based user interfaces, typed command labels or text navigation.

³ JavaFX - software platform for creating and delivering desktop applications, intended as the standard use of GUI library for Java.

The **first sub-question** is getting the information about the grass consumption of each animal. The way in which the answer to this question will be given, is by researching about the amount of grass each of the animals in Oostvaardersplassen needS in order to continue living. There is a lot of information about herbivores and geese grass consumption on the internet, however only the most similar specie of each animal of Oostvaardersplassen will be chosen, then take the figures found and implement it in the application.

In order to answer the **second sub-question**, research needs to be done about what is the formula that most fit the situation, in order to know how the availability of grass would affect the animals that are there. This information exists in the ecology book that was given as a reference.

The way in which the **third sub-question** will be answered, is by getting the existing numbers of Oostvaardersplassen herbivores and geese from the given information that was received and the information that is on Oostvaardersplassen website. Afterwards the process of implementation of those figures in the application will begin, so that the outcome would be as accurate as it can be.

In order to show the **fourth sub-question**, historical data of Oostvaardersplassen need to be accessed. There is a given website that can give all that information in graphs and actual numbers. The starting data would be the latest figures that are available in 2016, this would be the actual information that is going to be used as the starting data.

In the **fifth sub-question**, figures what mathematical models would fit the problem, deduced from the received ecology book which contains all the formulas that can be related to the problem. Research about that book and figure needs to be conducted in order to know which of the existing formulas will help with the calculation, in the best way and most accurate.

In order to implement all the information that is collected, for the **sixth sub-question** the use of Java and JavaFX will be needed. In order to show the graphs and the outcome based on the input that will be given.

The moment all those sub-questions can answered, the answer to the main research question will come into view, and the application would be ready for use.

4. Results

5. Conclusion

6. Recommendations

7. Bibliographies

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8. Appendices