Developing healthy and green residential areas

An analysis into the health benefits of greenery and nature

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Preface

I'm proud to present to you the final graduation thesis of the Master Management of the Build Environment of the Technical University of Delft. For this thesis research has been performed about the health benefits of nature. The goal was to determine if there is a correlation between the health of the population of The Netherlands and the quality of the nature in the area. This research sets itself apart by dividing nature into different landscapes and examining the quality of those individually. The quality of the different areas in The Netherlands will be determined by the living locations of selected birds. This research will build upon the already existing research into the relation between nature and health. Hopefully the findings from this research into the effects per landscape and the overall effect of biodiversity will present interesting results and will contribute to the overall knowledge.

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This document is partly inspired by my love of nature. For as long as I can remember I have been fascinated by all types of vegetation. I enjoy spending time in the small forest near the place where I live. I am amazed by the field of grass that characterizes the Dutch landscape. Also it is a privilege that the dunes and the sea are only 30 minutes away. During my study at the TUDelft there have been love could be expressed. This was mostly during architectural assignments. However, this is the first moment where I could combine my idea that cities could be improved with nature and my love for the management of urban areas.

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Summary

Introduction

At the start of the 20th century 48% of the available land was covered by forests. For wild grasslands and shrubs this percentage was 27%. A little more than a century later the amount of forest has been reduced by 10% and the amount for wild grasslands and shrubs has been reduced by 13%. During the period between 1900 and 2000 the amount of biodiversity in The Netherlands was reduced from 40% to 15%. The area in The Netherlands that has experienced the largest reduction of biodiversity is the urban area in the west of The Netherlands called the Randstad. The reduced space is used to increase the amount of land for crops and most importantly meat production. Forests, grassland, and shrubs are complex ecosystems where a variety of organisms live. This biodiversity is essential since the reason that these organisms can coexist is because they depend on each other to receive the resources that they require. Farmland focuses on one type of landscape with one function. Thus provides a habitat for only a select number of organisms. This has led to a worldwide reduction of the quality of the biodiversity with as a result the risk of losing a million different species (WWF,2020).

The Netherlands is not an exception to this global crisis. As explained before biodiversity was reduced massively. This reduction was the reason that the Dutch government has made the goal to increase the quality of nature in The Netherlands. The Dutch Ministry of Health in cooperation with the United Nations has already made a large amount of progress in this aspect with the TEEB calculator. However, the TEEB calculator has its shortcomings. Mostly that this calculation does not work optimal in urban areas like cities. A reason for this could be that a stroke of greenery can have a different function in the suburbs than in a city. A second shortcoming of this calculator is that to calculate the contribution of greenery and nature on the mental health the square meter of an area is used. This means that areas with a lower quality of nature are calculated equal to areas with a higher quality. This is insufficient because multiple studies have shown that there is a difference in the type of greenery and its effect on the human conditions.

Problem definition

There is currently an insufficient amount of information regarding the relation between nature and the diverse types of landscapes and the quality of nature. Due to this lack of information, it is impossible to create area programs that fully benefit from the positive effects. As a result, municipal workers and developers create the limited amount of nature required, regardless of the needs of the surrounding area. This reduces the biodiversity in The Netherlands even further while municipalities and the national government should increase the overall biodiversity of the country. By continuing this practice any positive health benefits for the local inhabitants are withheld.

This problem has led to the following research goal:

To search for a relation between the landscape and the quality of nature and human health in The Netherlands.

The main hypothesis of this research document that will be proven or disproven is: Diverse types of nature positively influences the health of the people living in The Netherlands.

The hypothesis consists of multiple aspects that need to be answered in order to answer the main hypothesis. These aspects are:

The amount of biodiversity has a positive influence on the health of the inhabitants of The Netherlands.

There is a difference between landscapes and the amount of positive effect on the health of the inhabitants of The Netherlands.

Landscapes which predominantly consist of greenspaces have a larger positive effect on the overall health than areas without greenery.

The main relevance of this study is related to planners, designers and Teeb. With a broader understanding of the positive effects of nature, planners could use this to create urban plans that fully utilize this effect.

Designers could use this research to gain a more in-depth knowledge about what kind of habitats need to be created in urban areas. It invites architects and designers to think about the needs of the ecosystems surrounding and in the urban area and adapt their strategy accordingly. It was previously mentioned before that Teeb has its shortcomings. With the knowledge provided by this research or the research that are inspired from this study the Teeb calculator could become more refined.

Purpose
The overall purpose of this paper is to stimulate the development of green areas or redesign existing ones. This has led to the following research goal:

Theoretical framework

Benefits of Nature and greenery
This research builds upon the multiple studies that searched for the influence of greenery on the wellbeing of people. Starting from the research by Roger Ulrich in 1984. In urban areas where the inhabitants have access to green spaces, the number of people who visit the doctor is lower than in areas that lack this access (Maas,2008). Living in areas with more nature than in urban areas reduces the risk of certain deceases. Among the list of diseases are coronary heart disease, depression, back and neck pain, diabetes, migraine and respiratory diseases (KPMG,2012). The most considerable influence of nature on the wellbeing of people is on mental health. Subjects were reported to have reduced amount of stress, increased amount of patience. increased amount of self-discipline, increased capacity for attention, increased recovery from mental fatigue or crisis and from psychophysiological imbalance (Russel et al, 2013).

Indicator species
This study relies heavily on the use of indicator species to generate quantifiable data. It is important to identify the indicator species that are going to be used to access a certain area. The following criteria are important for the selection of an indicator species.

1. The research questions should be able to be answered by monitoring the indicator species.
2. The aspect that the indicator species provide information about should be known beforehand. It should also be able to provide this information or else its assistance into answering the research question is limited.
3. The use of indicator species should preferably be used in combination with the right experimental control.
4. The use of the indicator species should not exceed a predetermined budget.
5. The impact of the indicator species on the decision-making process needs to be taken into account when selecting the right species.

Methodology

Data collection

<u>Data on the general health</u>
The Dutch department of public health, public wellbeing and sport is the ministry responsible for monitoring the health of the population. The observation size consists of three distinct levels. The first one categorizes the data on a provincial level, the second is on a district level and the last one on a neighbourhood level. included in the analysis are physical activities, weight, smoking, physical health, fear and depression, stress, and loneliness.

<u>Data on the indicator species</u>
The success of this study stands and falls with the data on the indicator species. The data serves two purposes. At first the data on the indicator species is used to determine the landscape. Secondly the data is used to determine the quality of the surrounding nature. There is no such thing as one landscape

and not all nature has the same quality in The Netherlands. To determine both the type of landscape and the quality of that type of nature the habits of birds will be analysed. The data concerning the different landscapes is retrieved from the document called *Hotspots of biodiversity in The Netherlands* based on the data of breeding birds. This document is created by SOVON. The data concerning the quality of nature is found by locating the indicator species presented by the government document called *natura 2000*. The location of the indicator species is found on the website of SOVON.

Transformation of the available data

In this part the process of creating the maps necessary to determine the quality of nature is discussed. The first phase consists of collecting the maps provided by SOVON indicating the areas that can be categorized as a certain landscape. The second phase is using those maps in combination with the location of the indicator species to create maps that shows the amount of indicator species in an area.

Grading the biodiversity of the different areas in The Netherlands

This part will explain the process of grading the nature in a location. For this task, the use of a computer program that would allow for different maps to be placed on top of each other is essential. This would allow the indicator maps to be shown on top of the maps showing the neighbourhoods. At first a municipality is chosen from the list of municipalities and neighbourhoods of The Netherlands. Secondly the location of the municipality is found with the use of Google Maps. After having found the location on Google Maps it is possible to locate the position on the map of the neighbourhoods of The Netherlands. If a neighbourhood is found the different layers can be turned on showing the amount of indicator species for that neighbourhood. The amount of indicator species is counted and placed in an Excel file.

Performing the analysis

In the previous part all the required information was gathered. In this part both the analysis's are performed. The first analysis is a mixed model analysis and is used to determine if there is a significant relation between the amount of biodiversity in an area and the health of the residents. Beside a significance relation the effect and the R-squared is calculated. An effect size between 0,5 and 0,8 would indicate a medium effect. Lastly, a number between 0,8 and 1,4 would indicate a large effect. An R-squared below 1,0% is not taken into consideration since the effect is not relevant. The second analysis is a generalized linear mixed model and is used to determine if a relation can be found between the aspects of health and the biodiversity score. This score is based on the amount of indicator species per landscape.

Validation

An important aspect of the analysis is validation. A simple check can be performed on the amount of skewness and the amount of kurtosis of the data. Generally, if the kurtosis and skewness is above 1,5 and lower than -1,5 additional measures have to be taken in order to create valid results. In this research the amount of kurtosis and skewness is low. However, there are some aspects of health with a score that exceeds the desired amount of 1,5 and -1,5. During the analysis it might become apparent that the skewness and kurtosis deform the results of the data. When this happens, a bootstrap can be performed in order to create a mean that has a larger reliability.

Results

This part of the document focusses on the results that are generated from the analysis's. First the results from the mixed model analysis are presented. The second part will present the results of the generalized linear mixed model. Both parts are divided by the various aspects of health. Smoking, Obesity and urbanisation are used in this analyses as the control group. Since the relationship between these variables is already well established.

Overall health

Mixed Model:

Health RIVM

	Sig.
Smoking	0,000
Obesity	0,000
Urbanisation	0.000
Heath, raised moor and shifting sand	0,002
Open agricultural area	0,937
Beaches	0,130
Half open and closed agricultural area	0,233
Dunes	0,202
Forest	<0,001
Swamp	0,608

a. Dependent Variable: Health RIVM

This test indicates that the following landscapes have a significant relation with the overall health: heath, raised moor and shifting sand and forest.

Smoking

Mixed Model:

Smoking RIVM

	Sig.
Smoking	0,000
Obesity	
Urbanisation	<0,001
Heath, raised moor and shifting sand	<0,001
Open agricultural area	<0,001
Beaches	0,004
Half open and closed agricultural area	<0,001
Dunes	<0,001
Forest	<0,001
Swamp	0,034

a. Dependent Variable: Smoking RIVM

This test indicates that there is a significant relation between the amount of smokers and the following landscapes: heath, raised moor and shifting sand, Open agricultural areas, beaches, Half open and closed agricultural areas, dunes, forests and swamps.

Obesity

Mixed Model:

Obesity RIVM

	Sig.
Smoking	0,000
Obesity	
Urbanisation	<0,001
Heath, raised moor and shifting sand	<0,001
Open agricultural area	<0,001
Beaches	0,004
Half open and closed agricultural area	<0,001
Dunes	<0,001
Forest	<0,001
Swamp	0,034

a. Dependent Variable: Obesity RIVM

This test indicates that there is a significant relation between the percentage of people suffering from obesity and the following landscapes: heath, raised moor and shifting sand, Open agricultural areas, beaches, Half open and closed agricultural areas, dunes, forests and swamps.

Morbid obesity

Mixed Model:

Morbid Obesity RIVM

	Sig.
Smoking	0,000
Obesity	0,000
Urbanisation	<0,001
Heath, raised moor and shifting sand	0,014
Open agricultural area	0,007
Beaches	0,024
Half open and closed agricultural area	<0,001
Dunes	<0,001
Forest	0,148
Swamp	0,006

a. Dependent Variable: Obesity Morbid RIVM

This test indicates that there is a significant relation between the percentage of people suffering from morbid obesity and the following landscapes: heath, raised moor and shifting sand, Open agricultural areas, beaches, Half open and closed agricultural areas, dunes and swamps.

Chronic physical conditions

Mixed Model:

Chronic conditions

	Sig.
Smoking	0,288
Obesity	0,000
Urbanisation	0,000
Heath, raised moor and shifting sand	<0,001
Open agricultural area	0,455
Beaches	0,024
Half open and closed agricultural area	0,072
Dunes	<0,001
Forest	<0,001
Swamp	0,840

a. Dependent Variable: Physical Health Cron RIVM

This test indicates that there is a significant relation between the percentage of people suffering from Chronic physical health conditions and the following landscapes: heath, raised moor and shifting sand, beaches, dunes, forests and swamps.

Medium risk of fear and/or depression

Mixed Model:

Medium Risk

	Sig.
Smoking	0,000
Obesity	<0,001
Urbanisation	<0,001
Heath, raised moor and shifting sand	0,026
Open agricultural area	0,040
Beaches	<0,001
Half open and closed agricultural area	0,024
Dunes	0,254
Forest	0,010
Swamp	0,492

a. Dependent Variable: Fear Depression Medium Risk RIVM

This test indicates that there is a significant relation between the percentage of people with a medium risk of fear and/or depression and the following landscapes: heath, raised moor and shifting sand, Open agricultural areas, beaches, Half open and closed agricultural areas and forest.

High risk of fear and/or depression

Mixed Model:

High Risk

	Sig.
Smoking	0,000
Obesity	0,000
Urbanisation	<0,001
Heath, raised moor and shifting sand	0,101
Open agricultural area	0,265
Beaches	<0,001
Half open and closed agricultural area	0,139
Dunes	0,034
Forest	0,079
Swamp	0,375

a. Dependent Variable: Fear Depression High Risk RIVM

This test indicates that there is a significant relation between the percentage of people with a high risk of fear and/or depression and the following landscape: beaches and dunes.

Loneliness

Mixed Model:

Loneliness

	Sig.
Smoking	0,000
Obesity	0,000
Urbanisation	<0,001
Heath, raised moor and shifting sand	0,007
Open agricultural area	0,045
Beaches	<0,001
Half open and closed agricultural area	0,696
Dunes	0,978
Forest	0,016
Swamp	0,241

a. Dependent Variable: Loneliness RIVM

This test indicates that there is a significant relation between the percentage of people suffering from loneliness and the following landscapes: heath, raised moor and shifting sand, Open agricultural areas, beaches and forests.

Severe loneliness

Mixed Model:

Severe Loneliness

	Sig.
Smoking	0,000
Obesity	0,000
Urbanisation	<0,001
Heath, raised moor and shifting sand	0,009
Open agricultural area	0,025
Beaches	<0,001
Half open and closed agricultural area	0,540
Dunes	0,268
Forest	0,004
Swamp	0,511

a. Dependent Variable: Loneliness Severe RIVM

This test indicates that there is a significant relation between the percentage of people suffering from severe loneliness and the following landscapes: heath, raised moor and shifting sand, Open agricultural areas, beaches and forest.

Stress

Mixed Model:

Stress

	Sig.
Smoking	0,000
Obesity	<0,001
Urbanisation	<0,001
Heath, raised moor and shifting sand	0,042
Open agricultural area	0,003
Beaches	<0,001
Half open and closed agricultural area	0,003
Dunes	0,115
Forest	0,407
Swamp	0,074

a. Dependent Variable: Stress RIVM

This test indicates that there is a significant relation between the percentage of people suffering from stress and the following landscapes: heath, raised moor and shifting sand, Open agricultural areas, beaches and half open en closed agricultural areas.

Meeting the standard of physical activities

Mixed Model:

Exercise Norm RIVM

	Sig.
Smoking	<0,001
Obesity	0,000
Urbanisation	<0,001
Heath, raised moor and shifting sand	0,066
Open agricultural area	0,199
Beaches	0,010
Half open and closed agricultural area	0,037
Dunes	<0,001
Forest	0,247
Swamp	0,480

a. Dependent Variable: Exercise Norm RIVM

This test indicates that there is a significant relation between the percentage of people who exercise the advised amount by the RIVM and the following landscapes: beaches and dunes.

Calculating the R-squared

In the first part of this analysis the areas and the amount of indicator species who share a significant relation with each other were formulated. This research will count an effect as valid if the R-square has a value of one percent or higher. The reason for this is an increase in the health of one percent of the population would mean that it possibly benefits many people.

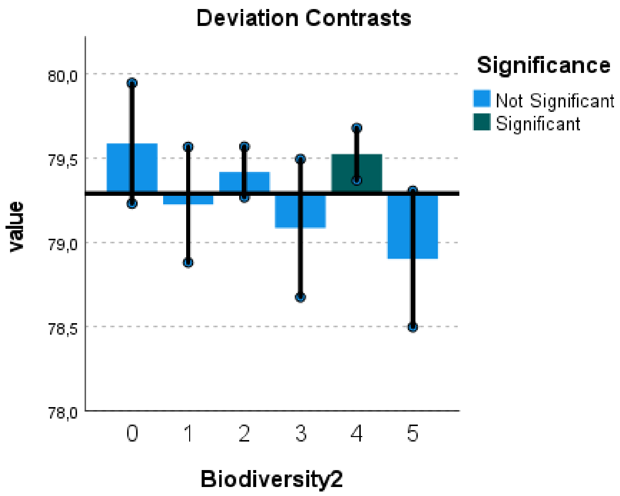
Summary of the results of the mixed model analysis

In the analysis presented above shows three findings. First, the areas that have a significant relation to the aspects of health were formulated. Secondly, the effect size of these areas was calculated. Thirdly, the R-squared was calculated which shows the proportion of the dependable variable that can be explained by the independent variable. This has shown that not all the findings have a significant effect. It could be that an area has a significant effect which means that there is a high chance that the areas influences the aspects of health. However, if the effect is not relevant that particular area will not be taken into further considerations

Aspect of health	Landscape	R-squared	Effect of the area	Number of indicators species	Effected number of indicator species	Size of the effect
Smoking	Half open and/or closed agricultural	1,3%	Positive	one	Without this landscape or without any indicator species	small
Obesity	Open agricultural	1,8%	Negative	one	Without this landscape or without any indicator species	small
			Negative	two	Without this landscape or without any indicator species	small
			Negative	three	Without this landscape or without any indicator species	medium
	Half open and/or closed agricultural	1,3%	Negative	one	Without this landscape or without any indicator species	small
	Forests	1,0%	Positive	one	Without this landscape or without any indicator species	small
			Positive	two	Without this landscape or without any indicator species	small
			Positive	three	Without this landscape or without any indicator species	medium
Medium risk of fear and/or depression	Forests	2,4%	Negative	one	Without this landscape or without any indicator species	small
			Positive	Two	One	small

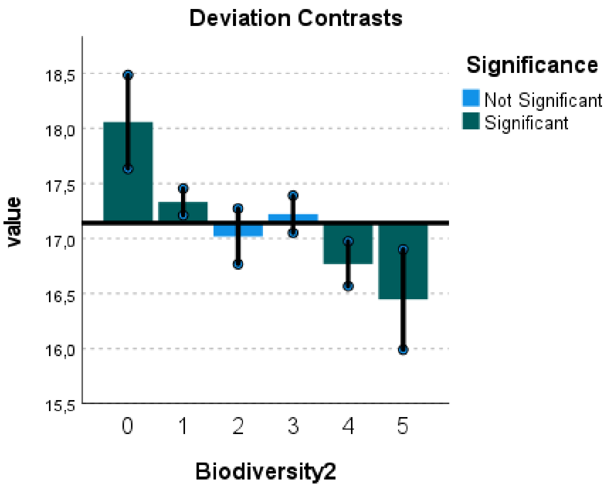
Aspect of health	Landscape	R-squared	Effect of the area	Number of indicators species	Effected number of indicator species	Size of the effect
High risk of fear and/or depression	Forests	1.8%	Negative	one	Without this landscape or without any indicator species	small
Loneliness	open agricultural	2,6%	Positive	two	Without this landscape or without any indicator species	small
	Forests	1,7%	Negative	One	Without this landscape or without any indicator species	small
Severe loneliness	open agricultural	1,5%	positive	two	Without this landscape or without any indicator species	small
	Forests	2,3%	negative	one	Without this landscape or without any indicator species	small
Stress	open agricultural	4,3%	Positive	one	Without this landscape or without any indicator species	small
Meeting the standard of physical activity	Dunes	1,8%	Positive	one	Without this landscape or without any indicator species	medium
			Positive	two	Without this landscape or without any indicator species	medium

Overall health



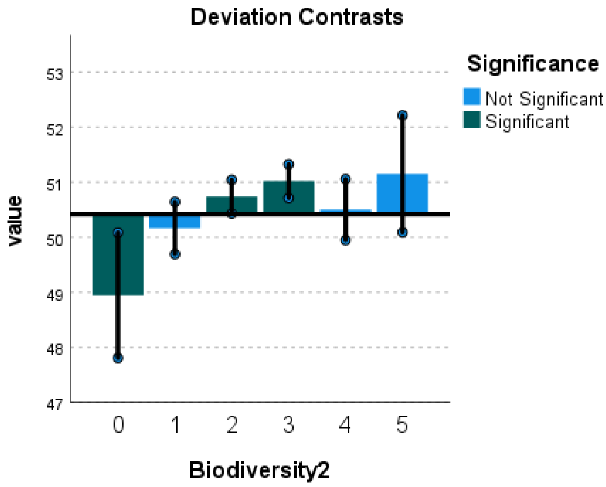
The figure above shows that although the different biodiversity scores can have fluctuating effects on the overall health. Only areas with a score of four have shown to have a significant relation. This relation is shown to be positive.

Smoking



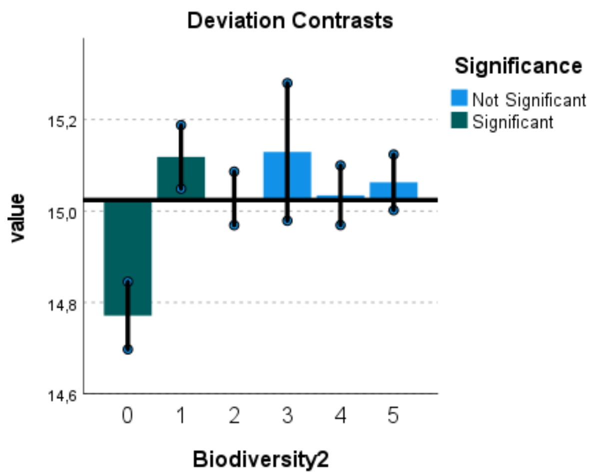
The figure above clearly shows that there are four significant relationships that can be found between areas with a score of zero, one, four and five. The amount of smokers in an area with a score of zero is the largest and decreases when the amount of biodiversity increases. Reaching the lowest point in areas with a score of five.

Obesity



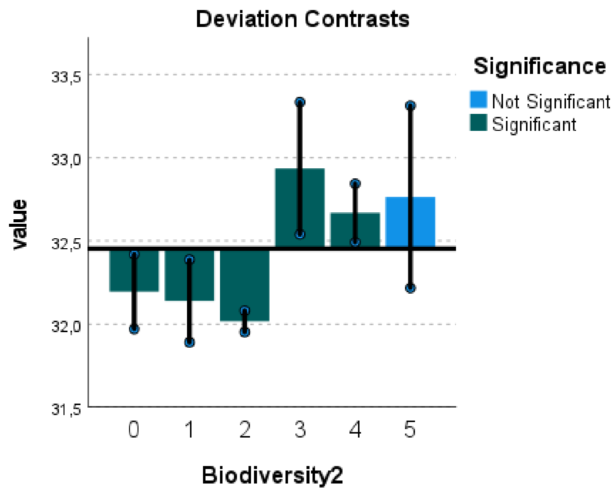
The figure above clearly shows that there are three significant relationships. These are areas with a biodiversity score of zero, two and three. The amount of people suffering from obesity in an area with a score of zero is the lowest. The amount of people suffering from obesity is larger than average in areas with a score of two. The amount of people with obesity is even greater in areas with a biodiversity score of three.

Morbid obesity



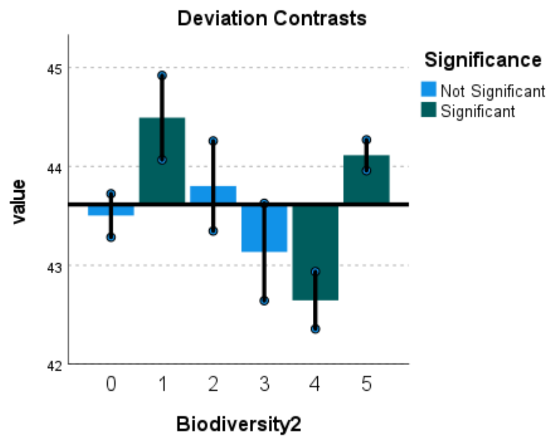
The figure above clearly shows that there are two significant relationships. These are areas with a biodiversity score of zero and one. The amount of people suffering from morbid obesity in an area with a score of zero is the lowest. The amount of people suffering from obesity is larger than average in areas with a score of one.

Chronic physical conditions



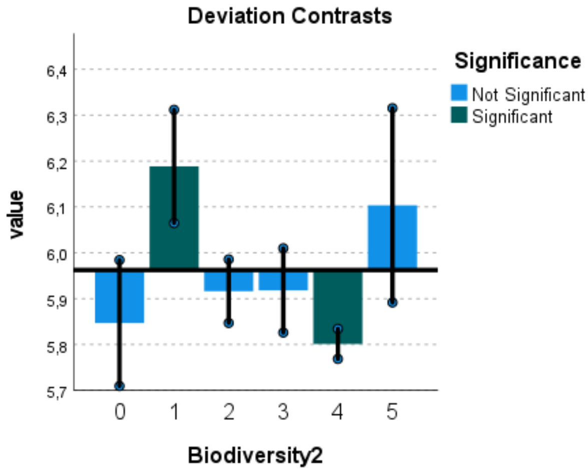
The figure above clearly shows that there are five significant relationships. These are areas with a biodiversity score of zero, one, two, three and four. The amount of inhabitants who suffer from chronic physical conditions decreases in areas with a biodiversity score from zero to two. In areas with a biodiversity score of three the amount of people suffering from chronic physical conditions increases. In areas with a biodiversity score of four it decreases again but remains larger than the average.

Medium risk of fear and/or depression



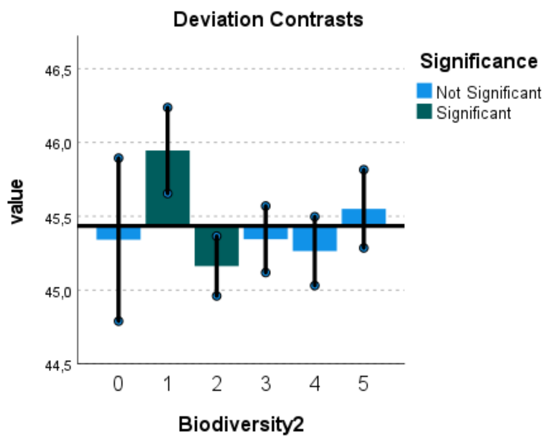
The figure above clearly shows that there are three significant relationships. These are areas with a biodiversity score of one, four and five. The amount of inhabitants with a medium risk of fear and/or depression is the highest in areas with a biodiversity score of one. In areas with a biodiversity score of four the amount of people with a medium risk of fear and/or depression decreases and reaches the lowest amount of all the areas. Then in areas with a biodiversity score of five it increases again and exceed the average.

High risk of fear and/or depression



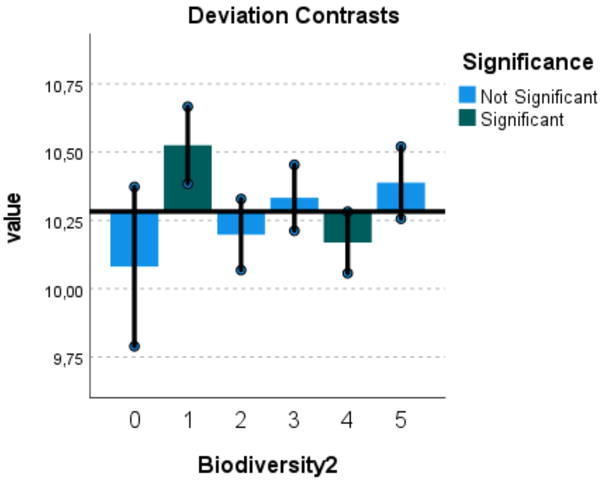
The figure above clearly shows that there are two significant relationships. These are areas with a biodiversity score of one and four. The amount of inhabitants with a high risk of fear and/or depression is the highest in areas with a biodiversity score of one. In areas with a biodiversity score of four the amount of people with a high risk of fear and/or depression decreases and reaches the lowest amount of all the areas.

Loneliness



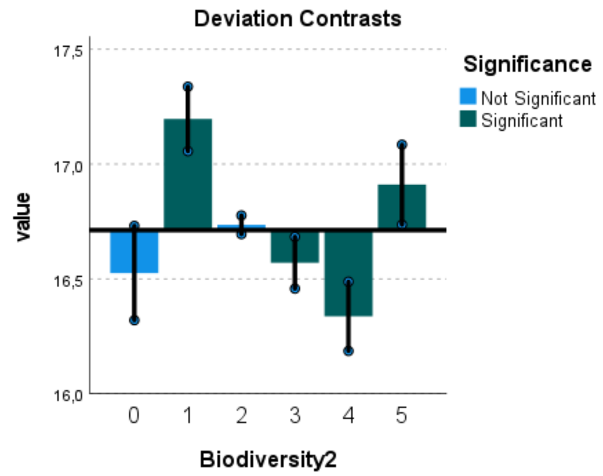
The figure above clearly shows that there are two significant relationships. These are areas with a biodiversity score of one and two. The amount of inhabitants who suffer from loneliness is the highest in areas with a biodiversity score of one. In areas with a biodiversity score of two the amount of people who suffer from loneliness decreases and reaches the lowest amount of all the areas.

Severe loneliness



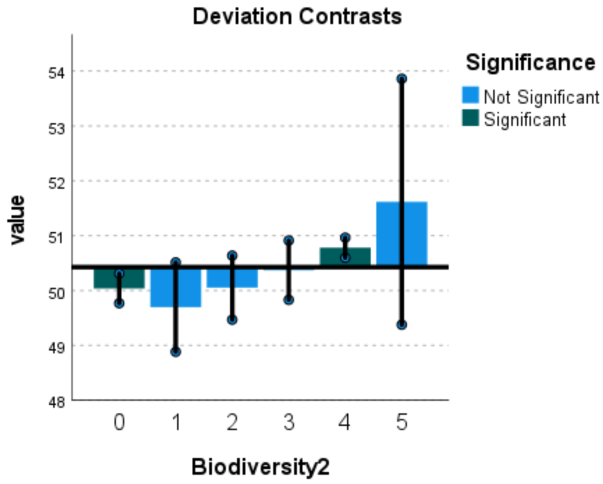
The figure above clearly shows that there are two significant relationships. These are areas with a biodiversity score of one and four. The amount of inhabitants who suffer from severe loneliness is the highest in areas with a biodiversity score of one. In areas with a biodiversity score of four the amount of people who suffer from severe loneliness decreases and falls under the average.

Stress



The figure above clearly shows that there are four significant relationships. These are areas with a biodiversity score of one, three, four and five. The amount of inhabitants suffering from stress is the highest in areas with a biodiversity score of one. In areas with a biodiversity score of three the value in contrast with that of areas with a biodiversity score of one drops drastically. The amount of people suffering from stress decreases and reaches the lowest amount of all the areas in areas with a biodiversity score of four. Then in areas with a biodiversity score of five it increases again and exceed the average.

Meeting the standard of physical activities



The figure above clearly shows that there are two significant relationships. These are areas with a biodiversity score of one and four. The amount of inhabitants meet the standard of physical activities is the lowest in areas with a biodiversity score of one. In areas with a biodiversity score of four the value in contrast with that of areas with a biodiversity score of one has been marginally increased.

Summary of the results of the second analysis

Similar to the summary of the first analysis the findings from the second analysis are comprised into a table in order to show the results more clearly. First the size of the influence was looked at. The influence from biodiversity fluctuated depending on the aspect of health. Secondly a comparison between the different biodiversity score is performed. This shows how the different biodiversity score influences the mean. The table below shows the different biodiversity score on the top and the aspects of health are shown on the left. A positive and negative is assigned to scores which have a significant influence on the mean.
the second table simplifies the results and only shows colours. This simplification shows that areas with a biodiversity score of zero score relatively well on subject as (morbid) obesity and chronic physical conditions, but the overwhelming positive effects can be found in areas with a biodiversity score of four. Interestingly the positive effects seem to decline in areas with a biodiversity score of five. Indicating that too much nature an biodiversity can negate the positive effects.

Aspects of health	0	1	2	3	4	5
Overall health					Positive	
Smoking	Negative	Positive			Positive	Positive
Obesity	Positive		Negative	Negative		
Morbid obesity	Positive	Negative				
Chronic physical conditions	Positive	Positive	Positive	Negative	Negative	
Medium risk of fear and depression		Negative			Positive	Negative
High risk of fear and depression		Negative			Positive	
Loneliness		Negative	Positive			
Severe loneliness		Negative			Positive	
Stress		Negative		Positive	Positive	Negative
Meeting the required amount of physical activities	Negative				Positive	

Aspects of health	0	1	2	3	4	5
Overall health						
Smoking						
Obesity						
Morbid obesity						
Chronic physical conditions						
Medium risk of fear and depression						
High risk of fear and depression						
Loneliness						
Severe loneliness						
Stress						
Meeting the required amount of physical activities						

Relation of the results with the hypotheses

In the first part of this document the hypothesis was formulated. This part will answer the different aspects of the hypothesis.

The amount of biodiversity has a positive influence on the health of the inhabitants of The Netherlands.

The assumption would be that since biodiversity has an impact on the health of humans this would be visible in the results. If the results from the second analyses are observed this phenomenon is present. The amount of biodiversity has shown to have a positive influence on the aspects of health. There are however limits to when the positive effect are outweighed by the negative effects. As indicated by the difference in health benefits between areas with a biodiversity score of four and a biodiversity score of five. This is also visible in the first analysis. Where it has shown that different amount of indicator species have a significant and relevant relation with areas without this landscape or without any indicator species.

There is a difference between landscapes and the amount of positive influence on the health of the inhabitants of The Netherlands.

If the summarized results are observed it can be noted without a doubt that the landscapes half open and and/or or closed agricultural areas, dunes and forests are present in the summary. However, the landscapes heath, raised moor and shifting sand, beaches and swamps are obviously absent. It can also be noted that there is a clear distinction about the relation of nature and the different aspects of health. The total aspects of health that relates to the physical health is significantly lower. This is shown by the percentage of effect related to smoking and obesity. At the same time, the overall health and chronic physical conditions were not even significant enough to be mentioned in the summary.

Landscapes which predominantly consists of greenspaces have a larger positive influence on the overall health opposed to areas without greenery

Similar to the second hypothesis the original assumption that nature has an exclusively positive influence on the health of the inhabitants needs to be discarded. However, it can still be observed that areas with larger amount of literal greenery have a larger influence on health. A more accurate statement could be: areas with visible green vegetation have a larger influence on the health of the inhabitants. The influence could be positive or negative depending on the different aspect of health.

Recommendations

In the part one: introduction the relevant parties that could benefit from this research were formulated. These parties are planners, designers and the Teeb calculator. Additional to the parties formulated in the first part the specific health care organizations and further research will also be included in the recommendations

Planners

The findings from this research could be used by planners as additional proof that biodiversity provides a variety of health benefits. Planners could identify areas with a low biodiversity score and improve the biodiversity. Also planners could uses this information to identify areas with a high biodiversity score. The planners could then create plans that limit the reduction of nature in order to maintain the positive health benefits. Considering individual plots this research also provides a guide on the effects of each landscape.

Designers

This group could split into two separate professions: urban designers and architects. Urban designers could use the importance of biodiversity to use the available space between buildings to create areas designed for bringing biodiversity into urban areas. The findings could also be used to redevelop low quality green areas into areas that support biodiversity. Architects could use the findings from this research as an argument to implement greenery in their design.

Teeb calculator
The Teeb calculator does not take the amount of biodiversity and the landscape into account when calculating the financial benefits of implementing greenery in an area. This research has shown that biodiversity does influence the health of the inhabitants. Advancing the calculator to include biodiversity could create a more accurate calculation. This research has also shown that the landscape has a large influence on the health benefits. Since this research has shown that not all types of nature have the same health benefits. The Teeb calculator could also take this into account when calculating the financial benefits.

Health care organization
The findings from this research might be very useful for mental health care facilities. Since the patients in these institutions suffer from a variety of mental disorders implementing greenery could improve the recovery process.

Additional research
Although this research document has completed the goals it was set out the find there are still multiple opportunities for follow up research. These are: water, additional indicator species and isolated experiments.

This research has not taken water into consideration. However, while gathering data on the indicator species from natura 2000, it became apparent that the landscape water was also present. However additional research could be performed which includes the availability of water.

This research has shown that areas with a greenery in the form of the landscapes open agricultural areas, half open and/or closed agricultural areas and the forest have a positive and negative effect on the aspect of health. The next step would be to perform an experiment. First the data concerning the aspects of health needs to be documented. After this an experiment can take place where greenery is implemented. This could indicate that the original results from this research can be contributed to the greenery itself or other external factors.

Conclusion
To conclude this research has achieved the goal that was set out in the beginning. The different landscapes of nature and the different qualities of nature have been analysed. This hypothesis has been proven to be true. The results however are mixed and parts of the hypothesis are proven to be wrong. The different amount of biodiversity can show to have a significant effect on the different aspects of health. however there is a limit for which this is true. Also it has not only shown a relation between large amount of biodiversity and an increase in the health benefits, but also a decrease in areas with a small amount of biodiversity. The landscapes with larger amounts of greenery have shown to be the landscapes which for the largest part have a significant and relevant influence. However, the results show that this is not always a positive effect. The original statement in the form of the hypothesis needs to be readjusted. A more accurate statement would be as follow: The quality of nature influence the health of the inhabitants to such a degree that areas with a large amount of high quality nature experience health benefits while areas with a low quality of nature experience a drawback.

Part one: Introduction

Introduction

In this chapter the following subjects are discussed: the current situation, the problems that the current situation causes, and the goal of this research. First the motivation that sparked the interest in the research topic will be explained. In this part the overall situation is explained. Secondly, the problem statement will be discussed. This will contain a more detailed description of the problem, together with relevant background information concerning the research topic. After the problem statement a short and descriptive formulation of the problem is presented. This will provide clarity concerning the research topic and set the boundaries. To explain the situation background information is provided in combination with findings from scientific studies which will be further elaborated upon in the next chapter.

Motivation

''If we choose to give forests time and space, they could recloak the earth with many rich and varied communities of animals and plants of which we have so recently robbed it. A future with more forests is key to the resilience of our planet''. With these words David Attenborough finished the documentary series 'Our planet'. During the program he looks back on his travels and cannot help but feel affected by the drastic changes of the global environment from the start of his career up until now. At the start of the 20th century 48% of the land available was covered by forests. For wild grasslands and shrubs this percentage was 27%. A little more than a century later the amount of forest has been reduced by 10% and the amount for wild grasslands and shrubs has been reduced by 13% (Ourworldindata, 2022). The reduced space is used to increase the amount of land for crops and most importantly meat production. Forests, grassland, and shrubs are complex ecosystems where a variety of organisms live. This biodiversity is essential since the reason that these organisms can coexist is because they depend on each other to receive the resources that they require. Farmland focuses on one type of landscape with one function. Thus provides a habitat for only a select number of organisms. This has led to a worldwide reduction of the quality of the biodiversity with as a result the risk of losing a million different species (WWF,2020).

The Netherlands is not an exception to this global crisis. During the period between 1900 and 2000 the amount of biodiversity in The Netherlands was reduced from 40% to 15%. This means that of all the flora and fauna in The Netherlands 15% is part of the original nature that can be found in these regions (PBL,2016). The reasons for this phenomenon are mining, intensifying agricultural land and urbanization. The government has made the goal to increase the quality of nature in The Netherlands. However, during the period between 2000 and 2017 the quality of nature has not improved nor decreased (CLO, 2018). The words from David Attenborough provide us with a warning that our current way is not sustainable and can cause many problems in the future. They also provide us with a task for the current and future generations to restore the damages caused by humanity and to create a sustainable global environment.

Problem statement

The area in The Netherlands that has experienced the largest reduction of biodiversity is the urban area in the west of The Netherlands called the Randstad (CBS,2016). It is therefore no surprise that the top five most green cities are all located in the east of The Netherlands where the urban areas are less dense (Daily greenspiration, 2020). This density creates areas with a monocultural landscape and cannot function as a habitat for a variety of organisms. This situation in which cities are lacking biodiversity and nature does not only create unappealing cities, it also negatively affects the health of the inhabitants. The quality of life is greatly impacted by the surrounding nature. Not only do people experience a sense of peace when they are around greenery that would relate to the mental aspect of health but also healthier bodies that would relate to the physical aspects. Areas with a larger amount of greenery have less carbon dioxide (C02), Nitrogen oxide (N2O) and fine dust particles. Plants function as natural air filters and depending on the type of plant can be used to clean the air. (Remme et al. 2017). Nature can also have an indirect effect on the physical health of people. The WUR reports that the existence of greenery and nature nearby is a stimulus to use this area for physical activities (WUR,2021). Concerning the mental aspect, the GGZ reports that in an area that has an 50 % urbanization rate or higher negatively affects the mental health of the inhabitants (GGZtotaal,2021). The previous paragraph indicates that the relation between greenery and human health is well established in multiple studies. However, the real uncertainties arrive when these relationships are quantified.

In 2020 the world suddenly experienced an abrupt change that influenced the daily life of most of the people. A once in a century pandemic occurred which shook up the whole world. For a lot of people this meant that the office where they would usually work was closed to prevent further spreading of the virus. According to the CPB (2021) during the first wave of the virus half of all worked hours took place at home. Although this percentage gradually was reduced over time still a third of the working hours in September 2020 took place at home. During this time of isolation, it is therefore no surprise that people started to look for parks and forests to spend some time outside of their homes. During the first wave (the period between March and June) the nature areas experienced an increase of visitors of 40% (Natuurmonumenten, 2020). This increase was so drastic that the parking lots were frequently over their capacity. This shows the importance of nature and the positive effects it has on the people.

The Dutch government shares this interest. The Dutch ministry of Health in cooperation with the United Nations has already made a large amount of progress in this aspect with the TEEB calculator. With this calculator planners and the finance division of municipalities can calculate the return of the investment of greenery and nature in the city. The goal of the TEEB calculator is to support municipal workers and developers with the financial information. With this information an investment can be more easily justified and thus will result in an increase in the amount of nature in urban areas. The calculation is based on four aspects: health, climate adaptivity, real estate and recreation. For each of these aspects the calculator can provide an insight in the reduction of the cost because of the improvement. Considering the aspect of health, the calculator creates a division between physical health and mental health. The contribution of greenery and nature on physical health is calculated by measuring the number of trees, grass, bushes and plants and the reduced amount of CO_2, NO_2, dust particles, etc. after the (re)development. A calculation like this would provide a decent guess as to what the return on the initial investment would be. Concerning mental health two factors are used for the calculation. The first one is the reduction of healthcare costs. Through multiple studies it became apparent that people living in an area with a larger square meter of greenery have a lower healthcare cost. The second factor is the employment rate. Where multiple studies have shown that people living in an area with a larger M2 of greenery have a higher employment rate. However, the TEEB calculator also mentions its shortcomings. Mostly that this calculation does not work optimal in urban areas like cities. A reason for this could be that a stroke of greenery can have a different function in the suburbs than in a city. A second shortcoming of this calculator is that to calculate the contribution of greenery and nature on the mental health the area in m2 is used. A negative consequence of this calculation is that areas with a lower quality of nature are in this calculation equal to areas with a higher quality. Although multiple studies have shown that there is a difference in the type of greenery and its effect on the human conditions.

Definition of the problem

There is currently an insufficient amount of information regarding the relation between nature and the different types of landscapes and the quality of nature. Due to this lack of information, it is impossible to create area programs that fully benefit from the positive effects. As a result, municipal workers and developers create the limited amount of nature required, regardless of the needs of the surrounding area. This reduces the biodiversity in The Netherlands even further while municipalities and the national government should increase the overall biodiversity of the country. By continuing this practice any positive health benefits for the local inhabitants is withheld.

Research goal

This problem has led to the following research goal:

To search for a relation between the landscape and the quality of nature and human health in The Netherlands.

Hypotheses

The main hypothesis of this research document that will be proven or disproven is: A higher quality of nature positively influences the health of the people living in The Netherlands. This hypothesis consists of three elements. The first aspect is: the amount of biodiversity has a positive influence on the health of the inhabitants of The Netherlands. The second aspect is: there is a difference between landscapes and the amount of positive influence on the health of the inhabitants of The Netherlands. The third aspect is that landscapes which predominantly consist of greenspaces have a larger positive influence on the overall health than areas without greenery.

Relevance

Planners

The main relevance of this study is related to planners. During the planning phase the desired amount and characteristics of the greenery in the project is documented. During the negotiation phase with the other parties, it might be that due to budget cuts the amount of greenery is reduced in the final design. This causes the overall quality of urban areas to diminish. With the findings of this study planners have a larger leverage during the bargaining phase to secure the creation of the natural elements.

Architects

Sustainability is one of most used words during the architecture program at the TUDelft. Most new projects also do not shy away from using sustainability to describe their design. An architect could for example place a green facade complete with an indoor garden and install solar panels on the roof. The company can then boost that their building is sustainable. This neglects the fact that the construction of the building creates more waste than the sustainable devices can reduce during its lifetime. Greenwashing is the term used to describe this phenomenon. This can also be found considering greenery, where rooftop gardens are advertised as bringing nature into urban areas but consist of a controlled environment contributing little to the overall problem of a reduction of biodiversity. This research could provide a more in-depth knowledge about what kind of habitats need to be created in urban areas. This could change the current idea that if a roof has greenery, it contributes to diversity. It instead invites architects and designers to think about the needs of the ecosystems surrounding and in the urban area and adapt their strategy accordingly.

Teeb

An important aspect of this study are the findings related to The Economics of Ecosystems & Biodiversity (TEEB). The need for more insight in this field was commissioned by multiple environmental ministers during a G8+5 Meeting. The goal of this initiative is to implement greenery and nature in the decision-making process in all the levels of government. It focuses on three points to achieve this goal. The first principle is to recognize the value of ecosystems, landscapes, species, and other aspects of biodiversity. The second principle is to demonstrate economic value. This enhances the chances of the policy being implemented, because it presents the full benefits and costs. The third value introduces the findings from all the research into the decision-making process through incentives and price signals (TEEBweb,2020). These concepts were the inspiration for the follow-up research performed in The Netherlands. Included in this research were the Ministry Of Economic Affairs and the Ministry Of Infrastructure And Environment. This additional research based on TEEB created the TEEB-city. This is a calculator that somewhat accurately determines the return of the investment of investing in greenery and nature.

Purpose

The overall purpose of this paper is to stimulate the development of green areas or redesign existing ones. Planners, architects, engineers, and landscape architects have come to understand the importance of greenery and nature for the wellbeing of humans. Examples of these are plants and trees placed in city squares to combat heat islands. Another example is the placement of vertical plants in offices to stimulate workers and to improve the air quality. To accelerate the process of increasing the amount of greenery in cities it is important to provide a full documentation of the benefits. While multiple studies have been performed and are still researched the subject is too large for one study. It is therefore that the subject is divided into multiple studies. This study will focus on the quality of greenery and the positive benefits of it.

The product

The end product would consist of a list that provided the reader with the number of benefits that can be obtained from the different landscapes and the different quality of nature. The reader could use this data base to determine the effect of improving an area by either increasing the amount of biodiversity or applying a particular landscape.

Theoretical framework

This chapter of the document is dedicated to explaining findings from previous studies. These studies will be used to create the research goal and to support the methodology used for this research. First, the relation between human health and nature is explained. Since these findings provide the base for this research document it is important to fully elaborate upon it. The second part consists of explaining the concept of indicator species and their importance in creating a method that can transform subjective data into quantifiable data. After reviewing existing literature, a couple of essential terms will be explained.

Relation health nature

This research builds upon the multiple studies that searched for the influence of greenery on the wellbeing of people. Starting from the research by Roger Ulrich in 1984 to the present the knowledge about the positive effect of greenery on the Health of people has grown significantly. A distinction can be made between studies performed into the overall effect of greenery, the physical aspect, and the mental aspect of wellbeing.

Overall wellbeing

In urban areas where the inhabitants have access to green spaces, the number of people who visit the doctor is lower than in areas that lack this access (Maas,2008). As mentioned before, the presence of nature among other things reduces the pollution on the air, invites physical activities and cools down urban areas. As a result, living in areas with more nature in urban areas reduces the risk of certain deceases. Among the list of diseases are coronary heart disease, depression, back and neck pain, diabetes, migraine and respiratory diseases (KPMG,2012) Research done by the Cultural Ecosystem Services Working Group tried to search for the connection between greenery and the wellbeing of humans. This research used a meta-analysis to determine the effect of knowing, perceiving, interacting, and living within green spaces on several aspects. Examples are: the physical health, mental health, spiritual health, Certainty, sense of control and security, learning and capability, inspiration and fulfilment of imagination, sense of place, identity and autonomy, connectedness and belonging and subjective wellbeing. The most relevant subjects for this study are physical health and mental health. To evaluate the greenery and nature in the observed area it is important to understand the multiple components that can influence the health conditions of the inhabitants. Research performed by Buxton, Pearson, et al (2020) studied the effects of sound on the experience of nature and greenery. The results from the study show that exposure to the natural sound has a positive effect on the health of the participant. This is shown in the reduction of stress. The opposite might also be through where a lack of natural sound can induce stress and stress-related issues. Greenery can also indirectly affect the overall wellbeing. This can be done by affecting the circumstances that influence the wellbeing. The temperature in the urban areas is an example of this. During warmer periods and heat waves in the summer the temperature in urban areas rises to such a level that it becomes dangerous for babies and elderly. Urban areas often contain buildings with darker materials such as asphalt and concrete. This raises the temperature since the darker materials absorb more sunlight. At the same time, these materials also retain the amount of heat for a longer period and release the heat at a slower pace. The composition of the cities reduces the speed of the wind. Due to a lack of open soil there is only a small amount of natural evaporation. The difference between the temperature of urban areas and rural areas is called the urban heat island effect (e.g. Kovats & Hajat, 2008).

Physical health

Previous studies focus on the relation between the recovery rate of patients and the environment in which the patients reside. Research performed in the United States showed the importance of local green areas. From the 2000 people who were interviewed the larger number identifies the importance of the park as the most common place where they performed exercises. It also became apparent that the distance to the park is the most important factor when considering the usage of the park. This shows that local parks can contribute to the physical health of the neighbourhood by providing a space to perform exercises (Cohen et al, 2007) Green spaces in urban areas do not only contribute to the health of young people but also contribute to the wellbeing of the elderly. A study from Japan tried to identify a possible link between the longevity of elderly people and urban green spaces. The last part in this study refers to parks and streets with multiple trees. In addition to this the green space must be in close proximity in order for the person to walk to those places. This study shows that when considered the age, sex, marital status and the socioeconomic status of the persons a link can be found between having green spaces in a close proximity and the longevity of elderly people in urban areas (Takano et al, 2002). Urban greenery can not only increase longevity, but also reduce the risk of strokes. A study in Florida looked at the relation between the risk of stroke mortality, the exposure to greenery and high levels of air pollution. This last aspect consists of pollution generated by traffic and individual polluters. inhabitants of urban areas have a higher risk of stroke mortality in areas with low exposure to green areas and higher levels of air pollution (Hu,Libens and Rao, 2008)

Mental health

The most significant influence of nature on the wellbeing of people is on mental health. Subjects were reported to have reduced amount of stress, increased amount of patience. increased amount of self-discipline, increased capacity for attention, increased recovery from mental fatigue or crisis and from psychophysiological imbalance (Russel et al, 2013). Similar findings have been reported by Epidemiol community health. Cohen-cline and Turkheimer researched the relation between green spaces and the mental health of adult twins. This study indicates a reduced number of cases of depression in the test subject who had access to more greenery. This research also took factors like income, physical activity, neighbourhood deprivation and population density into account (Cohen-cline and Turkheimer, 2015) A study performed by Erja Rappe and Paivi Topo tried to identify the positive effect of greenery on elderly people suffering from dementia. The patients with dementia were calmed by the presence of greenery. Additionally, plants that stimulate the different senses of the patients have shown to trigger memories and create associations in their mind. Furthermore, greenery has shown to reduce depression and enhance social well-being. A positive effect that was noted during this study was that family members of the patients would spend more time with their family if they had the opportunity to spend time with them in a natural setting (Rappe and Topo, 2007).

Indicator species

This study relies heavily on the use of indicator species to generate quantifiable data. Indicator species are species of animals that can provide information by analysing their numbers and whereabouts. This is useful since measuring biodiversity would mean researching and documenting all the individual components. This would not only be costly but also highly impractical. In the case of biodiversity keystone species can function as a benchmark to which areas can be compared to each other. These biodiversity indicators are already the most used practice in monitoring and measuring systems. The species used can consist of animals, plants, bacteria or fungi. Keystone species are characterized for being an essential part of the local habitat. This means that if the key species is removed from this habitat it will change the biodiversity and the structure of the ecosystem. In general ecosystems are quite complex and all the components have their purpose. However key species transcend the role of the other actors in ecosystems in their importance. An example of a keystone species is the Pisaster Ochraceus. A starfish found in waters at the northwest coast of North America. This small invertebrate animal is responsible for maintaining the local diversity. If this animal suddenly vanishes from its local ecosystem the mussel population would grow to such an extent that other species are expelled from the area due to a lack of living space. However, the starfish is only a keystone species in habitats where the starfish and the mussel both reside, and both support the species diversity. This means that in areas with a different composition of flora and fauna the starfish cannot be categorized as a keystone species since its effect on the overall structure and biodiversity on the community is insignificant. Another example of a key species are fig plants. This shows that to be able to function as a key species, the organism does not need to be part of the animal kingdom. Since figs produce fruits all year round, they have become an essential part of the diet of birds and mammals in times when food is scarce. Without this crucial dietary element, the plurality of species would not be able to remain in this habitat. It is important to identify the indicator species that are going to be used to access a certain area. The following criteria are important for the selection of an indicator species.

1. The research questions should be able to be answered by monitoring the indicator species.
2. The aspect that the indicator species provide information about should be known beforehand. It should also be able to provide this information or else its assistance into answering the research question is limited.
3. The use of indicator species should preferably be used in combination with the right experimental control.
4. The use of the indicator species should not exceed a predetermined budget.
5. The impact of the indicator species on the decision-making process needs to be taken into account when selecting the right species.

Part two: Methodology

Introduction

In this chapter the methodology of this thesis will be elaborated upon. There are four tasks that will need to be elaborated upon to provide clarity about the research process. The first task will be collecting the research data. The second task would be the transformation of the available data into usable maps. The third task will be using the created maps to grade the quality of nature in the different neighbourhoods in The Netherlands. The fourth task would be to perform an analysis to establish a possible relation.

Data collection

To be able to complete this study acquiring data is essential. There are three data sources needed for this study. The first type of information would be the numbers concerning the general health of the population. The second type would be the reduction of the health care cost. The third and most important information is the data about the indicator species.

Data on the general health

The Dutch department of public health, public wellbeing and sport is the ministry responsible for monitoring the health of the population. Part of this ministry is the state institute which publishes the data about the health condition. This data is updated every year to provide an up to date image. Researchers and policy makers can use this information. The access to this data is free and the sets can be downloaded from the website in the form of an Excel file. The observation size consists of three different levels. The first one categorizes the data on a provincial level, the second is on a district level and the last one on a neighbourhood level. Although a variety of health aspects can be included into the data set it is for the purpose of the research not necessary to include all these aspects in the analysis. included in the analysis are physical activities, weight, smoking, physical health, fear and depression, stress, and loneliness. Excluded for the analysis are alcohol consumption, usage of a bicycle, number of miles walked, experiencing noise nuisance and fiscal security. The reason for the exclusion can be that the subject is irrelevant to the overall research question or that the subject has such a complexity that the reliability of the result of the analysis cannot be guaranteed. An example of such an aspect would be alcohol use where there are a multitude of reasons as to why a person would consume a large amount. In the image below is a screenshot of the first rows of the Excel file. In the left column the neighbourhoods are mentioned and the province and district they reside in. On the right are different aspects of the health conditions of the inhabitants of that neighbourhood.

Data on the indicator species

The success of this study stands and falls with the data on the indicator species. The data serves two purposes. At first the data on the indicator species is used to determine the landscape. Secondly the data is used to determine the quality of the surrounding nature.

Landscape

There is no such thing as one landscape in The Netherlands. It is therefore essential that a difference will be made between the different landscapes. To determine both the type of landscape and the quality of that type of nature the habits of birds will be analysed. In this research this will be done by looking at the natural habitats of certain species. All living beings have the tendency to live in areas best suited to their own physical abilities. The vegetation surrounding the nest and the environmental conditions are of great importance. Also, the availability of food could be a quality that birds take into account during their selection process. This makes it possible to assess certain areas based on the animal living in those areas. The data concerning the different landscapes is retrieved from the document called: Hotspots of biodiversity in The Netherlands based on the data of breeding birds. This document is created by SOVON. This is a non-profit organization tasked with the measurement of the bird populations in The Netherlands. Information provided by this organization has been used to create policies. The WOT nature and environment has performed and is currently undertaking research into hotspots of important breeding birds. The goal of the study was to determine the location of these hotspots in The Netherlands. After which it could be possible to determine the location of birds that are placed on the red list. This list indicates that the survival of their species is uncertain due to the loss of habitat because of the expansion of the human living area. The product of this research can be used by policy makers to create effective legislation in order to maintain the bird population. This requires the creation of a plan that is based on the local habitat and the endangered birds. To assess the type of nature of these hotspots an inventory was created based on the breeding location of a selection of common bird species. Eighty-six of these common bird species can be used as indicators for seven different main types of nature that occur in The Netherlands. These types of nature being open agricultural area, half open and closed agricultural areas, forest areas, heath, raised moor and shifting sand, Dunes. Not only does the document of SOVON provide the list of the indicator species that can be used to determine the landscape of an area, but also provide maps of The Netherlands indicating where a particular landscape can be found. Two of these maps are shown below. Figure 1.1 is the map shown which indicates which areas can be categorized as heath, raised moor and shifting sand areas and figure 1.2 shows the areas that can be categorized as forest areas. Some areas can be categorized with multiple landscapes. This is possible because multiple landscapes can be found in an area of 5km by 5km.

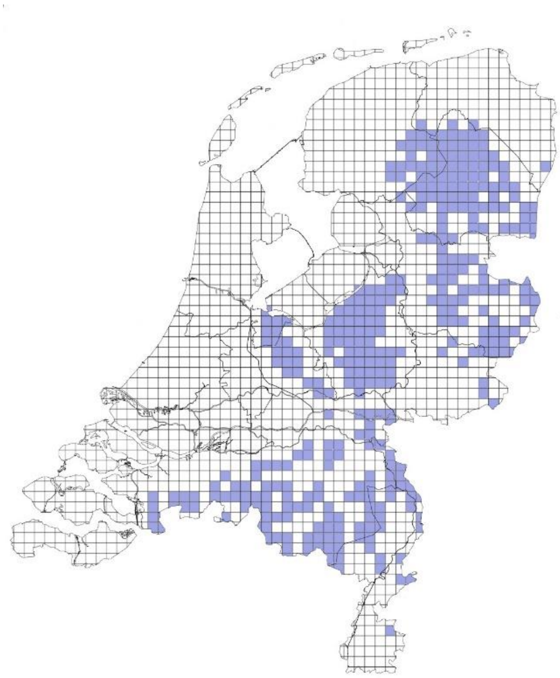


Figure 1.1 landscapes that can be categorized as heath, raised moor and shifting sand areas

Figure 1.2 landscapes that can be categorized as heath, raised moor and shifting sand areas

Quality of nature
The task of collecting the data concerning the determination of the quality of the nature starts with establishing which indicator species are going to be used. Since the quality of nature is related to the variety and richness of the species located in the area the use of keystone species would be most useful. A list of keystone species is presented in a document called the natura two thousand. Due to the current reduction of biodiversity in Europe, multiple member states of the European union have taken upon the goal to restore and protect important areas. These areas are places where species live whose numbers have been drastically reduced in recent years. Part of the *Natura 2000* is documentation of profiles of the different landscape types. These profiles provided indicator species that can be used to grade certain aspects of the landscape. This research will focus on the species that indicate a constant good abiotic environment and a constant good biotic environment. The list of indicators consist of mammals, birds, fishes, plants, and fungi. Using those two criteria instead of just one or other indicators will increase the probability that the area will indeed have a higher quality of nature. The Natura 2000 provided a list of 52 different landscapes. The landscapes that consist of lakes, seas, rivers, and canals are not included. The amount of people living in areas fully surrounded by water can be disregarded due to their small numbers. The rest of the landscapes are divided into the categories mentioned in the previous part namely: open agricultural area, half open and closed agricultural areas, forest areas, heath, raised moor and shifting sand, Dunes. The landscapes in the *Natura 2000* document are categorized based on small details. For example, a difference in forest based on the soil. While this is of course essential for the forest itself the research would be impractical since local small forests have to be divided to measure all the individual parts. With the list of keystone species per landscape it is possible to search for a data source. The National databank of flora and fauna (NDFF) would be the most logical starting point. This organization monitors and verifies data concerning the amount of flora and fauna in The Netherlands. Since this is a private organization, the information is not published for free. Instead, an arrangement is made for students who can access a selection of the available data. However, during the conversations with the NDFF the only information available for students contained the information for roughly one middle large city in The Netherlands. Since the scale of this study contains the whole of The Netherlands solely the information provided to students would not be enough. The remaining data could be bought but due to the scale of this research the price would have cost millions. Making the usage of this source not possible. With a lack of a reliable data source the original idea required a modification. Instead of using a variety of different animals and plants only birds are selected as indicator species. The same organization that provided the data about the indicator species to determine the landscape also provides information concerning the keystone species. Birds already make up the majority of the keystone species list. Therefore, the use of birds alone would not reduce the reliability with a critical amount. The list of the birds who function as a keystone species will be presented in the next part.

Transformation of the available data

In this part the process of creating the maps necessary to determine the quality of nature is discussed. These maps can be placed on top of geographical maps thus indicating which area can be categorized as which. The creation of the maps is done by hand and is done in different phases. The first phase consists of collecting the maps provided by SOVON indicating the areas that can be categorized as a certain landscape. This study focuses on the quality of nature and not solely on the influence of the different landscapes. The maps of SOVON do not only indicate where the landscape can be found but also the percentage. A higher percentage would indicate a larger amount of that landscape. Therefore, the first step would be to mark all the areas with a similar colour. The second step would be to print out the different maps and the maps indicate the location of the birds selected as keystone species. The next step could be done with a computer but by doing the task analog less time is used. The map indicating the location of the bird is placed on a light box. On top of the map indicating the location will be the map on the different landscapes. With the lightbox the underlying maps will shine through the map above. This will allow for a dot to be placed in the areas where the two maps overlap. SOVON provided two types of maps with two different scales. An example is provided. Figure 1.3 shows the habitat of the Blauwborst. This map has a more detailed scale and would require a modification. Figure 1.4 shows the habitat of the Bruine Kiekendief. This map has the same square raster as the maps about the landscapes and can therefore be used without any trouble.

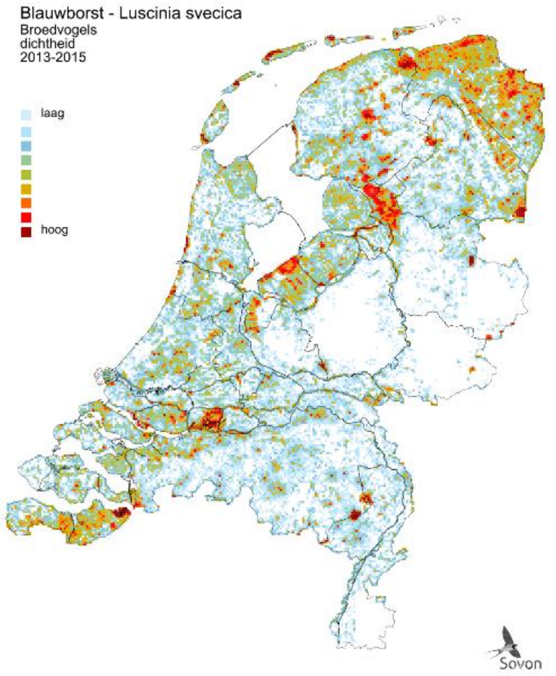


Figure 1.3 Habitat of the Blauwborst

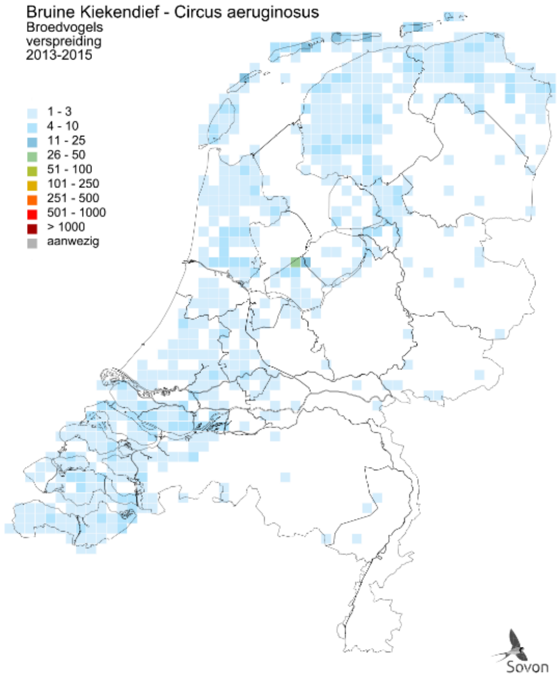


Figure 1.4 Habitat of the bruine Kiekendief

For this study a general rule is that if a square has the same number of birds as a square in the other map the area is counted, and a dot will be placed. When this process is repeated with the other keystone species map is created. The dots provide an indication about the amount of keystone species in an area. This process needs to be done for every landscape. An example is shown below. In figure 1.4 the clear squares are locations that can be categorized with the landscape open agricultural the black squares show the areas that are not categorized as such. This makes the process easier and reduces the chances of making a mistake.

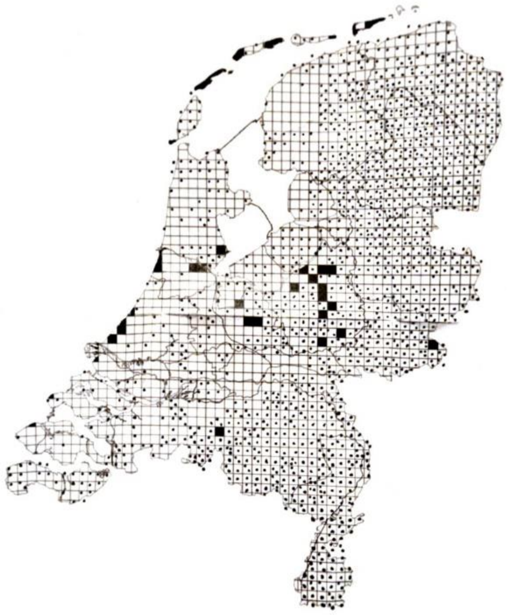


Figure 1.5 Map indicating the process

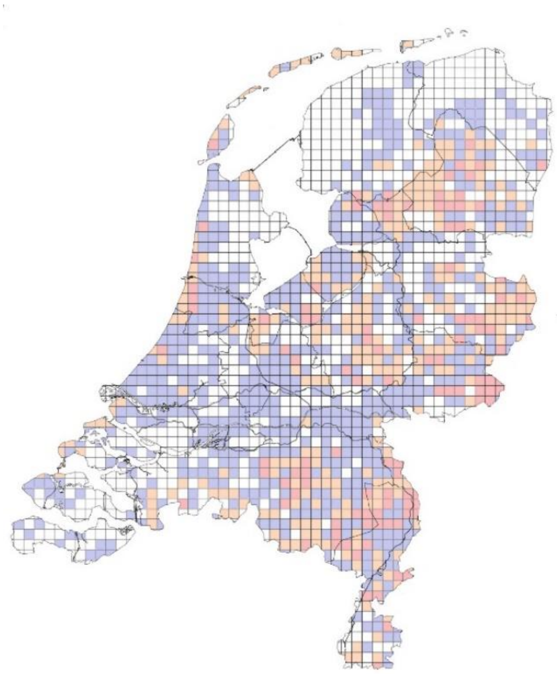


Figure 1.7 Map showing the location of the indicator species for the forest

The last step would be to translate these dotted maps into readable and clear maps. A colour scheme is used where the amount of blue indicates a low number of keystone species, and a more reddish colour indicates more keystone species. An example is provided from the landscapes forest and heath, raised moor, and shifting sand.

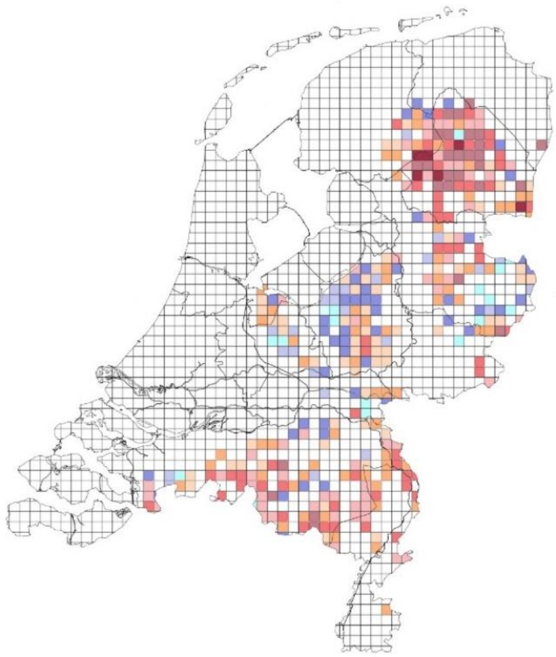
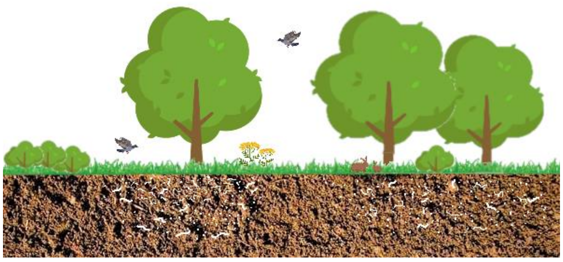


Figure 1.6 Map showing the location of the indicator species for the landscape Heath, Raised moor and Shifting sand

Differences between the amount of indicator species
This difference might be easy to understand if the statistics from the species of the different areas are laid down next to each other. However, since biodiversity is not easily noticeable for humans this part will explain the differences between the different grades for the same landscape. This will be done according to an example. In this example there is a landscape with three indicator species. This means that an area can have 1,2 or three different species and is graded accordingly.

The areas with one indicator species provide a habitat that accommodates the living conditions of one indicator species. This can be visualized by a field of grass with a singular tree. It could provide a living space for a multitude of organisms. However, there is a limited amount of difference in the vegetation. As a consequence, there is not much difference in the species of insects, microbes, mammals and birds. This limits the biodiversity greatly.



Areas that have two indicator species can be visualized by a field of grass with multiple trees, flowers, and bushes. Although there are different types of vegetation the trees, flowers and bushes belong to the same family. This still limits the amount of biodiversity in the area.

Areas that have three indicator species can be visualized by a field of grass with multiple trees, flowers, and bushes. The appearance might be similar to the area with two indicator species. The main difference here that the trees, flowers, and bushes belong to different families. The variety of trees, flowers and bushes provide a living habitat for a larger variety of organisms. This increases the amount of biodiversity of the area. The next part will provide information about the different landscapes and the corresponding maps

The landscapes

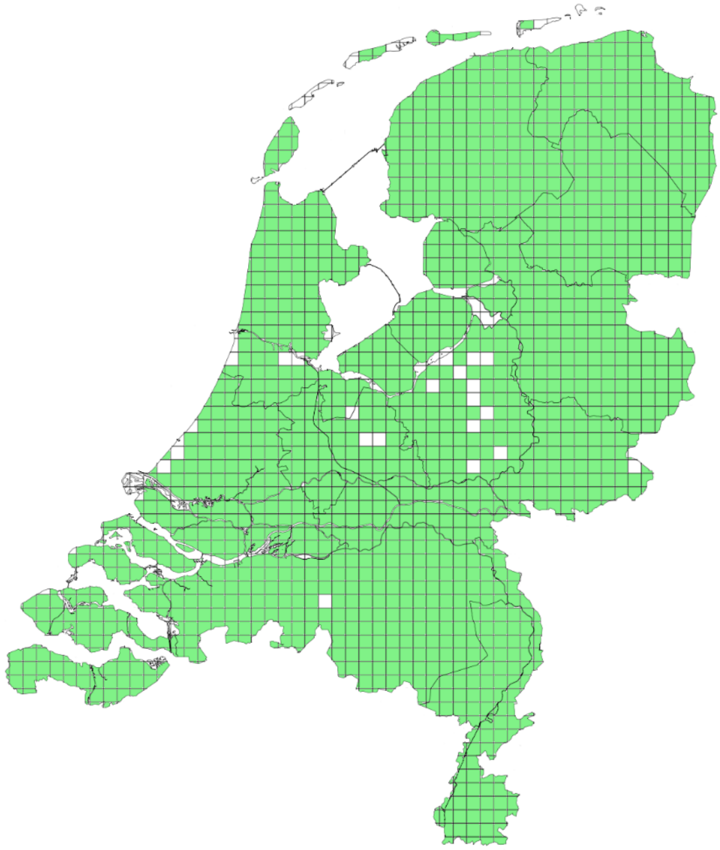
Open Agricultural areas

Characterised by grasslands and fields destined for agricultural purposes. This includes grasslands for kettle and fields for growing fruits and vegetables. The substance of the soil might differ ranging from chalk rich ground, clay rich ground and peat rich grounds. The vegetation however is similar, consisting of types of grass and low vegetation. This type of nature can be found in the south and/or west of Friesland, Groningen, the river area, North-Holland, and the area surrounding the Ackerdijksche Plassen. The soil in this habitat contains a moderate amount of nutrients and is moist all through the year with sweet water.

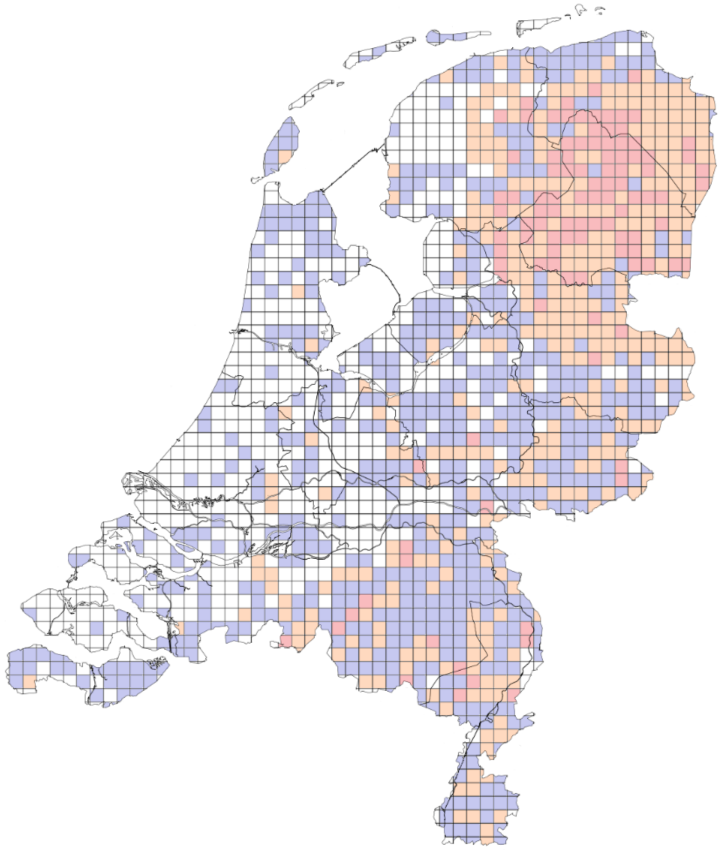
Map 1.1 shows the amount of area plots that can be categorised as open agricultural areas. This shows that most of the areas in The Netherlands can be categorised as open agricultural areas. In map 1.2 the areas are indicated where the indicator species are located. This shows that there are areas that are categorised as open agricultural areas but lack indicator species that would indicate them as a qualitative area. Interesting is that most of the areas have one indicator species and that the number of areas that have all three indicator species is the least and is located primarily in the north of The Netherlands. At the same time the urbanised area in the west is showing a lack of indicator species.

Open Agricultural areas indicators
stork
Garganey
Shoveler
tufted duck
Montagu's Harrier
skylark
grass pipit
Yellow Wagtail
English Wagtail
Partridge
Quail
Corncrake
Oystercatcher
Lapwing
Ruff
Snipe
black-tailed godwit
redshank
Black Tern
soy bunting

Indicators of well biotic and abiotic conditions
Snipe
Quail
Yellowhammer



Map 0-1.1 Areas with the landscape Open agricultural



Map 1.2 Amount of indicator species for the landscape Open agricultural

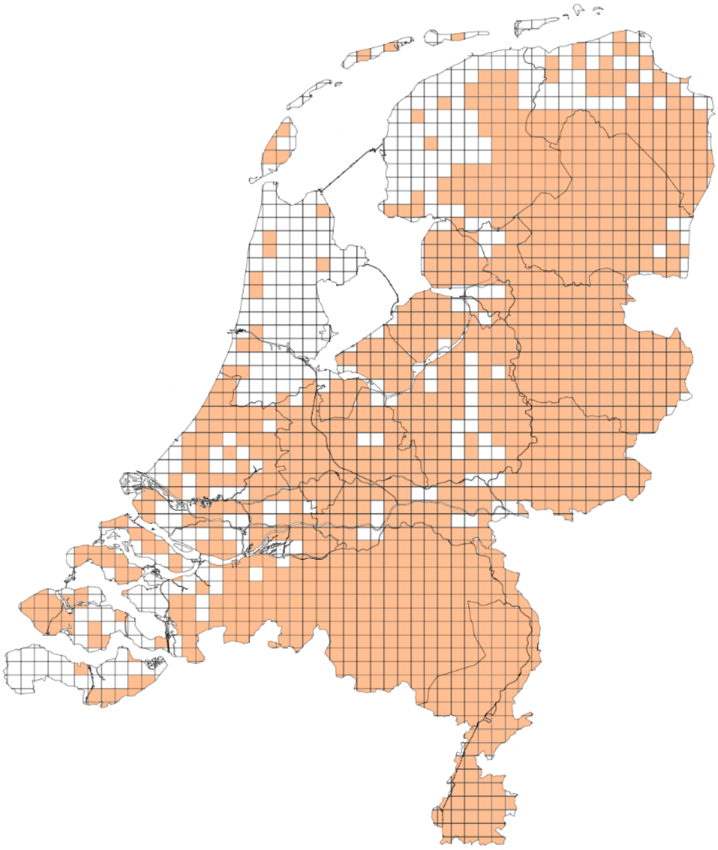
Half open and closed agricultural areas

These consist of plots of land dedicated to usually smaller agricultural practices with grassy meadows on dry ground. Consisting of mostly chalk rich grounds but also sand and silt rich ground can be found. These areas are often found downstream of rivers. The vegetation that can be found consist of small plants with most of the plants having a lifespan of a year. These areas can be found in the northern parts of The Netherlands like the southwest of the province called Drenthe the northeast of Twente. The southern part of the province of Utrecht can also be categorised by this type of nature.

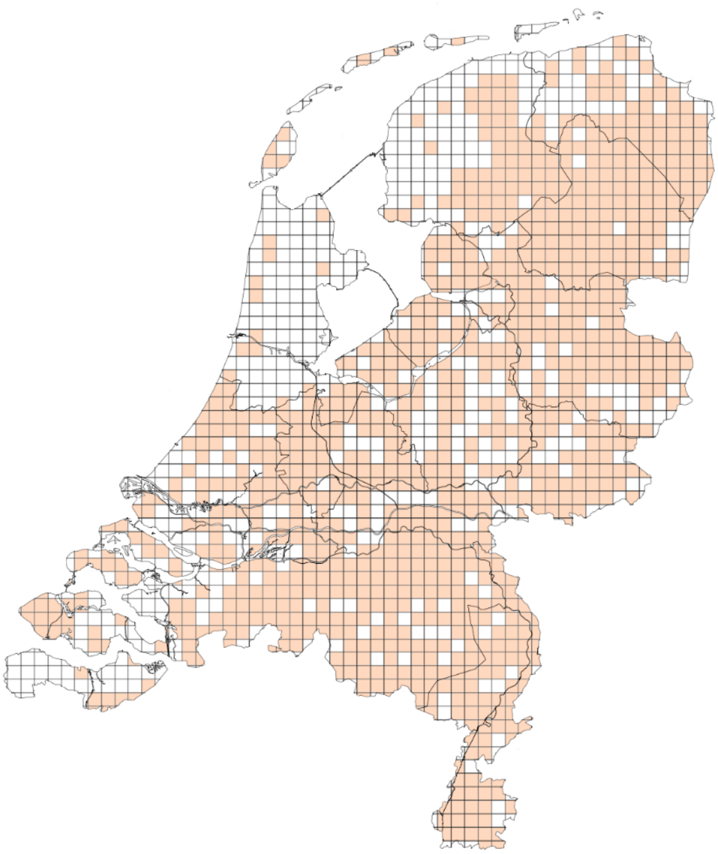
Map 2.1 shows the number of plots that can be categorised as half open and/or closed agricultural areas. These areas can be found across the country with the coastal areas as an exception. Map 2.2 shows the areas where the indicator species for this landscape can be found. Although there are still large amounts of areas, places without the indicator species can be found at the location of larger cities.

Half open and closed Agricultural areas indicators
stork
fieldfare
thrush
mockingbird
warbler
sooty flycatcher
rook
Turtle Dove
barn owl
little owl
barn swallow
European Stonechat
Kestrel
Partridge
Curlew
ring sparrow
putter
Linnet
Yellowhammer

Indicators of well biotic and abiotic conditions
Grass Pipit



Map 2.1 Areas with the landscape half open and/or closed agricultural



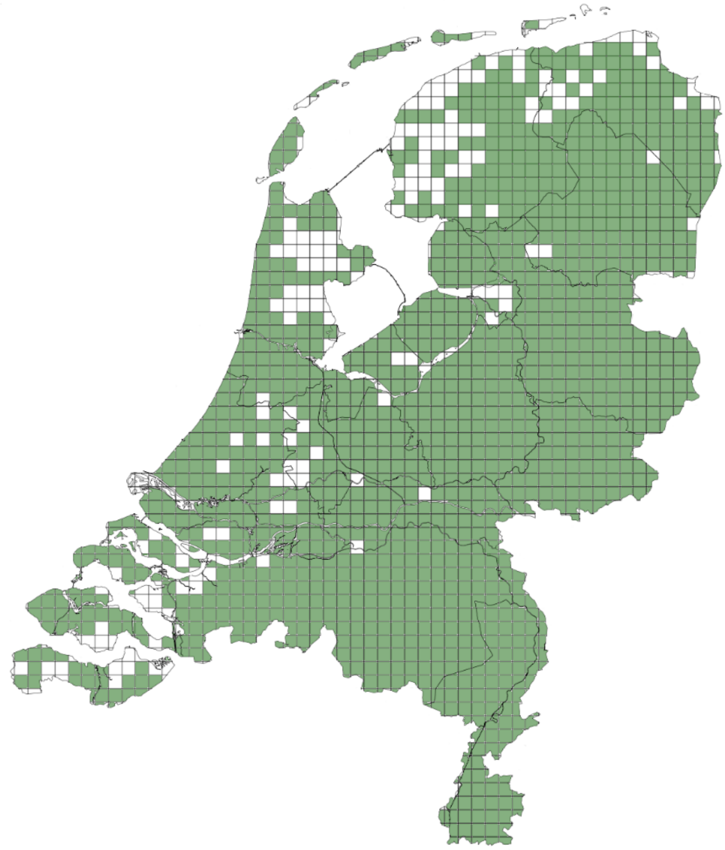
Map 2.2 Amount of indicator species for the landscape half open and/or closed agricultural

These areas are categorised by the large number of trees that can be found in the area. Common trees are oak and beech and can reach a height of 30m. The vegetation does not solely consist of trees but also bushes, grasses, mosses and mushrooms. The type of soil varies from moist areas surrounding the rivers and soils rich with loam to areas with large amounts of sand in the soil which were deposited by the glaciers during the ice age. A common aspect regardless of the type of soil is that all the areas have a low score considering the availability of nutrients. Examples of these areas which have high quality forests and therefore essential for a large variety of breeding birds can be found at the Veluwe, Utrechtse Heuvelrug, the south and/or west of Drente and the Sallandse heuvelrug.

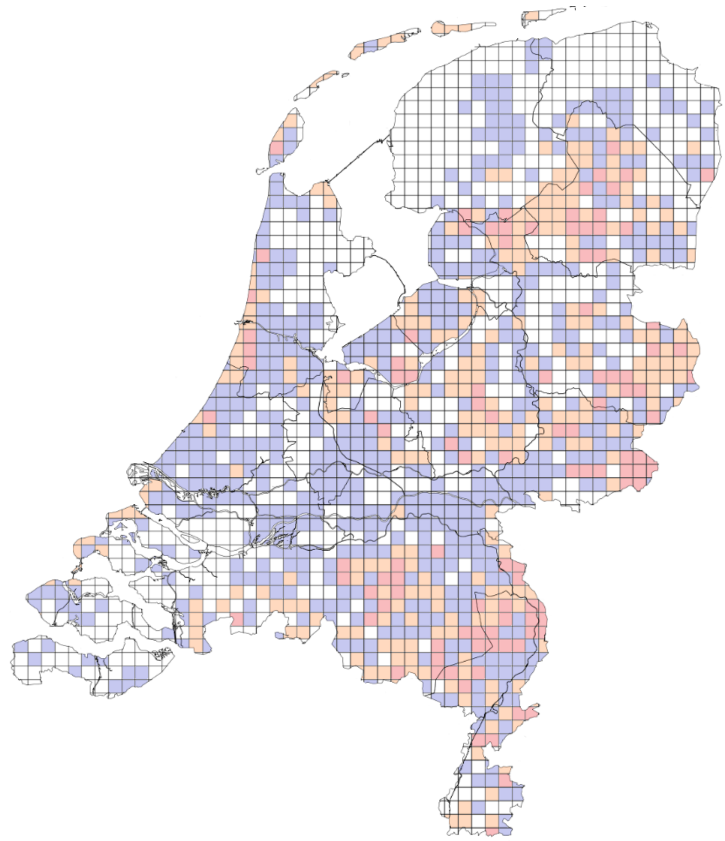
Map 3.1 shows the number of plots that can be categorised as forest. These areas can be found all across the country. Map 3.2 shows the areas where the indicator species for this landscape can be found. The lowest quality of forest can be found in the and becomes increasingly more diverse near the east. With the highest quality of forest in Brabant, Gelderland and Drenthe.

Forest Areas indicators	
Hawfinch	long-eared owl
honey buzzard	Nightjar
Hawk	wryneck
Whistler	Green woodpecker
goldcrest	Black Woodpecker
fire crest	Middle Spotted Woodpecker
Pied Fly Catcher	Lesser Spotted Woodpecker
glossy head	woodlark
Matt head	tree beeper
crested tit	Nightingale
black tit	Collared Redstart
nuthatch	sparrowhawk
Taiga Tree creeper	Buzzard
oriole	Woodcock
Raven	Siskin
stock dove	crossbill
Turtle Dove	Bullfinch
tawny owl	

Indicators of well biotic and abiotic conditions
Woodcock
Nightingale
honey buzzard



Map 3.1 Areas with the landscape Forest



Map 3.2 Amount of indicator species for the landscape Forest

Heath, raised moor and shifting sand

heath, raised moor and shifting sand
This type of nature consists of three different types. Since there are many similarities and overlaps between the types it is possible to group them together.

Heath
categorising for this area is the type of vegetation that can be found. Which mostly consist of heather, shrubs, moss and a small number of trees. This landscape was created as a by-product of the farming methods during the Middle Ages. During this period forests were cut down to create farmland. After a period of intensive farming the ground had lost its nutrients and as a conscience can only provide a habitable area for a certain type of species. This habitat can be found in areas with a lot of sand in the soil and in areas with peat bogs. There is a great amount of moisture in the ground which consists of only sweet water.

Raised moor
This habitat is categorised by the process in which this habitat is formed. The amount of organic material that is created by moss exceeds the amount of material that can be broken down. As a result, the landscape itself is raised over a long period of time. At the same time the soil retains water thus reducing the possibility of the material to be broken down. The vegetation that grows in these areas are of course mosses, small shrubs and heather. Similar to the previous described area this habitat also does not have a lot of nutrients in the soil. There is also a great amount of moisture in the ground which consists of only sweet water.

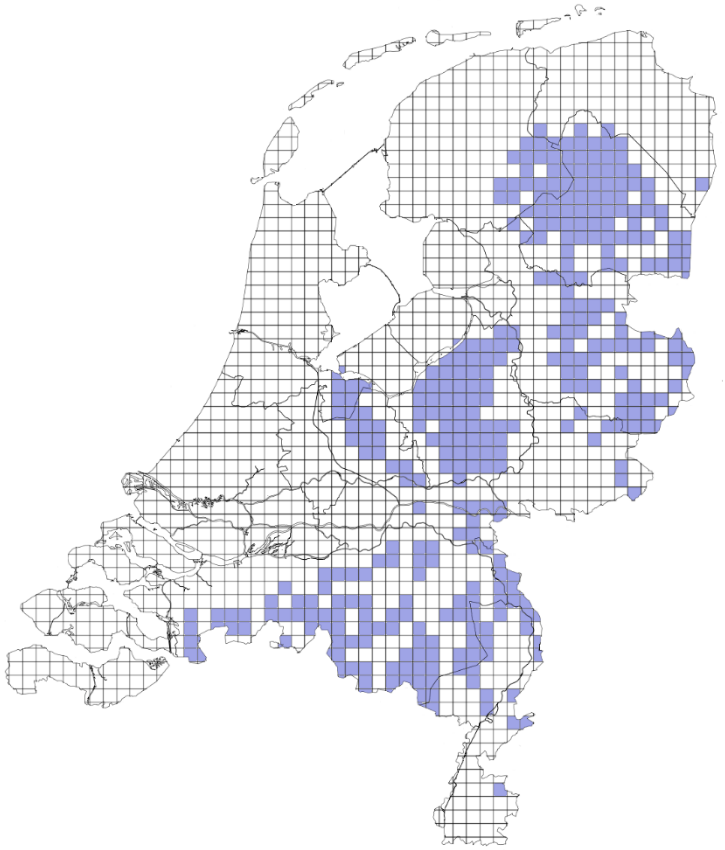
Heath, Raised moor and shifting sand indicators
Grebe
Black Grebe
Teal
Spring rooster singer
Red-backed Shrike
Gray shrike
Short-eared owl
Nightjar
Wryneck
Woodlark
Skylark
Dune pipit
Tree beeper
Bluethroat
Winchat
European Stonechat
Wheatear
Black grouse
Curlew
Yellowhammer

Indicators of well biotic and abiotic conditions
Bluethroat
Grasshopper warbler
Redshank
Snipe
Teal
Woodlark
Skylark
Woodcock
Central European Bullfinch
Wheatear
Grebe

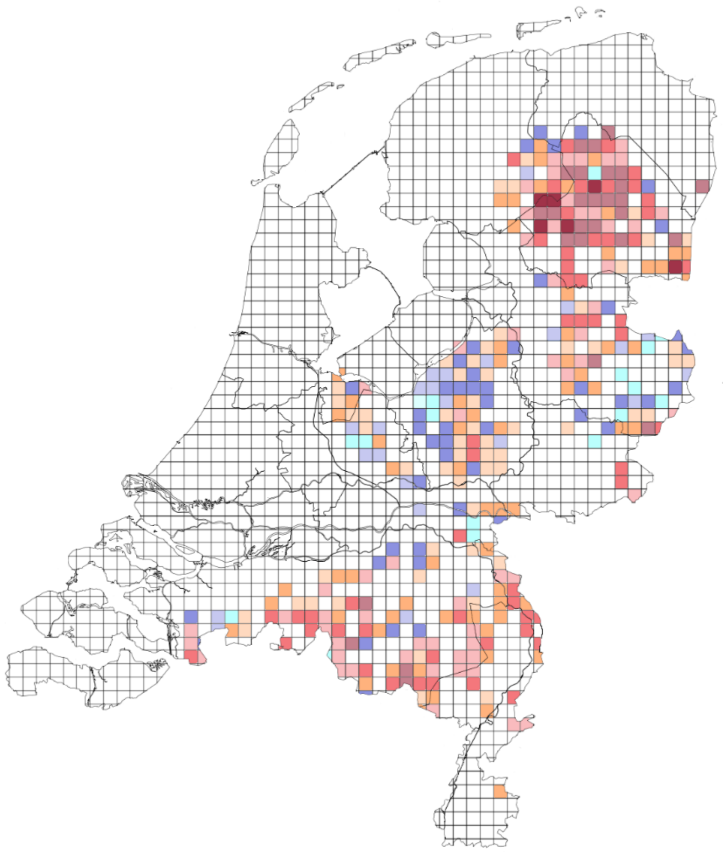
Shifting sand

This landscape can occur in small quantities as part of the heath landscape. It consists of open sandy spaces without a lot of vegetation and without a large variety of species. Plants that do survive in these habitats are heather plants. These areas were created thousand years ago by sand being blown away by the wind and have settled in the area. The soil is dry and does not contain a lot of nutrients.

Map 4.1 shows which areas in The Netherlands can be assigned this habitat. It shows that most of the areas are located in the east of The Netherlands. It is especially common in Drenthe, Gelderland and Brabant. Map 4.2 shows the amount of indicator species in the area. Since this habitat has a lot of indicator species the differences between the areas are well defined. It shows a large hotspot in Drenthe and smaller isolated areas in Brabant and Limburg



Map 4.1 Areas with the landscape Heath, Raised moor and shifting sand



Map 4.2 Amount of indicator species for the landscape Heath, Raised moor and shifting sand

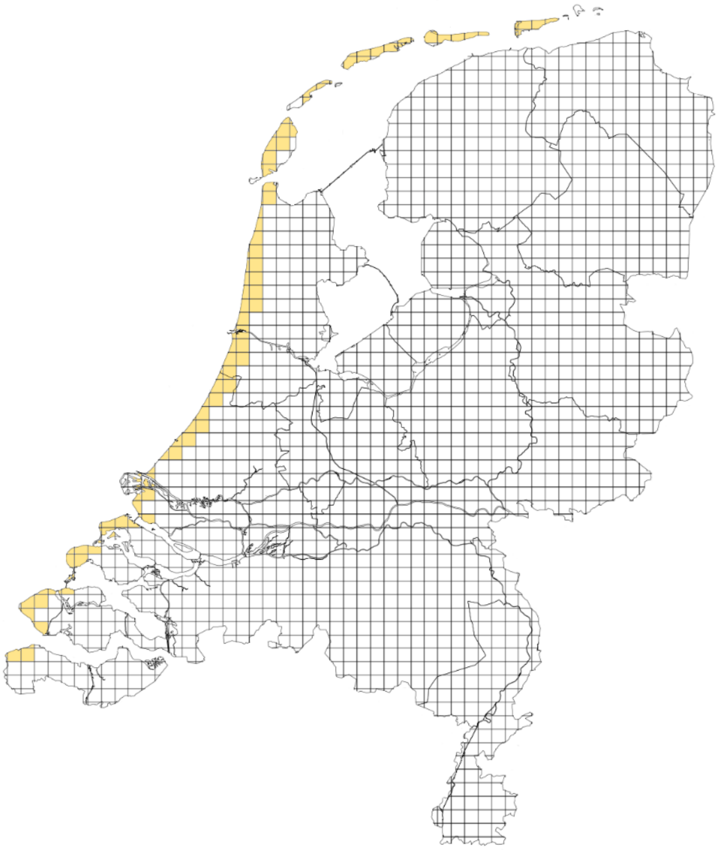
Dunes

This habitat can be categorised by its location and its function. It is located between the sea and the inland being a separation between salt areas and sweet areas. The dunes function as a natural protection against the sea to prevent flooding. This habitat can periodically be flooded. The frequency does not pose any problem for the structure of the dunes. It does however influence the vegetation that can be found. An example of a plant that fleurences in these circumstances is Bandwheatgrass. This species is of great importance for the creation of new dunes. It holds onto the sand surrounding the plants and over time due to uplifting sand that is slowed down by the grass creates new dunes. The further away from the sea and the salted water Helm is the most common type of vegetation. The roots of this plant can grow several metres deep to reach sweetened water located beneath the earth. This is essential for the viability of the dunes. The level of nutrients found in this habitat range from having a below average amount of an above average amount. The difference in the amount of salt in the soil varies from having a lot of salt on the beach side of the dunes and a very low amount of salt on the inland side of the dune.

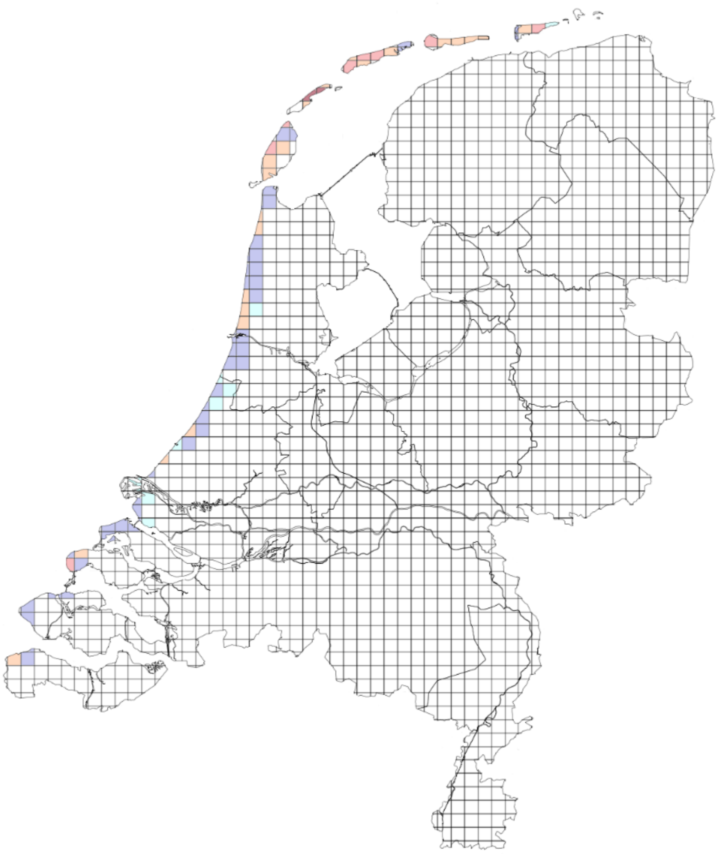
Map 5.1 shows the areas that can be categorized by dunes. As one would expect the dunes are located at the west coast of The Netherlands. The coastline from the northern provinces Friesland and Groningen do not have a dune like area. Instead, the Waddeneilanden which are located for the coast have the dune-like areas. Map 5.1 shows the amount of indicator species in an area. The levels of biodiversity can be divided into two areas. The coastline of the mainland has a low amount of indicator species. The couple of areas on the inland side of the dudes have the least amount of indicator species. The most indicator species can be found on the Waddeneilanden.

Dune indicators
Hen Harrier
Common Grasshopper Warbler
Common Whitethroat
European Turtle Dove
Short-eared Owl
Common Nightingale
Whinchat
European Stonechat
Northern Wheatear
Curlew
Mew Gull
Lesser Black-backed Gull
European Herring Gull
Yellow-legged Gull
Great Black-backed Gull
Common Linnet
Lesser Redpoll
Common Rosefinch

Indicators of well biotic and abiotic conditions
Wheatear
Grebe
Whinchat
Common Grasshopper Warbler
Curlew



Map 5.1 Areas with the landscape Dunes



Map 5.2 Amount of indicator species for the landscape Dunes

Salt marsh areas and beaches

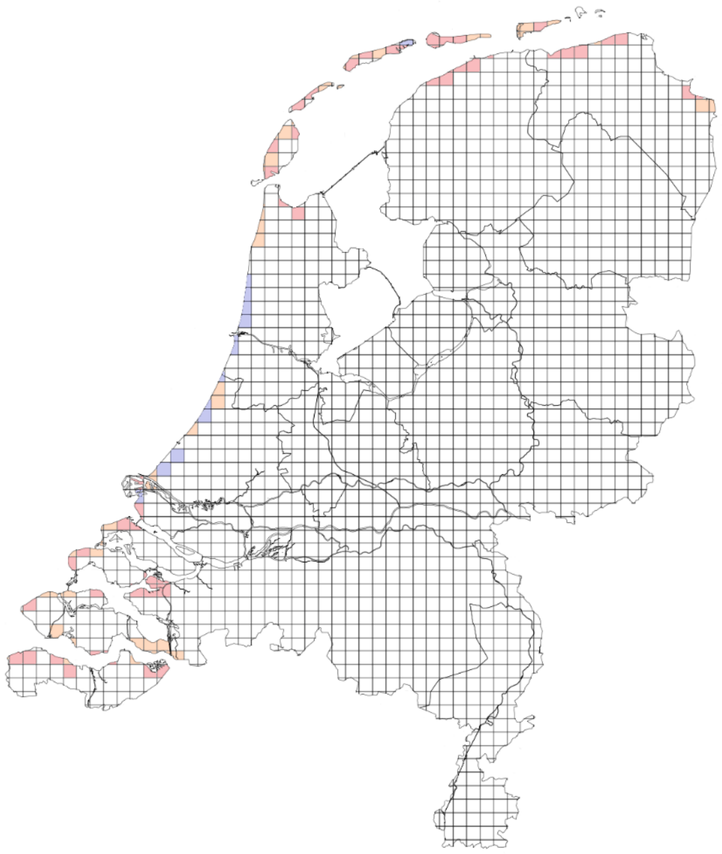
These areas are adjacent to the sea and oceans but can also be found in other salty areas near the coast. They typically consist of sand and pebbles, but vegetation can exist. This is mostly in the form of Juncus, rushes, herbs and reeds. The original species of mud grass that used to flourish on the European coast has disappeared. The species of vegetation that can grow in a certain area is dependent on a number of factors: the altitude, type of soil, salt content, age of the area and the amount of grazing that has taken place. There are areas where a different kind of vegetation grows. These areas are periodically underwater. Because of this water plants can grow. The amount of water and the salt content have the greatest influence on the species of plants. The amount of nutrients in the soil range from having an average amount to having a high amount of nutrients.

Unsurprisingly the areas in The Netherlands that can be categorised as this type of habitat are located near the coast. Exemptions are the inward waters in Zeeland and the Waddeneilanden since those are surrounded by water as shown in map 6.1. Map 6.2 shows the areas in The Netherlands with a lesser amount of indicator species and the areas with a larger amount. The coastal areas in Zuid-holland and Noord-holland (with the exception of the northern areas) have less indicator species. The coastal areas in Zeeland, northern part of The Netherlands adjacent to the sea and the Waddeneilanden have a larger amount of indicator species.

Salt marsh areas and beaches indicators
Little Egret
spoonbill
shelduck
Eider
Middle Sawbill
Grass Warbler
grass pipit
Oystercatcher
avocet
Ringed Plover
beach plover
Pied Sandpiper
redshank
little gull
sandwich tern
common tern
Arctic Tern
dwarf tern

Indicators of well biotic and abiotic conditions
shelduck
avocet
redshank

Map 6.1 Areas with the landscape Salt marshes and Beaches



Map 6.2 Amount of indicator species for the landscape Salt marshes and Beaches

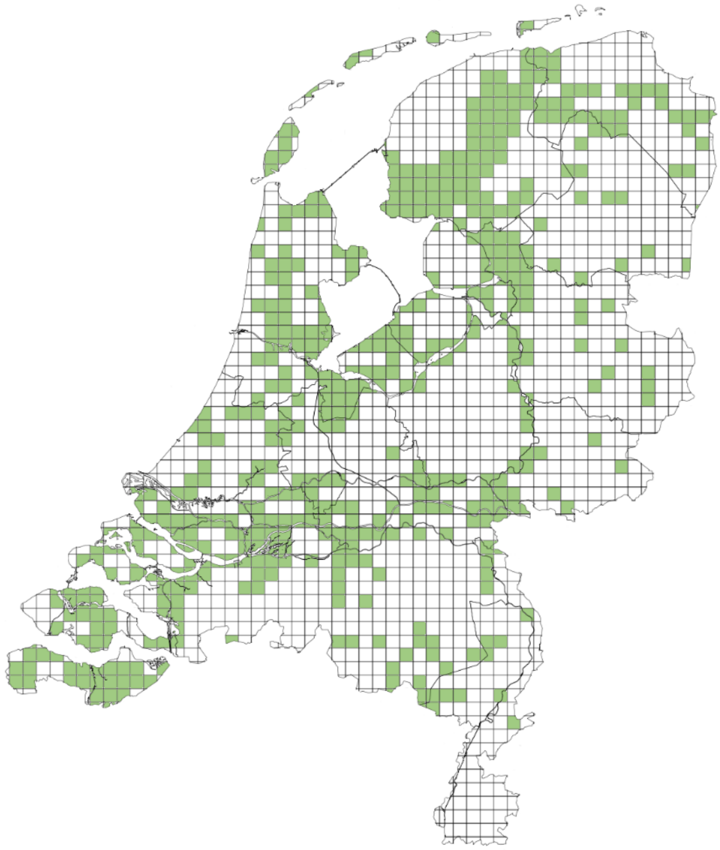
Swamp areas

Characterised by their wet and damp terrain. Vegetation like small peat-forming vegetation, non-grass species like the Cyperaceae and night mosses can be found in these areas. The ground in which these plants grow can range from lacking nutrients to an area with a mediocre amount of nutrients. The fields in which these plants grow maintain a level of moisture during the year. The Large difference in the vegetation makes the habitat quite complex. Swamps with a larger concentration of chalk can be found near creeks and riverbeds. In these habitats even rare species of plants can exist. An example of this is the swamp wasp orchid and the dioecious sedge. The Cladium mariscus is also a rare species of plant that can be found in The Netherlands. This plant is characterised by its razor-sharp edges. The sedge vegetation found in this habitat share a visual similarity to grasslands.

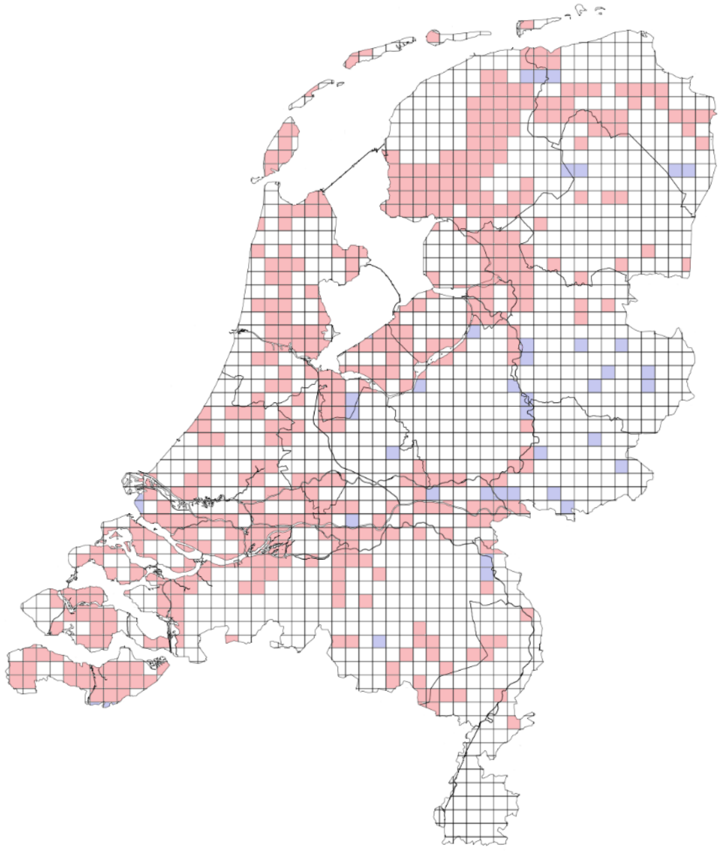
Map 7.1 shows the different areas in The Netherlands that can be categorised as swamps. Although the areas can be found sporadically throughout The Netherlands the larger amount can be found near the delta of the rivers and areas with a large number of lakes mostly located in the more western part of The Netherlands. An example of this is the province of Friesland. Map 7.2 shows the areas with a larger amount of indicator species and areas with a lesser amount. Interesting is that not only are the swamp areas located in the western part of The Netherlands, but also contain a large amount of keystone species.

Swamp areas indicators
Little Grebe
Eurasian Bittern
Little Bittern
Black-crowned Night Heron
Little Egret
Western Great Egret
Purple Heron
Eurasian Spoonbill
Greylag Goose
Garganey
Northern Shoveler
Red-crested Pochard
Common Pochard
Western Marsh Harrier
Common Grasshopper Warbler
Savi's Warbler
Sedge Warbler
Marsh Warbler
Eurasian Reed Warbler
Great Reed Warbler
Bearded Reedling
Eurasian Penduline Tit
Bluethroat
Water Rail
Spotted Crake
Little Crake
Baillon's Crake
Black Tern

Indicators of well biotic and abiotic conditions
Marsh Warbler
Bluethroat



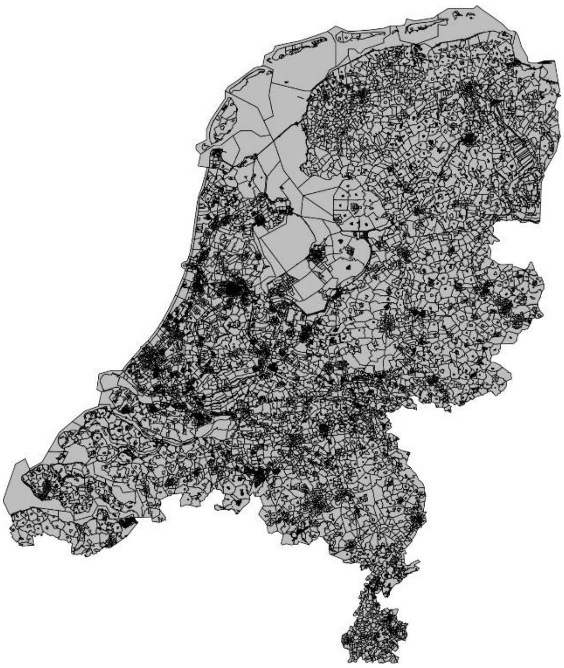
Map 7.1 Areas with the landcape Swamp

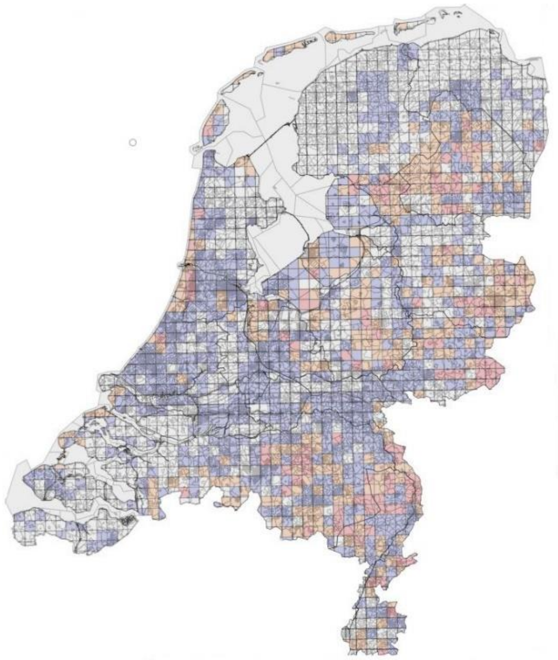


Map 7.2 Amount of indicator species for the landscape Swamp

Grading the biodiversity of the different areas in The Netherlands

In the previous part different maps were created per landscape that indicate the amount of indicator species. This part will describe the process of using those maps to determine the amount of biodiversity for the different areas in The Netherlands. The coloured maps indicating the amount of indicator species do not have the amount of detail to distinguish one neighbourhood from another. In this case the maps buurten en wijken from the Dutch government is used. This map provides a detailed description of the different neighbourhoods in The Netherlands. necessary for the task is the use of a computer program that would allow for different maps to be placed on top of each other. This would allow the indicator maps to be shown on top of the maps showing the neighbourhoods. The first map shows the different neighbourhoods and municipalities, and the second map shows the situation in which the map of the amount of indicator species is placed on top of the map of the neighbourhood. For this example, the maps for the location of the indicator species for forest is used.





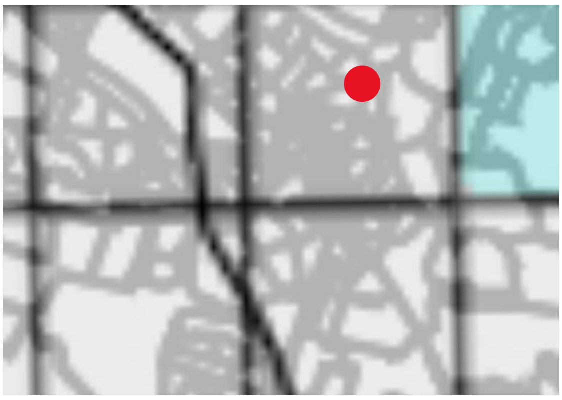
The process

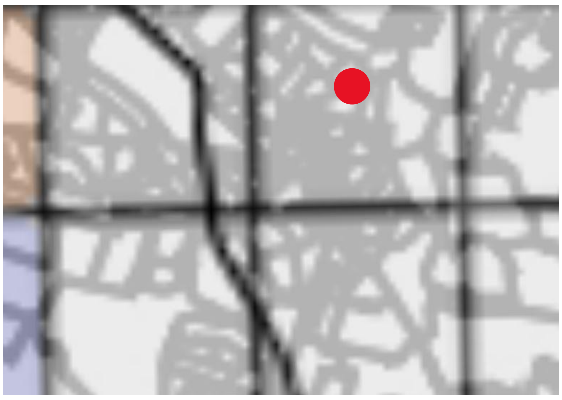
At first a municipality is chosen from the list of municipalities and neighbourhoods of The Netherlands. This is an alphabetical list that corresponds with the list in which the health of that area is documented. Secondly the location of the municipality is found with the use of Google Maps. After having found the location on Google Maps it is possible to locate the position on the map of the neighbourhoods of The Netherlands by the shape of the municipality and its distance to recognizable points. Having located the municipality and placing it in the centre of the frame the same steps that were taken to locate the municipality can be used to locate the different neighbourhoods of that municipality. If a neighbourhood is found the different layers can be turned on showing the amount of indicator species for that neighbourhood. The amount of indicator species is counted and placed in an Excel file. This process is repeated for every municipality and every neighbourhood in The Netherlands. This is a very time-consuming activity, but it creates a more detailed image of the biodiversity in The Netherlands than for example only looking at the municipality. An example of this process is shown below.

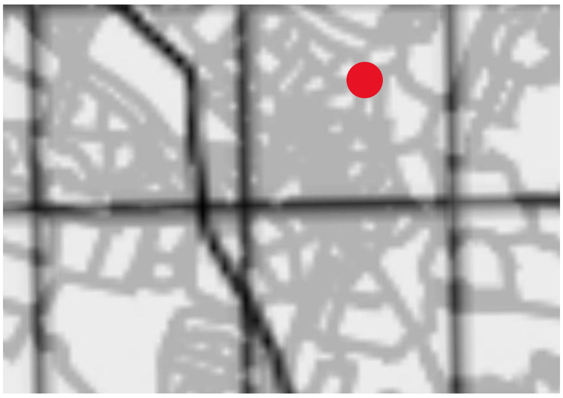
example
For this example the amount of indicator species for the neighbourhood vogelenbuurt will be documented. This neighbourhood is in an area called Noord-Oost in the city of Utrecht. The first step would be to find the municipality of Utrecht.

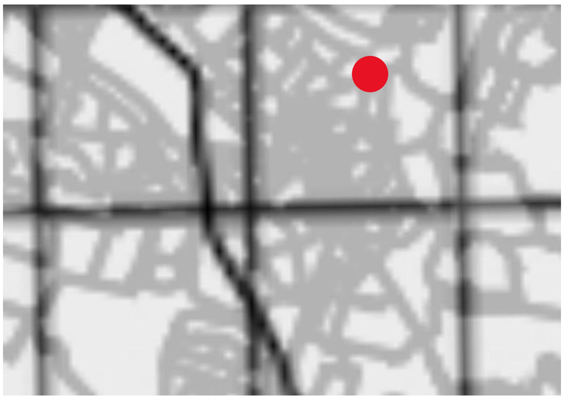
The second step would be to locate the area in which the neighbourhood is located.

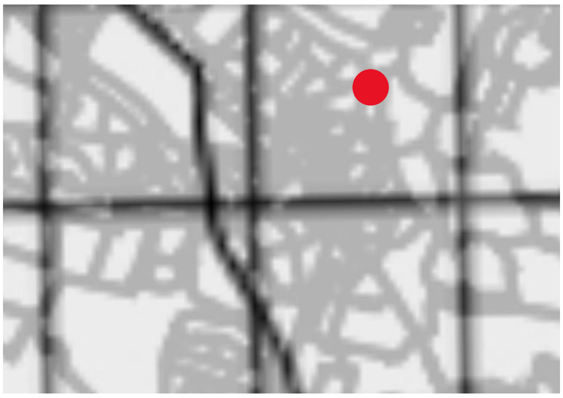
The third step is to locate the area on the map with all the different layers. This map is divided into a raster of 5km by 5km. If the whole area fits into that raster the number of indicators would be the same for all the neighbourhoods who are in that area. In the city this is often the case since the neighbourhoods are much closer together. In rural areas for example Friesland the neighbourhoods are so far apart that the number of indicators is different between neighbourhoods in the same area. After this it is possible to switch between the different maps to count the amount of indicator species per landscape. The darker red a square is, the larger the amount of indicator species in that area. The colour depends on the amount of indicator species that could be found for that landscape. A landscape with three indicator species would have blue, orange, and red. A landscape with five indicator species would have light blue, dark blue, orange, light red and red. The different layers are presented in the images below.

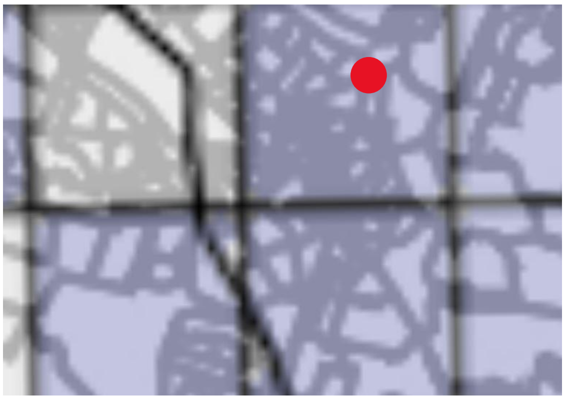












With the information from the indicator maps we can fill in the amount of indicator species into the Excel file. On the next page is the section placed referring to this the location of the Vogelenbuurt and the surrounding neighbourhoods located in Noord-Oost. The Excel file can be used for the analysis's which will be discussed in the next part.

Name	Region Type	*heath, raised moor and shifting sand*	*Open agricultural areas*	*Salt marsh areas and beaches*	*Half open and closed agricultural areas*	*Dunes*	*Forrest*	*Swamp*
Utrecht	Municipality	0	0	0	1	0	1	0
Noordoost	Area	0	0	0	1	0	1	0
Vogelenbuurt	Neighbourhood	0	0	0	1	0	1	0
Lauwerecht	Neighbourhood	0	0	0	1	0	1	0
staatsliedenbuurt	Neighbourhood	0	0	0	1	0	1	0
Tuinwijk-West	Neighbourhood	0	0	0	1	0	1	0
Tuinwijk-Oost	Neighbourhood	0	0	0	1	0	1	0
Tuindorp en Van Lieflandlaan-West	Neighbourhood	0	0	0	1	0	1	0
Tuindorp-Oost	Neighbourhood	0	0	0	1	0	1	0
Voordorp en voorveldsepolder	Neighbourhood	0	0	0	1	0	1	0
Huizingalaan K. Doormanlaan en omgeving	Neighbourhood	0	0	0	1	0	1	0
Zeeheldenbuurt, Hengeveldstraat en omgeving	Neighbourhood	0	0	0	1	0	1	0
Wittevrouwen	Neighbourhood	0	0	0	1	0	1	0

Table 1.1 Example of the amount of indicator species in the Excel file

Performing the analysis

In the previous part all the required information was gathered and placed in the SPSS file. In this part the analysis is performed to determine if there is a relation between the amount of biodiversity in an area and the health of the residents. This chapter of the document is divided into four parts. First the SPSS file will be explained. Secondly the control variables will be showed. In the third part the mixed model analysis will be explained. In the fourth and last part the generalized linear mixed model will be explained.

The SPSS file

In this part of the chapter the different variables and their functions will be explained. This will provide clarity and makes the next chapters easier to understand.

name	*Measurement*	*Indication*
Neighbourhood	Nominal	Indicates the Neighbourhood. Derived from the RIVM
MunicipalityRIVM	Nominal	Indicates the Municipality. Derived from the RIVM
TypeRegionRIVM	Nominal	Indicates the size of the region
RegionCode	Nominal	Code used by the RIVM to identify an area
Heath, raised moor and shifting sand	Nominal	The amount of indicator species ranging from 0-10
Open agricultural area	Nominal	The amount of indicator species ranging from 0-3
Beaches	Nominal	The amount of indicator species ranging from 0-3
Half open and closed agricultural area	Nominal	The amount of indicator species ranging from 0-1
Dunes	Nominal	The amount of indicator species ranging from 0-5
Forest	Nominal	The amount of indicator species ranging from 0-3
Swamp	Nominal	The amount of indicator species ranging from 0-2
HealthRIVM	Scale	Overall health reported by the residents
SmokingRIVM	Scale	Percentage of people who regular smoke
ObisityRIVM	Scale	Percentage of people who suffer from obesity
ObisityMorbideRIVM	Scale	Percentage of people who suffer from morbid obesity
ExcerciseNormRIVM	Scale	Percentage of people who exercise the advised amount by the RIVM
PhyicalHealthCronRIVM	Scale	Percentage of people who suffer from chronic health conditions
FearDepressionMediumRiskRIVM	Scale	Percentage of people with a medium risk of fear and/or depression
FearDepressionHighRiskRIVM	Scale	Percentage of people with a high risk of fear and/or depression
StressRIVM	Scale	Percentage of people who suffer from stress
LonlinessRivm	Scale	Percentage of people who suffer from loneliness
LonlinessServereRIVM	Scale	Percentage of people who suffer from severe loneliness
Urbanisation	Nominal	Amount of people within 1 square kilometre
UrbDegree	Nominal	Scale of urbanisation ranging from 1-6
Biodiversity2	Nominal	Biodiversity score based on the available indicator

	species in the different areas.

Table 1.2 names of variables used in SPSS

The names in this document might vary from the names used in the SPSS file. This is done because some of the names used in the SPSS file are difficult to relate to their subject.

Control variables
This term related to variables that are used in a analysis to reduce the possibility that an observed effect is actually caused by a different unknown variable. In this analysis three control variables were used. These are: smoking, obesity and urbanisation. Smoking and obesity have been thoroughly researched and have been proven without a doubt that they have a negative influence on the human health. The degree of urbanisation is used in this analysis to accommodate the sample size. The sample size used in the analysis is an area of 5 square kilometres. This could mean that a very populated area is surrounded by an areas with high quality nature. This areas would then receive a high biodiversity score, even though the inhabitants of the area would have little to none interaction with the surrounding area. In this case the degree of urbanisation would show that a lot of people are living in the same area. the model could then correct the results based on the degree of urbanisation. The importance of these three control variables become visible during the analysis since most if not all of the aspect of health have a significant relation with these variables.

The mixed model analysis
The method used for the first analysis will be a mixed model analysis. This model allows for the use of fixed effects and random effects. Health itself can be divided into multiple categories to create a more detailed analysis. These categories are overall health, smoking, Obesity, morbid obesity, chronic physical conditions, medium risk of fear and/or depression, high risk of fear and/or depression, stress, loneliness, severe loneliness and the amount of people who exercise the advised amount. These categories will be the dependable variable in the analyses. A variable has a significant effect on human health if the p-value has a percentage of 5% or lower. This is indicated in the table by the Sig. A Sig of 0.05 or lower would indicate a significant relation. The analysis starts by calculating the significance of the different landscapes in combination with smoking and obesity. When a landscape is found to have a significant impact that landscape can then be singled out to examine if the degree of biodiversity has an additional influence. The zero in this table is an indication for an area that has zero indicator species, or the area does not contain the landscape. The number indicates the amount of indicator species in that area. This could show an additional significance between the amount of indicator species. The table with the comparison between the amount of indicator within the same landscape can be found in appendix 2. After a significance is found the size of the effect is then calculated with the standardized mean difference. The outcome of this calculation can provide the size of the effect. A number between 0 and 0,2 would indicate an effect that is too small to be of relevance. A number between 0,2 and 0,5 indicates that the effect is small. A number between 0,5 and 0,8 would indicate a medium effect. Lastly, a number between 0,8 and 1,4 would indicate a large effect. The syntax used to determine which landscape have a significant relation is shown below. In this example the aspect of health is the overall health of the residents of an area.

```
MIXED HealthRIVM BY Heidehoogveenenstuifzand Openagrarischgebied strand Halfopenengeslotenagrarischgebied Duinen Bossen Moeras WITH SmokingRIVM ObisityRIVM Urbanisation
/CRITERIA=CIN(95) MXITER(100) MXSTEP(10) SCORING(1) SINGULAR(0.000000000001) HCONVERGE(0, ABSOLUTE) LCONVERGE(0, ABSOLUTE) PCONVERGE(0.000001, ABSOLUTE)
/FIXED=SmokingRIVM ObisityRIVM Urbanisation Heidehoogveenenstuifzand Openagrarischgebied strand Halfopenengeslotenagrarischgebied Duinen Bossen Moeras | SSTYPE(3)
/METHOD=ML
/PRINT=LMATRIX SOLUTION TESTCOV
/RANDOM=INTERCEPT | SUBJECT(MunicipalityRIVM) COVTYPE(ID)
/EMMEANS=TABLES(OVERALL)
```

When this syntax is executed a list of relevant landscape is shown. A landscape from this list can then be placed in the syntax below to compare the different amount of indicator species and their relation to aspects of health. In the syntax below the aspect of health that will be analysis is again the overall health. The landscape that is used in this example is forest.

```
MIXED HealthRIVM BY Heidehoogveenenstuifzand Openagrarischgebied strand Halfopenengeslotenagrarischgebied Duinen Bossen Moeras WITH SmokingRIVM ObisityRIVM Urbanisation
/CRITERIA=CIN(95) MXITER(100) MXSTEP(10) SCORING(1) SINGULAR(0.000000000001) HCONVERGE(0, ABSOLUTE) LCONVERGE(0, ABSOLUTE) PCONVERGE(0.000001, ABSOLUTE)
/FIXED=SmokingRIVM ObisityRIVM Urbanisation Heidehoogveenenstuifzand Openagrarischgebied strand Halfopenengeslotenagrarischgebied Duinen Bossen Moeras | SSTYPE(3)
/METHOD=ML
/PRINT=LMATRIX SOLUTION TESTCOV
/RANDOM=INTERCEPT | SUBJECT(MunicipalityRIVM) COVTYPE(ID)
/EMMEANS=TABLES(bossen) COMPARE ADJ(LSD).
```

The generalized linear mixed model

The first analysis focusses on the relation of the amount of indicator species within the same landscape. To achieve the goal of this research document areas with a combined landscape need to be compared. This is where the second analysis comes in. For this analysis the total amount of indicator species per landscape is used to create a biodiversity score. This is done by counting all the landscapes in an area with an amount of indicator species above two. The exception here is half open and closed agricultural areas. Since this landscape only has one indicator specie the limit for being included in the calculation is set to one. This gives every area a biodiversity score of 0-6. An area of 0 has a very low amount of high quality nature and an area with a biodiversity score of 6 have the most amount of high quality nature. The syntax below was used to research the relation between the amount of biodiversity and the different aspects of health. In the example below the aspect of health is the overall health of the residents.

```
GENLINMIXED
 /DATA_STRUCTURE SUBJECTS=UrbDegree*MunicipalityRIVM
/FIELDS TARGET= HealthRIVM TRIALS=NONE OFFSET=NONE
/TARGET_OPTIONS DISTRIBUTION=NORMAL LINK=IDENTITY
/FIXED EFFECTS=Biodiversity2 SmokingRIVM ObisityRIVM USE_INTERCEPT=TRUE
/RANDOM USE_INTERCEPT=TRUE SUBJECTS=UrbDegree COVARIANCE_TYPE=VARIANCE_COMPONENTS SOLUTION=FALSE
/BUILD_OPTIONS TARGET_CATEGORY_ORDER=ASCENDING INPUTS_CATEGORY_ORDER=ASCENDING HCONVERGE=0.00000001(RELATIVE) MAX_ITERATIONS=100 CONFIDENCE_LEVEL=95 DF_METHOD=RESIDUAL COVB=ROBUST SCORING=0 SINGULAR=0.000000000001
/EMMEANS TABLES=Biodiversity2 COMPARE=Biodiversity2 CONTRAST=DEVIATION
/EMMEANS_OPTIONS SCALE=ORIGINAL PADJUST=LSD.
```

Validation

In the next part of the document the effects of the different areas are analysed. Form this analysis a list could be created in which specified the amount of biodiversity and its relation to health. With this information it is possible to determent the effect of each area. In this part of the document the validity of the model and the results are discussed. This will start by checking if the data presented by the RIVM experiences skewness and kurtosis. Secondly, the model itself will be analysed to see if there is a good fit.

Distribution of the data
A normal distribution of the data would ensure that the result are valid. A simple check can be performed on the amount of skewness and the amount of kurtosis of the data. As a rule, if the kurtosis and skewness is above 1,5 and lower than -1,5 additional measure have to be taken in order to create valid results. The table below show the amount of kurtosis and skewness per aspect of health.

Aspect of health	Amount of kurtosis	Amount of skewness
Overall health	1,542	-0,974
Smoking	1,330	1,002
Obesity	0,651	0,457
Morbid obesity	0,651	0,457
Chronic physical conditions	1,186	0,355
Fear and depression (medium)	0,402	0,597
Fear and depression (high)	2,445	1,440
Loneliness	0,897	0,926
Severe loneliness	1,827	1,223
stress	1,381	1,080
Meeting the advised amount of physical activity	1,876	0,117

Table 1.3 Amount of kurtosis and skewness

This shows that the amount of kurtosis and skewness is low. However, there are aspects of health with a score that exceeds the desired amount of 1,5 and -1,5. During the analysis it might become apparent that the skewness and kurtosis deform the results of the data. When this happens, a bootstrap can be performed in order to create a mean that has a larger reliability.

Part three: Results

introduction

This part of the documents focusses on the results that are generated from the analysis. This part is divided by the different aspects of heath as mentioned in the chapter about data gathering. The areas and who present and significant influence in relation to the aspect of health are then described. Also, the effect sizes will be mentioned in order to understand the amount of influence that an area has. The second validation is performed on the data itself to see if there are abnormalities within the data.

Overall health

The first performed test used the overall health of the inhabitants as the dependable variable. The table below shows the outcome of this test.

Mixed Model: Health RIVM	
	Sig.
Smoking	0,000
Obesity	0,000
Urbanisation	0.000
Heath, raised moor and shifting sand	0,002
Open agricultural area	0,937
Beaches	0,130
Half open and closed agricultural area	0,233
Dunes	0,202
Forest	<0,001
Swamp	0,608
a. Dependent Variable: Health RIVM	

Table 1.4 Mixed model results with dependent variable health

This test indicates that there is a significant relation between the percentage of people suffering from Chronic physical health conditions and the following landscapes: heath, raised moor and shifting sand, beaches, dunes, forests and swamps. The previous analysis focused on the different landscapes and their perceived effect on health. The following analysis focuses on the difference between the amount of indicator species within the same landscape.

heath, raised moor and shifting sand

The table shown in the appendix shows the significance between the amount of indicator species for the landscape heath, raised moor and shifting sand. A significant relation can be found between areas with six indicator species and areas without this landscape or without any indicator species, two, three, four, five, seven, eight and nine indicator species. A second significant relation can be found between areas with nine indicator species and areas with one, four, five, seven, ten and areas without this landscape or without any indicator species. Firstly, the standardized mean difference is calculated for the effect of the landscape heath, raised moor and shifting sand with six indicator species in relation to areas without this landscape or without any indicator species, two, three, four, five, seven, eight and nine indicator species. This gives an effect size of 0,11, -0,17, 0,16, 0,16, 0,14, 0,09, 0,12, 0,17 and 0,32. The relation with an area with nine indicator species can be considered medium. The other effect sizes can be considered small. Secondly, the standardized mean difference is calculated for the effect of the landscape heath, raised moor and shifting sand with nine indicator species and areas with one, four, five, seven, ten and areas without this landscape or without any indicator species. This gives an effect size of -0,73, -0,18, -0,23, -0,21, -0,34 and -0,20. The relation with an area with one indicator species gives a large effect size. The relation with an area with ten indicator species gives a medium effect size. The other effect sizes are considered small.

Forrest

The table shown in the appendix shows the significance between the amount of indicator species for the landscape forest. A significant relation can be found between areas with one, two and three indicator species and areas without this landscape or without any indicator species. A second significant relation can be found between areas with one and two indicator species and areas with three indicator species. First The standardized mean difference is calculated for the effect of an area without the landscape forests or without any indicator species in relation to areas with one, two and three indicator species. This gives an effect of -0,06 -0,08 and -0,14. These effects can be considered to be small. Secondly the standardized mean difference is calculated for the effect of an area with three indicator species in relation to areas with one and two indicator species. This gives an effect of -0,08 and 0,07 which are considered small.

Smoking

The first performed test used the smoking of the inhabitants as the dependable variable. The table below shows the outcome of this test.

Mixed Model: Smoking RIVM	
	Sig.
Smoking	
Obesity	0,000
Urbanisation	0,000
Heath, raised moor and shifting sand	<0,001
Open agricultural area	0,377
Beaches	0,126
Half open and closed agricultural area	0,056
Dunes	0,079
Forest	0,007
Swamp	0,018
a. Dependent Variable: Smoking RIVM	

Table 1.5 Mixed model results with dependent variable smoking

This test indicates that there is a significant relation between the amount of smokers and the following landscapes: heath, raised moor and shifting sand, Open agricultural areas, beaches, Half open and closed agricultural areas, dunes, forests and swamps. The following analysis focuses on the difference between the amount of indicator species within the same landscape.

heath, raised moor and shifting sand

The table shown in the appendix shows the significance between the amount of indicator species for the landscape heath, raised moor and shifting sand. A significant relation can be found between areas with two indicator species and areas with one, five, seven, eight and nine indicator species. the standardized mean difference is calculated for the effect of areas with two indicator species and areas with one, five, seven, eight and nine indicator species. This gives an effect size of 0,78, 0,31, 0,20, 0,21 and 0,30. The effect size of the relation with areas with one indicator species can be considered large while the effect size of the relation with the other areas can be considered medium.

Additionally a significant relation can be found between areas with five indicator species and areas with three, four, six and areas without this landscape or without any indicator species. The standardized mean difference is calculated for the effect of areas with five indicator species in relation to areas with three, four, six and areas without this landscape or without any indicator species. This gives an effect size of -0,21, -0,19, -0,27 and -0,23. The effect size of the relation with areas with four indicator species can be considered small. The other effect sizes can be considered medium.

A significant relation can also be found between areas with one indicator species and areas with six and areas without this landscape or without any indicator species. The standardized mean difference is calculated for the effect of areas with one indicator species in relation to areas with six and areas without this landscape or without any indicator species. This gives an effect size of -0,83 and -0,74. Both effect sizes can be considered large.

forests

The table shown in the appendix shows the significance between the amount of indicator species for the landscape Forests. A significant relation on the number of smokers can be found in areas with three indicator species and areas without this landscape or without any indicator species, one and two indicator species. The standardized mean difference is calculated for the effect of an area without the landscape forest or without any indicator species in relation to areas with one indicator species. This gives an effect size of 0,09 this effect size is considered small.

Swamps

The table shown in the appendix shows the significance between the amount of indicator species for the landscape swamps. A significant relation can be found between areas with one indicator species and areas with two indicator species and areas without this landscape or without any indicator species. the standardized mean difference is calculated for the effect of an area with one indicator species in relation to areas without the landscape forest or without any indicator species and areas with two indicator species. This gives an effect size of -0,15 and 0,18. These effect sizes are considered small.

Obesity

The first performed test used the obesity rate of the inhabitants as the dependable variable. The tables below show the outcome of this test.

Mixed Model: Obesity RIVM	
	Sig.
Smoking	0,000
Obesity	
Urbanisation	<0,001
Heath, raised moor and shifting sand	<0,001
Open agricultural area	<0,001
Beaches	0,004
Half open and closed agricultural area	<0,001
Dunes	<0,001
Forest	<0,001
Swamp	0,034
a. Dependent Variable: Obesity RIVM	

Table 1.6 Mixed model results with dependent variable Obesity

This test indicates that there is a significant relation between the percentage of people suffering from obesity and the following landscapes: heath, raised moor and shifting sand, Open agricultural areas, beaches, Half open and closed agricultural areas, dunes, forests and swamps. The following analysis focuses on the difference between the amount of indicator species within the same landscape.

heath, raised moor and shifting sand
The table shown in the appendix shows the significance between the amount of indicator species for the landscape heath, raised moor and shifting sand. A significant relation can be found between areas with two indicator species and areas with three, four, five ,six, seven eight and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of -0,25, -0,28, -0,38, -0,28, -0,46, -0,46 and -0,25. These effect sizes can be considered medium. Additionally, a significant relation can be found with areas with seven indicator species and areas with four, six nine and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of 0,19, 0,16, 0,34 and 0,17. The effect sizes of the areas with four, six and areas without this landscape or without any indicator species can be considered small. The effect size of areas with nine indicator species can be considered medium. A significant relation can also be found between areas with five indicator species and areas with nine and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of 0,26 and 0,11. The effect size of areas with nine indicator species can be considered small, while the effect size of areas without this landscape or without any indicator species can be considered medium. A significant relation can also be found between areas with eight indicator species and areas with nine indicator species. When the estimated effect size is calculated this gives an effect size of 0,34. This effect size can be considered medium.

Open agricultural areas
The table shown in the appendix shows the significance between the amount of indicator species for the landscape open agricultural landscape. A significant relation can be found between areas without this landscape or without any indicator species and areas with one, two and three indicator species. When the estimated effect size is calculated this gives an effect size of -0,12, -0,14 and -0,17. These effect sizes can be considered small.

Beaches
The table shown in the appendix shows the significance between the amount of indicator species for the landscape beaches. A significant relation can be found between areas without this landscape or without any indicator species and areas with one and three indicator species. When the estimated effect size is calculated this gives an effect size of -0,31 and -0,22. These effect sizes can be considered medium.

half open and/or closed agricultural area
The table shown in the appendix shows the significance between the amount of indicator species for the landscape half open and/or closed agricultural areas. A significant relation

can be found between areas without this landscape or without any indicator species and areas with one indicator species. When the estimated effect size is calculated this gives an effect size of -0,08. These effect sizes can be considered medium.

Dunes
The table shown in the appendix shows the significance between the amount of indicator species for the landscape dunes. A significant relation can be found between areas without this landscape or without any indicator species and areas with two and three indicator species. When the estimated effect size is calculated this gives an effect size of 0,32 and 0,40. These effect sizes can be considered medium. Additionally a significant relation can be found between areas with one indicator species and areas with two and three indicator species. When the estimated effect size is calculated this gives an effect size of 0,36 and 0,45. These effect sizes can be considered medium.

Forest
The table shown in the appendix shows the significance between the amount of indicator species for the landscape forest. A significant relation can be found between areas without this landscape or without any indicator species and areas with one, two and three indicator species. When the estimated effect size is calculated this gives an effect size of 0,05, 0,08 and 0,18. These effect sizes can be considered small. Additionally a significant relation can be found between areas with three indicator species and areas with one and two indicator species. When the estimated effect size is calculated this gives an effect size of 0 0,12 and 0,11. These effect sizes can be considered small.

Swamp
The table shown in the appendix shows the significance between the amount of indicator species for the landscape swamp. A significant relation can be found between areas without this landscape or without any indicator species and areas with two indicator species. When the estimated effect size is calculated this gives an effect size of -0,05. This effect size is considered to be small.

Morbid obesity
The first performed test used the morbid obesity rate of the inhabitants as the dependable variable. The tables below show the outcome of this test.

Mixed Model:

Morbid Obesity RIVM	
	Sig.
Smoking	0,000
Obesity	0,000
Urbanisation	<0,001
Heath, raised moor and shifting sand	0,014
Open agricultural area	0,007
Beaches	0,024
Half open and closed agricultural area	<0,001
Dunes	<0,001
Forest	0,148
Swamp	0,006
a. Dependent Variable: Obesity Morbid RIVM	

Table 1.7 Mixed model results with dependent variable Morbid obesity

This test indicates that there is a significant relation between the percentage of people suffering from morbid obesity and the following landscapes: heath, raised moor and shifting sand, Open agricultural areas, beaches, Half open and closed agricultural areas, dunes and swamps. The following analysis focuses on the difference between the amount of indicator species within the same landscape.

heath, raised moor and shifting sand
The table shown in the appendix shows the significance between the amount of indicator species for the landscape heath, raised moor and shifting sand. A significant relation dan be found between areas with four indicator species and areas with three, five, six, seven, eight, nine and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of -0,11, -0,09, -0,08 and -0,08, -0,08, -0,10, -0,14 and -0,07. These effect size are considered small. Additionally a significant relation dan be found between areas with nine indicator species and areas with ten indicator species. When the estimated effect size is calculated this gives an effect size of 0,17. This effect size is considered small.

open agricultural area
The table shown in the appendix shows the significance between the amount of indicator species for the landscape open agricultural areas. A significant relation dan be found between areas with three indicator species and areas with one and two indicator species and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of -0,06, -0,04 and -0,05. These effect size are considered small.

Beaches
The table shown in the appendix shows the significance between the amount of indicator species for the landscape beaches. A significant relation dan be found between areas with three indicator species and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of -0,11 This effect size is considered small.

half open and/or closed agricultural area
The table shown in the appendix shows the significance between the amount of indicator species for the landscape half open and/or closed agricultural area. A significant relation dan be found between areas with one indicator species and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of 0,03 This effect size is considered small.

Dunes
The table shown in the appendix shows the significance between the amount of indicator species for the landscape dunes. A significant relation dan be found between areas with four indicator species and areas with one, two, three and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an

effect size of -0,68, -0,54, -0,65 and -0,60. These effect size are considered large.

Swamp
The table shown in the appendix shows the significance between the amount of indicator species for the landscape swamp. A significant relation dan be found between areas with two indicator species and areas with one and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of 0,06 and 0,02. These effect size are considered small.

Chronic physical conditions

The first performed test used chronic physical conditions of the inhabitants as the dependable variable. The tables below show the outcome of this test.

Mixed Model: Chronic conditions	
	Sig.
Smoking	0,288
Obesity	0,000
Urbanisation	0,000
Heath, raised moor and shifting sand	<0,001
Open agricultural area	0,455
Beaches	0,024
Half open and closed agricultural area	0,072
Dunes	<0,001
Forest	<0,001
Swamp	0,840
a. Dependent Variable: Physical Health Cron RIVM	

Table 1.8 Mixed model results with dependent variable chronic physical conditions

This test indicates that there is a significant relation between the percentage of people suffering from Chronic physical health conditions and the following landscapes: heath, raised moor and shifting sand, beaches, dunes, forests and swamps. The following analysis focuses on the difference between the amount of indicator species within the same landscape.

heath, raised moor and shifting sand

The table shown in the appendix shows the significance between the amount of indicator species for the landscape heath, raised moor and shifting sand. A significant relation dan be found between areas with nine indicator species and areas with one, four, five, six, seven, eight, ten and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of.0,87, 0,27, 0,27, 0,34, 0,22, 0,21, 0,48 and 0,27. The effect size of the relation with areas with one indicator species can be considered large, while the other effect sizes are considered medium. Additionally a significant relation can be found between areas with six indicator species and areas with two, three, four, five, seven, eight and areas without the landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of -0,21, -0,20, -0,09, -0,10, -0,14, -0,17 and 0,08. The effect size of the relation with areas with two indicator species can be considered medium, while the other effect sizes are considered small. A significant relation can also be found between areas with two indicator species and areas with one, four, ten and areas without the landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of 0,58, 0,14, 0,30 and 0,15. The effect size of the relation with areas with one indicator species can be considered large. The effect size of the relation with areas with ten indicator species can be considered medium, while the other effect sizes are considered small. A significant relation can also be found between areas with three indicator species and areas with one indicator species. When the estimated effect size is calculated this gives an effect size of 0,59. This effect size is considered large.

Beaches

The table shown in the appendix shows the significance between the amount of indicator species for the landscape beaches. A significant relation dan be found between areas with one indicator species and areas with two, three and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of 0,33, 0,24 and 0,18. The effect size of the relation with areas without this landscape or without any indicator species can be considered small, while the other effect sizes can be considered medium.

Dunes

The table shown in the appendix shows the significance between the amount of indicator species for the landscape dunes. A significant relation dan be found between areas without this landscape or without any indicator species and areas with one, two, three and four indicator species. When the estimated effect size is calculated this gives an effect size of -0,32, -0,24, -0,24 and -0,32. These effect sizes are considered medium.

Forests
The table shown in the appendix shows the significance between the amount of indicator species for the landscape forest. A significant relation dan be found between areas without this landscape or without any indicator species and areas with one, two and three indicator species. When the estimated effect size is calculated this gives an effect size of -0,10, -0,12 and -0,18. These effect sizes are considered small. Additionally a significant relation dan be found between areas with three indicator species and areas with one and two indicator species. When the estimated effect size is calculated this gives an effect size of 0,08 and 0,07. These effect sizes are considered small.

Medium risk of fear and/or depression

The first performed uses medium risk of fear and/or depression as the dependable variable. The tables below show the outcome of this test.

Mixed Model:	
Medium Risk	
	Sig.
Smoking	0,000
Obesity	<0,001
Urbanisation	<0,001
Heath, raised moor and shifting sand	0,026
Open agricultural area	0,040
Beaches	<0,001
Half open and closed agricultural area	0,024
Dunes	0,254
Forest	0,010
Swamp	0,492
a. Dependent Variable: Fear Depression Medium Risk RIVM	

Table 1.9 Mixed model results with dependent variable medium risk of fear and depression

This test indicates that there is a significant relation between the percentage of people with a medium risk of fear and/or depression and the following landscapes: heath, raised moor and shifting sand, Open agricultural areas, beaches, Half open and closed agricultural areas and forest. The following analysis focuses on the difference between the amount of indicator species within the same landscape.

heath, raised moor and shifting sand

The table shown in the appendix shows the significance between the amount of indicator species for the landscape heath, raised moor and shifting sand. A significant relation dan be found between areas with one indicator species and areas with three, four, five, six, seven, eight, ten and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of 0,47, 0,47, 0,42, 0,50, 0,41, 0,41, 0,75 and 0,41. The effect size from the relation with an area with 10 indicator species is considered large, while the other effect sizes are considered medium. Additionally a significant relation can be found between areas with two indicator species and areas with three, four, six and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of 0,11, 0,10, 0,11 and 0,08. These effect sizes are considered small. A significant relation can also be found between areas with nine indicator species and areas with three, four, six and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of 0,15, 0,15, 0,16 and 0,11. These effect sizes are considered small.

open agricultural area

The table shown in the appendix shows the significance between the amount of indicator species for the landscape open agricultural areas. A significant relation dan be found between areas with three indicator species and areas with one, two and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of -0,06, -0,04 and -0,07. These effect sizes are considered small.

Beaches

The table shown in the appendix shows the significance between the amount of indicator species for the landscape beaches. A significant relation dan be found between areas without this landscape or without any indicator species and areas with one and two indicator species. When the estimated effect size is calculated this gives an effect size of -0,21 and 0,20. The effect size form the relation with an area with one indicator species is considered medium, while the other effect size is considered small. Additionally a significant relation dan be found between areas with three indicator species and areas with one and two indicator species. When the estimated effect size is calculated this gives an effect size of 0,23 and 0,22. These effect sizes are considered medium.

half open and/or closed agricultural area

The table shown in the appendix shows the significance between the amount of indicator species for the landscape half open and/or closed agricultural area. A significant relation dan be found between areas with one indicator species and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of 0,02 This effect size is considered small.

Forests
The table shown in the appendix shows the significance between the amount of indicator species for the landscape forest. A significant relation dan be found between areas with one indicator species and areas with two and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of 0,04 and 0,03. These effect sizes are considered small.

High risk of fear and/or depression

The first performed test uses high risk of fear and depression as the dependable variable. The tables below show the outcome of this test.

Mixed Model:	
High Risk	
	Sig.
Smoking	0,000
Obesity	0,000
Urbanisation	<0,001
Heath, raised moor and shifting sand	0,101
Open agricultural area	0,265
Beaches	<0,001
Half open and closed agricultural area	0,139
Dunes	0,034
Forest	0,079
Swamp	0,375
a. Dependent Variable: Fear Depression High Risk RIVM	

Table 1.10 Mixed model results with dependent variable high risk of fear and depression

This test indicates that there is a significant relation between the percentage of people with a high risk of fear and/or depression and the following landscape: beaches and dunes. The following analysis focuses on the difference between the amount of indicator species within the same landscape.

Beaches

The table shown in the appendix shows the significance between the amount of indicator species for the landscape beaches. A significant relation can be found between areas without this landscape or without any indicator species and areas with one and two indicator species. When the estimated effect size is calculated this gives an effect size of 0,31 and 0,22. These effect sizes are considered medium. An additional significant relation can be found between areas with three indicator species and areas with one indicator species. When the estimated effect size is calculated this gives an effect size of 0,32. This effect size is considered medium.

Dunes

The table shown in the appendix shows the significance between the amount of indicator species for the landscape dunes. A significant relation can be found between areas without this landscape or without any indicator species and areas with one and two indicator species. When the estimated effect size is calculated this gives an effect size of 0,13 and 0,10. This effect size is considered small.

Loneliness

The first performed test used the inhabitants that experience loneliness as a dependable variable. The tables below show the outcome of this test.

Mixed Model: Loneliness	Sig.
Smoking	0,000
Obesity	0,000
Urbanisation	<0,001
Heath, raised moor and shifting sand	0,007
Open agricultural area	0,045
Beaches	<0,001
Half open and closed agricultural area	0,696
Dunes	0,978
Forest	0,016
Swamp	0,241
a. Dependent Variable: Loneliness RIVM	

Table 1.11 Mixed model results with dependent variable loneliness

This test indicates that there is a significant relation between the percentage of people suffering from loneliness and the following landscapes: heath, raised moor and shifting sand, Open agricultural areas, beaches and forests. The following analysis focuses on the difference between the amount of indicator species within the same landscape.

heath, raised moor and shifting sand
The table shown in the appendix shows the significance between the amount of indicator species for the landscape heath, raised moor and shifting sand. A significant relation can be found between areas with two indicator species and areas with four, five and six indicator species. When the estimated effect size is calculated this gives an effect size of 0,14, 0,15 and 0,17 These effect sizes can be considered small. An additional significant relation can be found between areas with three indicator species and areas with four, five and six indicator species. When the estimated effect size is calculated this gives an effect size of 0,14, 0,15 and 0,17 These effect sizes can be considered small. A significant relation can also be found between areas without this landscape or without any indicator species and areas with five and six indicator species. When the estimated effect size is calculated this gives an effect size of 0,07 and 0,09 These effect sizes can be considered small. A significant relation can also be found between areas with six indicator species and areas with eight and nine indicator species. When the estimated effect size is calculated this gives an effect size of -0,16 and -0,22. The effect size from the relation with eight indicator species is considered small while the effect size of the relation with nine indicator species is medium.

open agricultural area
The table shown in the appendix shows the significance between the amount of indicator species for the landscape open agricultural areas. A significant relation can be found between areas with two indicator species and areas with one and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of -0,04 and -0,06. These effect sizes are considered small.

Beaches
The table shown in the appendix shows the significance between the amount of indicator species for the beaches. A significant relation can be found between areas without this landscape or without any indicator species and areas with one and three indicator species. When the estimated effect size is calculated this gives an effect size of 0,29 and 0,05. The effect size from the relation with three indicator species can be considered medium, while the effect size from the relation with areas with one indicator species can be considered small. An additional significant relation can be found between areas with one indicator species and areas with three indicator species. When the estimated effect size is calculated this gives an effect size of -0,29. This effect size is considered medium

Forrest
The table shown in the appendix shows the significance between the amount of indicator species for the forest. A significant relation can be found between areas without this landscape or without any indicator species and

areas with one and two indicator species. When the estimated effect size is calculated this gives an effect size of -0,05 and -0,05. These effect sizes can be considered small.

Severe loneliness

The first performed test used the inhabitants that experience severe loneliness as a dependable variable. The tables below show the outcome of this test.

Mixed Model: Severe Loneliness	
	Sig.
Smoking	0,000
Obesity	0,000
Urbanisation	<0,001
Heath, raised moor and shifting sand	0,009
Open agricultural area	0,025
Beaches	<0,001
Half open and closed agricultural area	0,540
Dunes	0,268
Forest	0,004
Swamp	0,511
a. Dependent Variable: Loneliness Severe RIVM	

Table 1.12 Mixed model results with dependent variable severe loneliness

This test indicates that there is a significant relation between the percentage of people suffering from severe loneliness and the following landscapes: heath, raised moor and shifting sand, Open agricultural areas, beaches and forest. The following analysis focuses on the difference between the amount of indicator species within the same landscape.

heath, raised moor and shifting sand

The table shown in the appendix shows the significance between the amount of indicator species for the landscape heath, raised moor and shifting sand. A significant relation can be found between areas with six indicator species and areas with seven, eight, nine and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of -0,15, -0,17, -0,22 and -0,10. The effect size from the relation with an area with nine indicator species can be considered medium. The other effect sizes can be considered small. An additional significant relation can be found between areas with four indicator species and areas seven indicator species. When the estimated effect size is calculated this gives an effect size of -0,10. This effect size can be considered small.

open agricultural area

The table shown in the appendix shows the significance between the amount of indicator species for the landscape open agricultural areas. A significant relation can be found between areas with two indicator species and areas with one and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of -0,03 and -0,06. These effect sizes are considered small.

Beaches

The table shown in the appendix shows the significance between the amount of indicator species for the beaches. A significant relation can be found between areas without this landscape or without any indicator species and areas with one, two and three indicator species. When the estimated effect size is calculated this gives an effect size of 0,11, -0,08 and 0,04. These effect sizes can be considered small. An additional significant relation can be found between areas with one indicator species and areas with three indicator species. When the estimated effect size is calculated this gives an effect size of -0,07. This effect size is considered small.

Forrest

The table shown in the appendix shows the significance between the amount of indicator species for the forest. A significant relation can be found between areas without this landscape or without any indicator species and areas with one, two and three indicator species. When the estimated effect size is calculated this gives an effect size of -0,05, -0,04 and -0,04. These effect sizes can be considered small.

Stress

The first performed test used the inhabitants that experience stress as a dependable variable. The tables below show the outcome of this test.

Mixed Model: Stress	Sig.
Smoking	0,000
Obesity	<0,001
Urbanisation	<0,001
Heath, raised moor and shifting sand	0,042
Open agricultural area	0,003
Beaches	<0,001
Half open and closed agricultural area	0,003
Dunes	0,115
Forest	0,407
Swamp	0,074
a. Dependent Variable: Stress RIVM	

Table 1.13 Mixed model results with dependent variable stress

This test indicates that there is a significant relation between the percentage of people suffering from stress and the following landscapes: heath, raised moor and shifting sand, Open agricultural areas, beaches and half open en closed agricultural areas. The following analysis focuses on the difference between the amount of indicator species within the same landscape.

heath, raised moor and shifting sand
The table shown in the appendix shows the significance between the amount of indicator species for the landscape heath, raised moor and shifting sand. A significant relation can be found between areas with one indicator species and areas with one, five, seven and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of -0,52, -0,54, -0,61 and -0,45. The effect size from the relation with an area without this landscape or without any indicator species can be considered medium. The other effect sizes can be considered large. An additional significant relation can be found between areas with four indicator species and areas with two and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of -0,12 and -0,06. These effect sizes can be considered small. A significant relation can also be found between areas with eight indicator species and areas with seven and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of -0,14 and -0,09. These effect sizes can be considered small.

open agricultural area
The table shown in the appendix shows the significance between the amount of indicator species for the landscape open agricultural areas. A significant relation can be found between areas with two indicator species and areas with one and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of -0,05 and -0,07. These effect sizes are considered small. An additional significant relation can be found between areas with three indicator species and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of -0,06. This effect size is considered small.

Beaches
The table shown in the appendix shows the significance between the amount of indicator species for the beaches. A significant relation can be found between areas without this landscape or without any indicator species and areas with one, two and three indicator species. When the estimated effect size is calculated this gives an effect size of 032, 0,23 and 0,22. These effect sizes can be considered medium.

Half open and/or closed agricultural area
The table shown in the appendix shows the significance between the amount of indicator species for the landscape half open and/or closed agricultural area. A significant relation dan be found between areas with one indicator species and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of 0,04 This effect size is considered small.

Meeting the standard of physical activities

The first performed test used the inhabitants that meet the standard number of physical activities as a dependable variable. The tables below show the outcome of this test.

Mixed Model: Exercise Norm RIVM	
	Sig.
Smoking	<0,001
Obesity	0,000
Urbanisation	<0,001
Heath, raised moor and shifting sand	0,066
Open agricultural area	0,199
Beaches	0,010
Half open and closed agricultural area	0,037
Dunes	<0,001
Forest	0,247
Swamp	0,480
a. Dependent Variable: Exercise Norm RIVM	

Table 1.14 Mixed model results with dependent variable Meeting the exercise norm of the RIVM

This test indicates that there is a significant relation between the percentage of people who exercise the advised amount by the RIVM and the following landscapes: beaches and dunes. The following analysis focuses on the difference between the amount of indicator species within the same landscape.

Beaches

The table shown in the appendix shows the significance between the amount of indicator species for the beaches. A significant relation can be found between areas with one indicator species and areas with two, three and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of -0,28, -0,18 and -0,20. The effect size from the relation with the areas with three indicator species can be considered small, while the other indicator species are medium in size.

Half open and/or closed agricultural area

The table shown in the appendix shows the significance between the amount of indicator species for the landscape half open and/or closed agricultural area. A significant relation dan be found between areas with one indicator species and areas without this landscape or without any indicator species. When the estimated effect size is calculated this gives an effect size of 0,02 This effect size is considered small.

dunes

The table shown in the appendix shows the significance between the amount of indicator species for the landscape dunes. A significant relation can be found between areas without this landscape or without any indicator species and areas with one, two, three and four indicator species. When the estimated effect size is calculated this gives an effect size of -0,12, -0,34, -0,56 and -0,59. The effect size from the relation with the area with one indicator species is small. The effect size from the relation with the area with two indicator species is medium. The other effect sizes are large. An additional significant relation can be found between areas with one indicator species and areas with two, three and four indicator species. When the estimated effect size is calculated this gives an effect size of -0,20, -0,45 and -0,45. These effect sizes can be considered medium. A significant relation can also be found between areas with two indicator species and areas with three indicator species. When the estimated effect size is calculated this gives an effect size of -0,29. The effect size can be considered medium.

Calculating the pseudo R-squared

In the first part of the analysis the areas and the amount of indicator species who share a significant relation which each other were formulated. Then the areas who have a significant relation to the different aspects of health were found, it was possible to determine whether the effect was positive or negative and to which extend the aspect of health is influenced. In this part the R-square is calculated this will explain the proportion of the dependable variable that can be explained by the independent variable. In the table below are the different health aspects shown in relation to the landscape that had shown to have a significant relation.

Health aspect	**landscape**	**R-square in percentage**
Overall health	Total	0,4%
	heath, raised moor and shifting sand	0,1%
	Forests	0,3%
Smoking	Total	0,9%
	heath, raised moor and shifting sand	0,4%
	Forests	0,2%
	Swamps	0,2%
Obesity	total	3,9%
	heath, raised moor and shifting sand	0,0%
	open agricultural area	1,8%
	beaches	0,0%
	Half open and/or closed agricultural area	1,3%
	Dunes	0,4%
	Forests	1,0%
	Swamps	0,0%
Morbid obesity	Total	1,1%
	heath, raised moor and shifting sand	0,0%
	open agricultural area	0,5%
	Half open and/or closed agricultural area	0,4%
	Dunes	0,3%
	Forests	0,1%
	Swamps	0,0%
Chronic physical conditions	Total	0,3%
	heath, raised moor and shifting sand	0,0%
	beaches	0,0%
	Dunes	0,2%
	Forests	0,0%
Medium risk of fear and/or depression	total	4,1%
	heath, raised moor and shifting sand	0,3%
	open agricultural area	0,8%
	beaches	0,1%
	Half open and/or closed agricultural area	0,7%
	Forests	2,4%
High risk of fear and/or depression	total	2,0%
	beaches	0,1%
	Dunes	0,1%
Loneliness	total	4,6%
	heath, raised moor and shifting sand	0,7%
	open agricultural area	2,6%

	beaches	0,0%
	Forests	1,7%
Severe loneliness	total	4,1%
	heath, raised moor and shifting sand	0,4%
	open agricultural area	1,5%
	beaches	0,0%
	Forests	2,3%
Stress	total	5,6%
	heath, raised moor and shifting sand	0,8%
	open agricultural area	4,3%
	beaches	0,1%
	Half open and/or closed agricultural area	1,7%
Meeting the standard of physical activity	total	1,8
	beaches	0,2%
	dunes	1,8%

Table 1.15 calculations of the pseudo-R

Overall, the numbers derived from this analysis show that the influence of biodiversity on the health of the inhabitants of The Netherlands is quite limited. When observing the differences in biodiversity within the same landscape. However, that are still interesting findings that can be reported. In other fields for example in economics with an effect sizes below a certain amount would not be regarded as valid. However, since health is such a complicated subject there is a multitude of factor that could contribute to the health of humans. This research will count an effect as valid if the R-square has a value of one percent or higher. This is done since an one percent increase in the health of the population would mean that the health of a large amount of people positively influenced. A focused reader might have noticed that in some cases the percentages do not add up correctly to the overall total. This is caused by rounding up or rounding down of the numbers. In the next part all the viable data will be combined within a single table. This will show all the landscapes and the amount of indicator species who have a reasonable effect and a reasonable influence on the dependable variable.

Summary of the results from the mixed model analysis

In the previous part the analysis was performed into the effect of biodiversity within the same landscapes. First, the areas that have a significant relation to the aspects of health were formulated. Secondly, the effect size of these areas was calculated. Thirdly, the R-squared was calculated which explains the proportion of the dependable variable that can be explained by the independent variable. This has shown that not all the findings have a significant effect. This could mean that an area could have a significant relation which means that there is a high change that the landscape influences the different aspects of health. However, if the effect is not relevant that particular landscape will not be taking into further considerations. The table below shows the landscapes which meets all the criteria of significance and relevance. To avoid any confusion about the number formulated in the previous part an explanation will be given. If an effect is positive this means that it will positively affect the overall health. An example can be that if an area has a positive effect size in relation to smoking this means that in that particular area the number of smokers increases. However, this contributes negatively to the health of that person. Therefore, this will be registered as having a negative effect.

Aspect of health	Landscape	R-squared	Effect of the area	Number of indicators species	In relation to area	Size of the effect
Obesity	Open agricultural	1,8%	Negative	one	Without this landscape or without any indicator species	small
			Negative	two	Without this landscape or without any indicator species	small
			Negative	three	Without this landscape or without any indicator species	medium
	Half open and/or closed agricultural	1,3%	Negative	one	Without this landscape or without any indicator species	small
	Forests	1,0%	Positive	one	Without this landscape or without any indicator species	small
			Positive	two	Without this landscape or without any indicator species	small
			Positive	three	Without this landscape or without any indicator species	medium
Medium risk of fear and/or depression	Forests	2,4%	Negative	one	Without this landscape or without any indicator species	small
			Positive	one	two	small
Loneliness	open agricultural	2,6%	Positive	two	Without this landscape or without any indicator species	small
			Positive	two	One	small

Aspect of health	Landscape	R-squared	Effect of the area	Number of indicators species	Effected number of indicator species	Size of the effect
	Forests	1,7%	Negative	One	Without this landscape or without any indicator species	small
			Negative	Two	Without this landscape or without any indicator species	small
Severe loneliness	open agricultural	1,5%	positive	two	Without this landscape or without any indicator species	small
			positive	two	one	small
	Forests	2,3%	negative	one	Without this landscape or without any indicator species	small
			negative	two	Without this landscape or without any indicator species	small
			negative	three	Without this landscape or without any indicator species	small
Stress	open agricultural	4,3%	Positive	two	Without this landscape or without any indicator species	small
			Positive	two	one	small
	Half open and/or closed agricultural	1,7%	Negative	one	Without this landscape or without any indicator species	small

Aspect of health	Landscape	R-squared	Effect of the area	Number of indicators species	Effected number of indicator species	Size of the effect
Meeting the standard of physical activity	Dunes	1,8%	Positive	one	Without this landscape or without any indicator species	medium
			Positive	two	Without this landscape or without any indicator species	medium

Table 1.16 Summary of the results

Comparing different areas

In the previous chapter the different amount of indicator species within the same landscape were compared. In this part different areas will be compared with each other. These areas can consist of a combination of different landscapes and different amount of indicator species. A score is given to each area in order to group them. The score is based on the amount of indicator species per landscape. If an areas has two or more indicator species for a landscape that is counted as a one. Half open agricultural landscape is the exception where one indicator species is enough to be counted. Two indicator species is chosen as a criteria since most landscapes have one indicator species this would create a distortion in the groups. The sum of all these landscapes provides a score ranging from zero to five. A score of zero would suggest the lowest amount of indicator species per landscape and the lowest amount of nature in an area. A score of five would suggest the highest amount of indicator species per landscape and the highest amount of nature in an area. These scores are compared with each other in relation to the aspects of health in order to determine if the combined biodiversity of an area has an effect on the health of the inhabitants. The degree of urbanisation is not shown in the result since it was part of the calculation to determine the degree of nature.

Overall health

The results from the comparison are shown below in figure 1.18. This figure shows the different factors that influence the overall health. The thickness of the line indicates a larger influence and the colour represents a positive or negative effect.

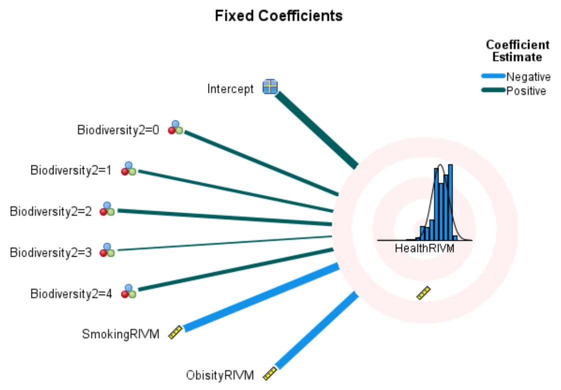


Figure 1.18 Contributions of different factors to overall health

The figure above indicates that both smoking and obesity have a negative effect on the overall health. The thickness of the lines indicate that the influence is considerable. The influence of biodiversity is shown to have a positive effect on the overall health. However by the size of the lines it can be said that the influence is minimal. The next figure shows the significant relations between biodiversity score and the overall health. The colour in this case indicates if the relation can be considered significant.

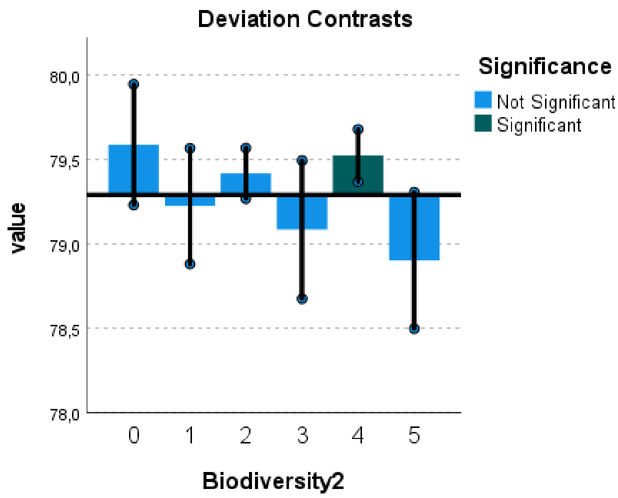


Figure 1.19 Relation between biodiversity score and overall health

The figure above shows that although the different biodiversity score can have fluctuating effects on the overall health only areas with a score of four have shown to have a significant relation. This relation is shown to be positive.

Smoking

The results from the comparison are shown below in figure 1.20. This figure shows the different factors that influence the amount of smokers in an area. The thickness of the line indicates a larger influence and the colour represents a positive or negative effect.

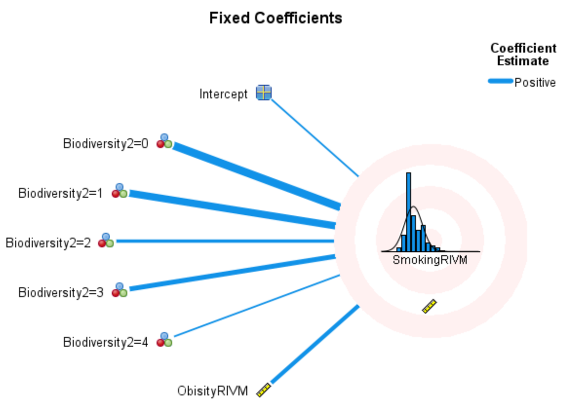


Figure 1.20 Contributions of different factors to the amount of smokers

The figure above indicates that obesity has an positive effect on the amount of smokers. However a positive effect would mean that the amount of smokers increases. The thickness of the lines indicate that the influence is relatively low. The influence of biodiversity is shown to also have a positive effect on the amount of smokers in an area. However by the size of the lines it can be said that the influence of areas with a score of two and above are minimal. The influence of areas with a score of zero and one can be considered considerable. The next figure shows the significant relations between biodiversity score and the amount of smokers in an area. The colour in this case indicates if the relation can be considered significant.

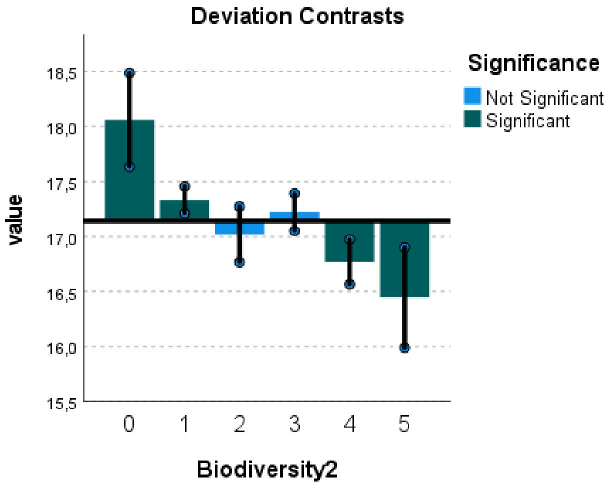


Figure 1.21 Relation between biodiversity score and amount of smokers

The figure above clearly shows that there are four significant relationships that can be found between areas with a score of zero, one, four and five. The amount of smokers in an area with a score of zero is the largest and decreases when the amount of biodiversity increases. Reaching the lowest point in areas with a score of five.

Obesity

The results from the comparison are shown below in figure 1.22. This figure shows the different factors that influence the amount of inhabitants in an area that suffer from obesity. The thickness of the line indicates a larger influence and the colour represents a positive or negative effect.

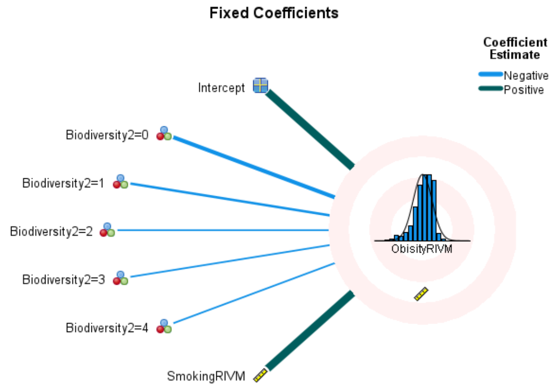


Figure 1.22 Contributions of different factors to the amount of people suffering from obesity

The figure above indicates that smoking has a positive effect on the amount of people suffering from obesity. The thickness of the lines indicate that the influence is relatively high. The influence of biodiversity is shown to have a negative effect on the amount of people in the area suffering from obesity. However by the size of the lines it can be said that the influence is minimal. The next figure shows the significant relations between biodiversity score and the amount of people suffering from obesity. The colour in this case indicates if the relation can be considered significant.

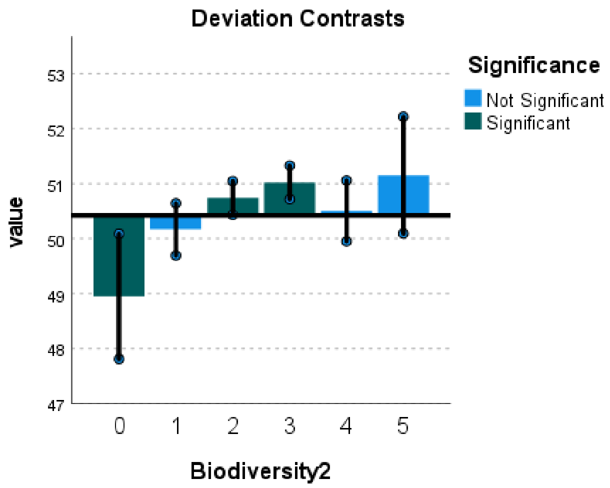


Figure 1.23 Relation between biodiversity score and amount of people suffering from obesity

The figure above clearly shows that there are three significant relationships. These are areas with a biodiversity score of zero, two and three. The amount of people suffering from obesity in an area with a score of zero is the lowest. The amount of people suffering from obesity is larger than average in areas with a score of two. The amount of people with obesity is even greater in areas with a biodiversity score of three.

Morbid obesity

The results from the comparison are shown below in figure 1.24. This figure shows the different factors that influence the amount of inhabitants in an area that suffer from morbid obesity. The thickness of the line indicates a larger influence and the colour represents a positive or negative effect.

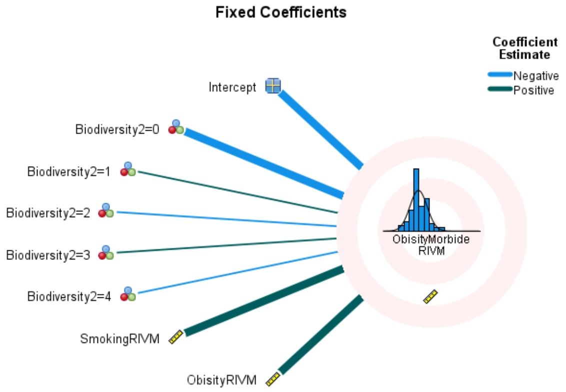


Figure 1.24 Contributions of different factors to the amount of people suffering from morbid obesity

The figure above indicates that smoking and obesity have a positive effect on the amount of people suffering from morbid obesity. The thickness of the lines indicate that the influence is relatively high. The influence of biodiversity is shown to have a mixed effect on the amount of people in the area suffering from obesity. Areas with a score of zero, two and four are shown to have a negative effect. While areas with a score of one and three are shown to have a positive effect. By the size of the lines it can be said that the influence is minimal. Aside from areas with a score of zero which influence is relatively high. The next figure shows the significant relations between biodiversity score and the amount of people suffering from obesity. The colour in this case indicates if the relation can be considered significant.

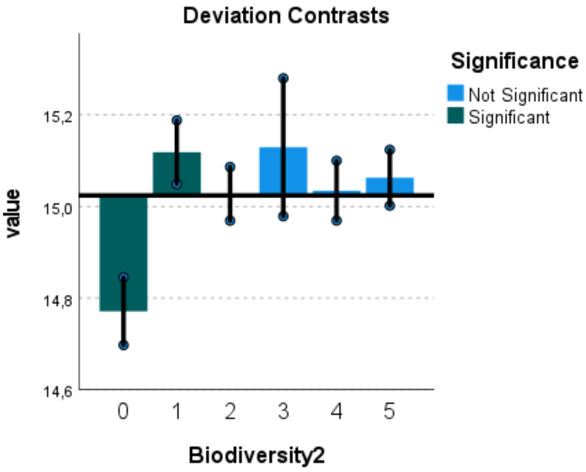


Figure 1.25 Relation between biodiversity score and amount of people suffering from morbid obesity

The figure above clearly shows that there are two significant relationships. These are areas with a biodiversity score of zero and one. The amount of people suffering from morbid obesity in an area with a score of zero is the lowest. The amount of people suffering from obesity is larger than average in areas with a score of one.

Chronic physical conditions

The results from the comparison are shown below in figure 1.26. This figure shows the different factors that influence the amount of inhabitants in an area that suffer from chronic physical conditions. The thickness of the line indicates a larger influence and the colour represents a positive or negative effect.

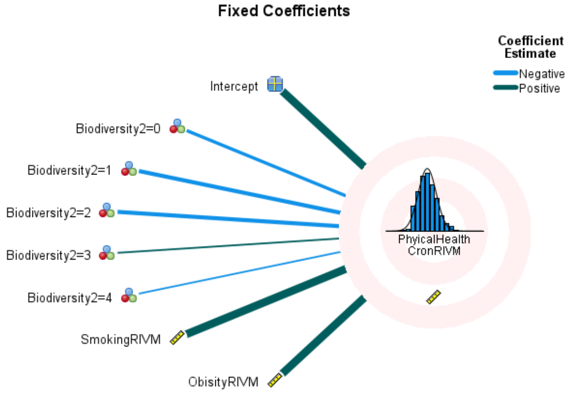


Figure 1.26 Contributions of different factors to the amount of people suffering from chronic physical conditions

The figure above indicates that smoking and obesity have a positive effect on the amount of people suffering from chronic physical conditions. The thickness of the lines indicate that the influence is relatively high. The influence of biodiversity is shown to have a mixed effect on the amount of people in the area suffering from chronic physical conditions. Areas with a score of zero, one, two and four are shown to have a negative effect. While areas with a score of three are shown to have a positive effect. By the size of the lines it can be said that the influence is minimal. The next figure shows the significant relations between biodiversity score and the amount of people suffering from obesity. The colour in this case indicates if the relation can be considered significant.

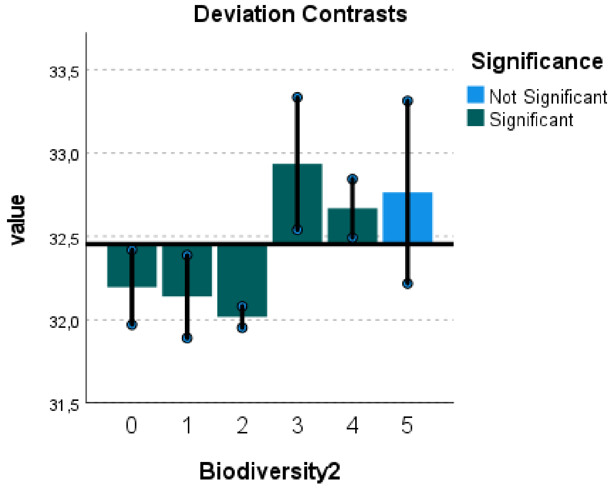


Figure 1.27 Relation between biodiversity score and amount of people suffering from chronic physical conditions

The figure above clearly shows that there are five significant relationships. These are areas with a biodiversity score of zero, one, two, three and four. The amount of inhabitants who suffer from chronic physical conditions decreases in areas with a biodiversity score from zero to two. In areas with a biodiversity score of three the amount of people suffering from chronic physical conditions increases. In areas with a biodiversity score of four it decreases again but remains larger than the average.

Medium risk of fear and/or depression

The results from the comparison are shown below in figure 1.27. This figure shows the different factors that influence the amount of inhabitants with a medium risk of fear and/or depression. The thickness of the line indicates a larger influence and the colour represents a positive or negative effect.

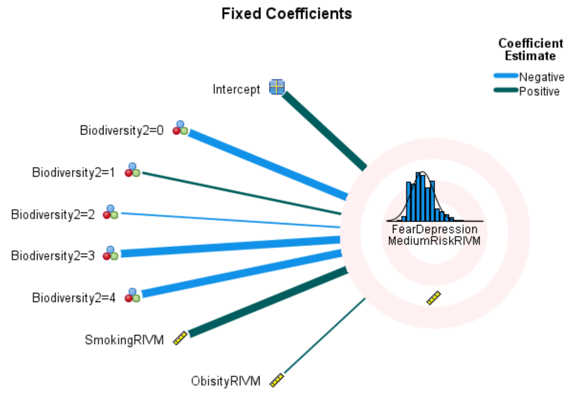


Figure 1.28 Contributions of different factors to the amount of people with a medium risk of fear and/or depression

The figure above indicates that smoking and obesity have a positive effect on the amount of people with medium fear and/or depression. The thickness of the lines indicate that the influence of smoking is relatively high. The influence of obesity is shown to be minimal. The influence of biodiversity is shown to have a mixed influence on the amount of people with a medium risk of fear and/or depression. Areas with a score of zero, two, three and four are shown to have a negative effect. By the size of the lines it can be said that the influence is considerable. While areas with a score of one are shown to have a positive effect. The influence of areas with a biodiversity score of one and two is minimal. The next figure shows the significant relations between biodiversity score and the amount of people with a medium risk of fear and/or depression. The colour in this case indicates if the relation can be considered significant.

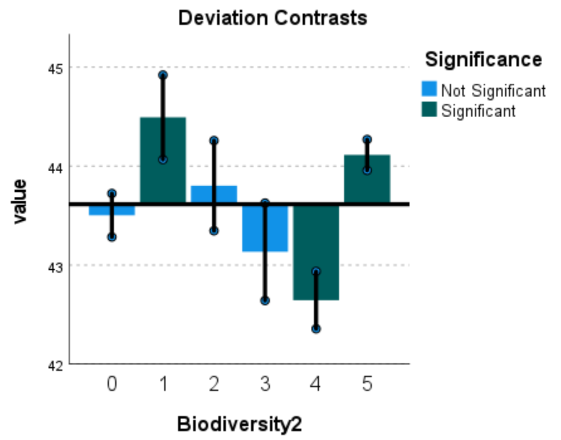


Figure 1.29 Relation between biodiversity score and amount of people with a medium risk of fear and/or depression

The figure above clearly shows that there are three significant relationships. These are areas with a biodiversity score of one, four and five. The amount of inhabitants with a medium risk of fear and/or depression is the highest in areas with a biodiversity score of one. In areas with a biodiversity score of four the amount of people with a medium risk of fear and/or depression decreases and reaches the lowest amount of all the areas. Then in areas with a biodiversity score of five it increases again and exceed the average.

high risk of fear and/or depression

The results from the comparison are shown below in figure 1.30. This figure shows the different factors that influence the amount of inhabitants with a high risk of fear and/or depression. The thickness of the line indicates a larger influence and the colour represents a positive or negative effect.

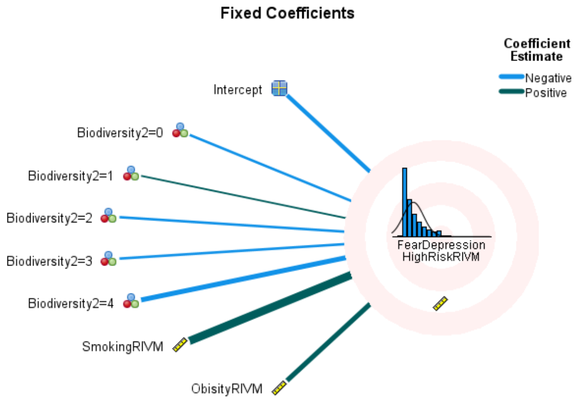


Figure 1.30 Contributions of different factors to the amount of people with a high risk of fear and/or depression

The figure above indicates that smoking and obesity have a positive effect on the amount of people with a high risk of fear and/or depression. The thickness of the lines indicate that the influence of smoking is relatively high. The influence of obesity is shown to be minimal. The influence of biodiversity is shown to have a mixed influence on the amount of people with a high risk of fear and/or depression. Areas with a score of zero, two, three and four are shown to have a negative effect. By the size of the lines it can be said that the influence is minimal. While areas with a score of one are shown to have a positive effect. This influence is also minimal. The next figure shows the significant relations between biodiversity score and the amount of people with a high risk of fear and/or depression. The colour in this case indicates if the relation can be considered significant.

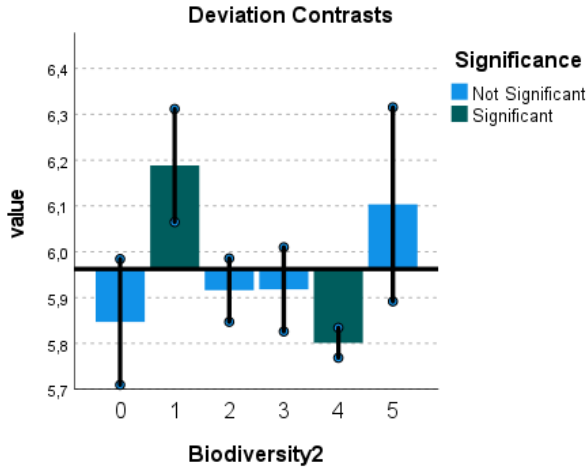


Figure 1.31 Relation between biodiversity score and amount of people with a high risk of fear and/or depression

The figure above clearly shows that there are two significant relationships. These are areas with a biodiversity score of one and four. The amount of inhabitants with a high risk of fear and/or depression is the highest in areas with a biodiversity score of one. In areas with a biodiversity score of four the amount of people with a high risk of fear and/or depression decreases and reaches the lowest amount of all the areas.

Loneliness

The results from the comparison are shown below in figure 1.32. This figure shows the different factors that influence the amount of inhabitants who suffer from loneliness. The thickness of the line indicates a larger influence and the colour represents a positive or negative effect.

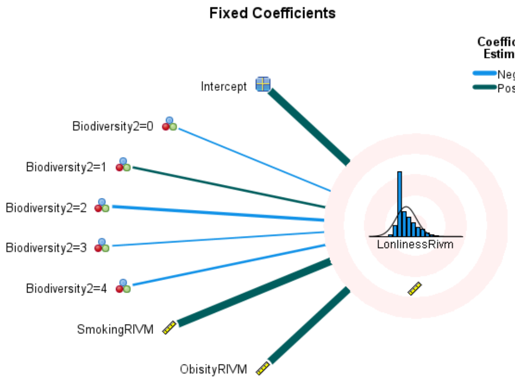


Figure 1.32 Contributions of different factors to the amount of people who suffer from loneliness

The figure above indicates that smoking and obesity have a positive effect on the amount of people who suffer from loneliness. The thickness of the lines indicate that the influence of smoking and obesity are relatively high. The influence of biodiversity is shown to have a mixed influence on the amount of people who suffer from loneliness. Areas with a score of zero, two, three and four are shown to have a negative effect. By the size of the lines it can be said that the influence is minimal. While areas with a score of one are shown to have a positive effect. This influence is also minimal. The next figure shows the significant relations between biodiversity score and the amount of people who suffer from loneliness. The colour in this case indicates if the relation can be considered significant.

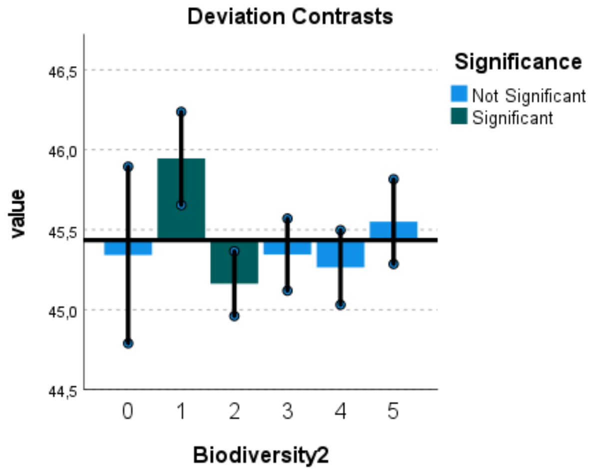


Figure 1.33 Relation between biodiversity score and amount of people who suffer from loneliness

The figure above clearly shows that there are two significant relationships. These are areas with a biodiversity score of one and two. The amount of inhabitants who suffer from loneliness is the highest in areas with a biodiversity score of one. In areas with a biodiversity score of two the amount of people who suffer from loneliness decreases and reaches the lowest amount of all the areas.

Severe Loneliness

The results from the comparison are shown below in figure 1.34. This figure shows the different factors that influence the amount of inhabitants who suffer from severe loneliness. The thickness of the line indicates a larger influence and the colour represents a positive or negative effect.

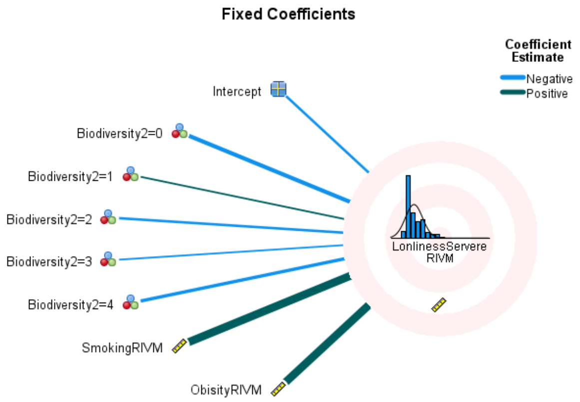


Figure 1.34 Contributions of different factors to the amount of people who suffer from severe loneliness

The figure above indicates that smoking and obesity have a positive effect on the amount of people who suffer from loneliness. The thickness of the lines indicate that the influence of smoking and obesity are relatively high. The influence of biodiversity is shown to have a mixed influence on the amount of people who suffer from loneliness. Areas with a score of zero, two, three and four are shown to have a negative effect. By the size of the lines it can be said that the influence is minimal. While areas with a score of one are shown to have a positive effect. This influence is also minimal. The next figure shows the significant relations between biodiversity score and the amount of people who suffer from severe loneliness. The colour in this case indicates if the relation can be considered significant.

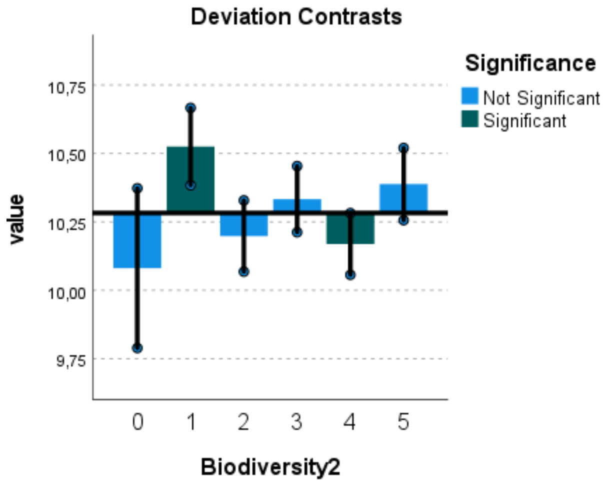


Figure 1.35 Relation between biodiversity score and amount of people who suffer from severe loneliness

The figure above clearly shows that there are two significant relationships. These are areas with a biodiversity score of one and four. The amount of inhabitants who suffer from severe loneliness is the highest in areas with a biodiversity score of one. In areas with a biodiversity score of four the amount of people who suffer from severe loneliness decreases and falls under the average.

Stress

The results from the comparison are shown below in figure 1.36. This figure shows the different factors that influence the amount of inhabitants who suffer from stress. The thickness of the line indicates a larger influence and the colour represents a positive or negative effect.

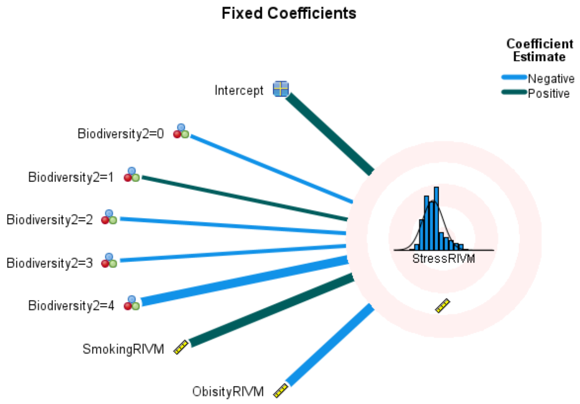


Figure 1.36 Contributions of different factors to the amount of people who suffer from stress

The figure above indicates that smoking has a positive effect on the amount of people who suffer from stress. Obesity in this case has shown to have a negative influence. The thickness of the lines indicate that the influence of smoking and obesity are relatively high. The influence of biodiversity is shown to have a mixed influence on the amount of people who suffer from stress. Areas with a score of zero, two, three and four are shown to have a negative effect. By the size of the lines it can be said that the influence is minimal. With the exception of areas with a biodiversity score of 4 which has a considerable larger influence. Areas with a score of one are shown to have a positive effect. This influence is also minimal. The next figure shows the significant relations between biodiversity score and the amount of people who suffer from stress. The colour in this case indicates if the relation can be considered significant.

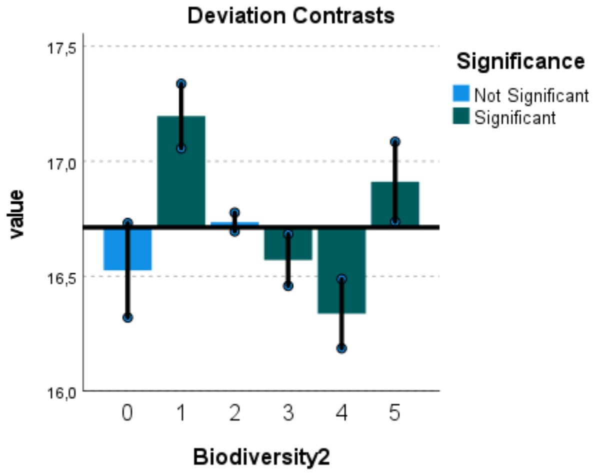


Figure 1.37 Relation between biodiversity score and amount of people who suffer from stress

The figure above clearly shows that there are four significant relationships. These are areas with a biodiversity score of one, three, four and five. The amount of inhabitants suffering from stress is the highest in areas with a biodiversity score of one. In areas with a biodiversity score of three the value in contrast with that of areas with a biodiversity score of one drops drastically. The amount of people suffering from stress decreases and reaches the lowest amount of all the areas in areas with a biodiversity score of four. Then in areas with a biodiversity score of five it increases again and exceed the average.

Meeting the standard of physical activities

The results from the comparison are shown below in figure 1.38. This figure shows the different factors that influence the amount of inhabitants who meet the standard of physical activities. The thickness of the line indicates a larger influence and the colour represents a positive or negative effect.

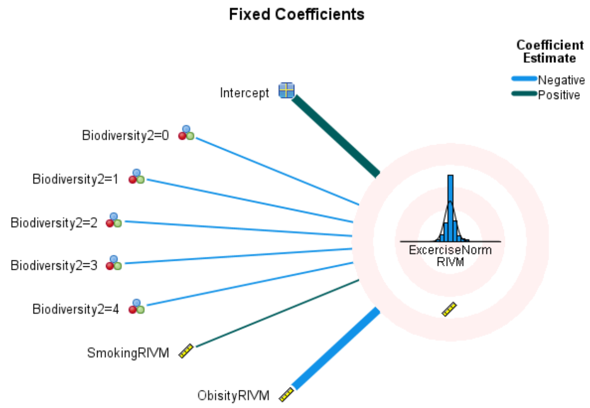


Figure 1.38 Contributions of different factors to the amount of people meet the standard of physical activities

The figure above indicates that smoking has a positive effect on the amount of people who meet the standard of physical activities. The thickness of the lines indicate that the influence of is minimal. Obesity in this case has shown to have a negative influence. The thickness of the lines indicate that the influence of obesity is relatively high. The influence of biodiversity is shown to have a negative influence on the amount of people who meet the standard of physical activities. By the size of the lines it can be said that the influence is minimal. The next figure shows the significant relations between biodiversity score and the amount of people who meet the standard of physical activities. The colour in this case indicates if the relation can be considered significant.

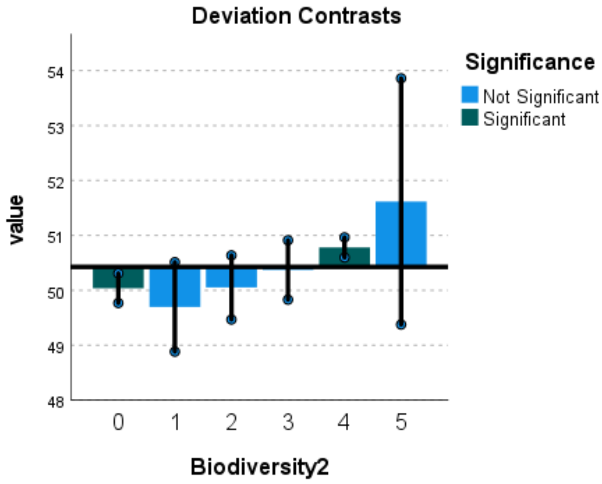


Figure 1.39 Relation between biodiversity score and amount of people meet the standard of physical activities

The figure above clearly shows that there are two significant relationships. These are areas with a biodiversity score of one and four. The amount of inhabitants meet the standard of physical activities is the lowest in areas with a biodiversity score of one. In areas with a biodiversity score of four the value in contrast with that of areas with a biodiversity score of one has been marginally increased.

Summary of the results of the second analysis

Similar to the summary about the first analysis the findings from the second analysis will be comprised into a table in order to show the results more clearly. First the size of the influence was looked at. In almost all cases obesity and smoking were presented to have a large influence. The influence from biodiversity fluctuated depending on the aspect of health. Secondly a comparison between the different biodiversity scores is performed. This shows how the different biodiversity scores influences the mean. Since this study focuses on applicable results that could support the case for a larger amount of greenery in living areas. Therefore the results indicating the difference between the different biodiversity scores will be taken into the summary. The table below shows the different biodiversity score on the top and the aspects of health are shown on the left. A positive and negative is assigned to scores which have a significant influence on the mean. A positive could also be attributed to biodiversity scores that display a negative influence, but are shown to be considerably lower than other negative influences.

table 1.17 simplifies the results and only shows colours. This simplification shows that areas with a biodiversity score of zero score relatively well on subject as (morbid) obesity and chronic physical conditions, but the overwhelming positive effects can be found in areas with a biodiversity score of four. Interestingly the positive effects seem to decline in areas with a biodiversity score of five. Indicating that too much nature an biodiversity can negate the positive effects.

Aspects of health	0	1	2	3	4	5
Overall health					Positive	
Smoking	Negative	Positive			Positive	Positive
Obesity	Positive		Negative	Negative		
Morbid obesity	Positive	Negative				
Chronic physical conditions	Positive	Positive	Positive	Negative	Negative	
Medium risk of fear and depression		Negative			Positive	Negative
High risk of fear and depression		Negative			Positive	
Loneliness		Negative	Positive			
Severe loneliness		Negative			Positive	
Stress		Negative		Positive	Positive	Negative
Meeting the required amount of physical activities	Negative				Positive	

Table 1.17 summary of the results

Aspects of health	0	1	2	3	4	5
Overall health						
Smoking						
Obesity						
Morbid obesity						
Chronic physical conditions						
Medium risk of fear and depression						
High risk of fear and depression						
Loneliness						
Severe loneliness						
Stress						
Meeting the required amount of physical activities						

Table 1.18 simplifications of the findings

Part four: Conclusions

Relation of the results with the hypotheses

In the first part of this document the hypothesis was formulated. It was explained that it consist of three different assumptions. With the findings formulated in the summary it is possible to determine whether the hypotheses were accurate.

The amount of biodiversity has a positive influence on the health of the inhabitants of The Netherlands.
An example of an expected result could be that there is a noticeable difference between areas with multiple landscape with multiple indicator and areas without a multitude of landscapes and indicator species. The assumption would be that since biodiversity has an impact on the health of humans this would be visible in the results. First the results from the mixed model analysis will be discussed. This analysis compares the effect of the amount of indicator species within the same landscape. If the results are observed this phenomenon is present. An example of this is within the landscape forest. The relation between forest and obesity has shown that areas with different amounts of indicator species do not have a significant or relevant relation with areas with different amounts of indicator species. The different amount of indicator species do have a significant and relevant relation with areas without this landscape or without any indicator species. This phenomenon is also visible within the other landscapes. During the calculations of the effect size, it became apparent that there are differences between the effect of areas with different amount of indicator species. Even though there were mostly relations with areas without the landscape or without any indicator species there are cases where the amount of indicator species influences the effect size. This effect could be either positive, or negative. From the first analysis it can be noted that there is a relation between the amount of indicator species and the effect on the different aspects of the human health. The effects could be beneficial or influence the aspect of human health negatively depending on the type of landscape. Secondly the overall amount of biodiversity will be taken into account in the generalized linear mixed model. From the summary of the result of this analysis it becomes clear that areas with a biodiversity score of 4 are shown to provide the most health benefits of all the areas. A second an equal important finding is that in areas with a biodiversity score of one the influence of the amount of biodiversity is shown to negatively influence the aspect of health. Two additional findings from this analysis are also useful in answering the hypothesis. The first finding is that areas with a biodiversity score of zero do not experience the same amount of negative influence from the lack of biodiversity. On the contrary obesity seems to be reduced due to a reduction in the amount of biodiversity. The second finding is that areas with an a biodiversity score of five is shown to not experience the same health benefits as areas with a biodiversity score of five. Areas with a biodiversity score of five has shown to even experience negative influence due to the amount of the biodiversity score. To conclude the amount of biodiversity has shown to have a positive influence on the aspects of health. There are however limits to when the positive effect are outweighed by the negative effects. As indicated by the difference in health benefits between areas with a biodiversity score of four and a biodiversity score of five.

There is a difference between landscapes and the amount of positive influence on the health of the inhabitants of The Netherlands.
An example of an expected result could be that there is a noticeable difference between areas with the landscape dunes and the landscape forests. If the summarized result are observed it can be noted without a doubt that the landscapes open and/or closed agricultural areas and forest areas are largely present in the summary of the result while the landscapes heath, raised moor and shifting sand, beaches and swamps are obviously absent. The exception here is dunes. Which has shown to have a relevant influence on the aspect meeting the standard of physical activity. It can also be noted that there is a clear distinction about the relation of nature and the different aspects of health. The aspect of health that

relate to the physical aspect of health are significantly lower. This is shown by the percentage of effect related to smoking and obesity. At the same time the aspects of health overall health and physical conditions were not even significant enough to be mentioned in the summary. the exception again being the aspect of meeting the advised amount of physical activity. The aspect of health that relate to the mental aspect of health are significantly higher. This is noticeable by having all the aspect related to mental health being present in the summary. There needs to be an addition made to the hypothesis assumed that the different types of nature would have a positive effect on the health of the inhabitants of that area. This was derived from the literature. If the summary of the result is observed, it becomes clear that this is not the case. The landscapes Open agricultural areas, half open and/or closed and forest and dunes all a positive effect on some aspects of health, but the relation to other aspects of health is negative or non-existing. The original hypothesis needs to be revised in order to provide a more accurate statement. The conclusion from the summary of the results is: Not all landscapes have an effect on health. Only The landscapes Open agricultural areas, half open and/or closed and forest and dunes have a significant effect on the aspect of health. These effects can be positive or negative depending on the aspect of health.

landscapes which predominantly consist of greenspaces have a larger positive influence on the overall health than areas without greenery Similar to the second hypothesis the original assumption that nature has an exclusively positive influence on the health of the inhabitants needs to be discarded. However, it can still be observed that areas with larger amount of literal greenery have a larger influence on health. A more accurate statement could be Areas with visible green vegetation have a larger influence on the health of the inhabitants. The influence could be positive or negative depending on the aspect of health.

With these answers the research has achieved the goal that was set out in the beginning. The different landscapes of nature and the different qualities of nature have been analysed. The main hypothesis of this study could be proven or disproven. This hypothesis has been proven to be true. The results however are mixed and while proving the full hypothesis parts can be considered proven to be wrong. The different amount of biodiversity can show to have a significant effect on the different aspects of health however there is a limit for which this is true. Also it has not only shown a relation between large amount of biodiversity and an increase in the health benefits, but also a decrease in areas with a small amount of biodiversity. The result from comparing the different landscapes is more complicated. The landscapes with larger amounts of greenery have shown to be the landscapes which for the largest part have a significant and relevant influence. However, the results show that this is not always a positive effect. The original statement in the form of the hypothesis needs to be readjusted. A more accurate statement would be as follow: The quality of nature influence the health of the inhabitants to such a degree that areas with a large amount of high quality nature experience health benefits while areas with a low quality of nature experience a drawback.

Discussion

In this part the result are discussed. During research it is important that the result reliable. This also means that the research could be repeated, and the results would be similar. The aspects that will be looked at are the method and the data collection.

Methods

The main method that were used in this research was a statistical analysis. For this study the analysing program SPSS was used. This is a computer program that uses different statistical methods to arrive at a number or percentage. This program has built in features that determine the validity of an analysis. Since this is a computer program that uses input to arrive at an output the outcome would always be the same if the input is the same. This gives an amount of reliability to the result generated. There could be a distortion of the results if the input and the use of the program contained mistakes. Since the first mentor was present at the time of inserting the numbers and during the computing process the certainty that the process went correct was increased. There could however be an improvement made to the execution. The input for the generalized linear mixed model uses a counting system where if the landscape meets the threshold of a certain amount of indicator species it is counted. However, this allows for the possibility that an area with the maximum amount of indicator species for a couple of landscape and another area with the same landscape only with two indicator species in each are placed in the same group. This could create a distortion in the group formation.

Data collection

This research stand and falls with the acquired data since this is the input for the analysing program. There are two factor that could not be taken into account that could influence the results of this study. The first is sample size and the second factor is a limited amount of indicator species. Since areas with a larger amount of greenery are scarce this leaves a small number of inhabitants who can be used as references. An example is the landscape heath, raised moor and shifting sand with nine indicator species. During the analysis it became apparent that this particular landscape in combination with the amount of indicator species was more than ones shown to have under average percentages concerning the different aspects of health. There is a large possibility that this is due to lifestyle or other external factors. A smaller sample size would have eliminated this anomaly. This research used an area of 5km by 5km. Since areas with amount of indicator species are quite rare a single area where the inhabitants have health percentages that are below average could distort the results. If a smaller area was used the areas with the less healthy could perhaps be excluded from the analysis. The end result would be that only areas with greenery and nature in the direct vicinity are included. This limitation is derived from the data from SOVON. Birds are generally hard to count, and some birds are quite rare. As a result, the makers of the maps that displays a particular type of bird often do not have a choice but to increase the size of an area. Other that giving mixed result this has not proven to be a problem. Since this research does not only rely on the significance but also on the effect size and the R-squared this distortion was filtered out.

The second factor was the amount of indicator species. During the data collection phase, it was difficult to find a source that was accessible for free. The only source that was able to provide the location of indicator species on a scale of The Netherlands was SOVON. However, SOVON focuses on birds, this leaves out the other indicator species mentioned by the *natura 2000* document. As a result, the area half open and/or closed agricultural areas have only one indicator species. This is a problem that could not be overcome. Additional research could be performed with all the indicator species.

Recommendation

In the part one: introduction the relevant parties that could benefit from this research were formulated. These parties are planners, designers and the Teeb calculator. Additional to the parties formulated in the first part the specific health care organizations and further research will also be included in the recommendations.

Planners

The findings from this research could be used by planners as additional proof that increasing the amount of biodiversity in an area provides a variety of health benefits. The numbers from the analysis show that 36% of the areas have a biodiversity score of one. Areas with this score experience a lot of negative consequences from the lack of biodiversity. Planners could identify areas with a low biodiversity score and improve the biodiversity. Also planners could uses this information to identify areas with a high biodiversity score. The planners could then create plans that limit the reduction of nature in order to maintain the positive health benefits. Considering individual plots this research also provides a guide on the effects of each landscape. This research has shown that the landscape open agricultural has a positive effect on the mental health but has a negative effect on the percentage of obesity in the area. The effect of forest is completely the opposite. A planner could for example create fields with the landscape open agriculture in areas where there is no type of vegetation. This will allow for the inhabitant to experience the benefits of this landscape. Additionally, the planner could create small areas of forest in areas where there is no other vegetation since this landscape is associated with a lower obesity rate.

Designers

This group could split into two separate professions: urban designers and architects. Urban designers could use the importance of biodiversity to use the available space between buildings to create areas designed for bringing biodiversity into urban areas. The findings could also be used to redevelop low quality green areas into areas that support biodiversity. Architects could use the findings from this research as an argument to implement greenery in their design. Adding greenery often increase the cost of maintenance. However, if the designer could argue that certain types of greenery have a positive effect on the health of the residents or workers and is therefore justifiable. This could be especially interesting for designing offices. Since the employees in office buildings often experiences stress, it could be useful to apply open agricultural elements in the building and in the surrounding area.

Teeb calculator

As mentioned in the introduction the Teeb calculator does not take the amount of biodiversity and the landscape into account when calculating the financial benefits of implementing greenery in an area. This research has shown that biodiversity does influence the health of the inhabitants. Advancing the calculator to include biodiversity could create a more accurate calculation. This research has also shown that the landscape has a large influence on the health benefits. Since this research has shown that not all types of nature have the same health benefits. The Teeb calculator could also take this into account when calculating the financial benefits.

Health care organization

An unexpected result from this is that the mental health benefits are greater than the physical benefits. as a result, the findings from this research might be very useful for mental health care facilities. Since the patients in these institutions suffer from a variety of mental disorders implementing greenery could improve the recovery process.

Additional research

Although this research document has completed the goals it was set out the find there are still multiple opportunities for follow up research. These are: water, additional indicator species and isolated experiments.

This research has not taken water into consideration. However, while gathering data on the indicator species from *natura 2000*, it became apparent that the landscape water was also present. This landscape does not have any indicator species that are birds and could therefore not be included in this research. It was also more difficult to research since most houses are not built on or directly near the water. However additional research could be performed which includes the availability of water.

As mentioned in the discussion this research could only access the location of a limited amount of indicator species. As a result, the maps used for grading the areas in The Netherlands is not as detailed as could be with the other indicator species. Additional research could be performed with the other indicator species. This could create a more detailed map. As a result, differences between areas with the same landscape could become apparent.

This research has shown that areas with a greenery in the form of the landscapes open agricultural areas, half open and/or closed agricultural areas and the forest have a positive and negative effect on the aspect of health. The next step would be to perform an experiment. First the data concerning the aspects of health needs to be documented. After this an experiment can take place where greenery is implemented. This could indicate that the original results from this research can be contributed to the greenery itself or other external factors.

Conclusion

This research paper was created to contribute to the overall knowledge on the benefits of greenery and nature. The goal of all this research is to establish the importance of nature and especially biodiversity. This is necessary since the amount of biodiversity and nature is rapidly declining. At the start of the 20e century 48% of the land available was covered by forests. For wild grasslands and shrubs this percentage was 27%. A little more than a century later the amount of forest has been reduced by 10% and the amount for wild grasslands and shrubs has been reduced by 13%. The Netherlands is not an exemption to this global crisis. During the period between 1900 and 2000 the amount of biodiversity in The Netherlands was reduced from 40% to 15%. This research paper will contribute to this goal by adding information to the already comprehensive data on the benefits of greenery. This research paper sets itself apart by dissecting nature into landscapes and grading them by the amount of indicator species. There is currently an insufficient amount of information regarding the relation health and the diverse types of landscapes and the quality of nature. Due to this lack of information, it is impossible to create area programs that fully benefit from the positive effects. As a result, Municipal workers and developers create the limited amount of nature required, regardless of the needs of the surrounding area. This reduces the biodiversity in The Netherlands even further while municipalities and the national government should increase the overall biodiversity of the country. By continuing this practice any positive health benefits for the local inhabitants is withheld.

This has problem has led to the following research goal:
To search for a relation between the landscape and the quality of nature and human health in The Netherlands.

The main hypothesis of this research: document that will be proven or disproven is: A higher quality of nature positively influences the health of the people living in The Netherlands.

The main hypothesis consisted of multiple aspects that were answered individually. The first sub hypothesis was: *The amount of biodiversity has a positive influence on the health of the inhabitants of The Netherlands.* An example of an expected result could be that there is a noticeable difference between areas with multiple landscape with multiple indicator and areas without a multitube of landscapes and indicator species. The assumption would be that since biodiversity has an impact on the health of humans this would be visible in the results. First the results from the mixed model analysis will be discussed. This analysis compares the effect of the amount of indicator species within the same landscape. If the results are observed this phenomenon is present. During the calculations of the effect size, it became apparent that there are differences between the effect of areas with different amount of indicator species. Even though there were mostly relations with areas without the landscape or without any indicator species there are cases where the amount of indicator species influences the effect size. This effect could be either positive, or negative. From the first analysis it can be noted that there is a relation between the amount of indicator species and the effect on the different aspects of the human health. The effects could be beneficial or influence the aspect of human health negatively depending on the type of landscape.
Secondly the overall amount of biodiversity will be taken into account in the generalized linear mixed model. From the summary of the result of this analysis it becomes clear that areas with a biodiversity score of 4 are shown to provide the most health benefits of all the areas. A second an equal important finding is that in areas with a biodiversity score of one the influence of the amount of biodiversity is shown to negatively influence the aspect of health. To conclude the amount of biodiversity has shown to have a positive influence on the aspects of health. There are however limits to when the positive effect are outweighed by the negative effects. As indicated by the difference in health benefits between areas with a biodiversity score of four and a biodiversity score of five.

The second sub hypothesis was: *There is a difference between landscapes and the amount of positive influence on the health of the inhabitants of The Netherlands.* It can be noted without a doubt that the landscapes open and/or closed agricultural areas and forest areas are present in the summary of the result while the landscapes heath, raised moor and shifting sand, and swamps are obviously absent. The exception here is dunes. Which has shown to have a relevant relation to the aspect meeting the standard of physical activity. It can also be noted that there is a clear distinction about the relation of nature and the different aspects of health. The aspect of health that relate to the physical aspect of health are significantly lower. While the aspects overall health and physical conditions were not even significant enough to be mentioned in the summary. the exception again being the aspect of meeting the advised amount of physical activity. The aspect of health that relate to the mental aspect of health are significantly higher. An addition needs to be made. Not all landscapes have an positive effect on the aspects of health.

The third Sub hypothesis 3: landscapes which predominantly consist of greenspaces have a larger positive influence on the overall health It can be observed that areas with larger amount of literal greenery have a larger influence on health. A more accurate statement could be Areas with visible green vegetation have a larger influence on the health of the inhabitants. The influence could be positive or negative depending on the aspect of health.

With these answers the research has achieved the goal that was set out in the beginning. The different landscapes of nature and the different qualities of nature have been analysed. The main hypothesis of this study could be proven or disproven. This hypothesis has been proven to be true. The results however are mixed and while proving the full hypothesis parts can be considered proven to be wrong. The different amount of biodiversity can show to have a significant effect on the different aspects of health however there is a limit for which this is true. Also it has not only shown a relation between large amount of biodiversity and an increase in the health benefits, but also a decrease in areas with a small amount of biodiversity. The result from comparing the different landscapes is more complicated. The landscapes with larger amounts of greenery have shown to be the landscapes which for the largest part have a significant and relevant influence. However, the results show that this is not always a positive effect. The original statement in the form of the hypothesis needs to be readjusted. A more accurate statement would be as follow: The quality of nature influence the health of the inhabitants to such a degree that areas with a large amount of high quality nature experience health benefits while areas with a low quality of nature experience a drawback.

Reference list

Buxton, R. T., Pearson, A. L., Allou, C., Fristrup, K., & Wittemyer, G. (2021). A synthesis of health benefits of natural sounds and their distribution in national parks. *Proceedings of the National Academy of Sciences*, *118*(14), e2013097118. https: and/or and/or doi.org and/or 10.1073 and/or pnas.2013097118

Carver, A., Lorenzon, A., Veitch, J., Macleod, A., & Sugiyama, T. (2018). Is greenery associated with mental health among residents of aged care facilities? A systematic search and narrative review. *Aging & Mental Health*, *24*(1), 1–7. https: and/or and/or doi.org and/or 10.1080 and/or 13607863.2018.1516193

CLO. (2016a, May 29). Afstand tot groen, 2010 | Compendium voor de Leefomgeving. Retrieved from https: and/or and/or www.clo.nl and/or indicatoren and/or nl0546-afstand-tot-openbaar-groen

CLO. (2016b, June 10). Verlies natuurlijkheid in Nederland, Europa en de wereld | Compendium voor de Leefomgeving. Retrieved from https: and/or and/or www.clo.nl and/or indicatoren and/or nl1440-ontwikkeling-biodiversiteit-msa

CLO. (2018, September 3). Trends in kwaliteit van natuur, 1990 - 2017 | Compendium voor de Leefomgeving. Retrieved from https: and/or and/or www.clo.nl and/or indicatoren and/or nl2052-trend-kwaliteit-natuurtypen

Coeterier, J. F. (1997). Een meetinstrument voor de belevingswaarde van landschappen. Retrieved from https: and/or and/or www.google.com and/or url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjH84SS-6r6AhVS3KQKHf55CuwQFnoECAUQAQ&url=https%3A%2F%2Fedepot.wur.nl%2F336539&usg=AOvVaw3aQMKTczS1clT0T4PrInWl

Cohen-Cline, H., Turkheimer, E., & Duncan, G. E. (2015). Access to green space, physical activity and mental health: a twin study. *Journal of Epidemiology and Community Health*, *69*(6), 523–529. https: and/or and/or doi.org and/or 10.1136 and/or jech-2014-204667

community ecology - The process of succession. (n.d.). Retrieved 22 May 2022, from https: and/or and/or www.britannica.com and/or science and/or community-ecology and/or The-process-of-succession

Dean, J., van Dooren, K., & Weinstein, P. (2011). Does biodiversity improve mental health in urban settings? *Medical Hypotheses*, *76*(6), 877–880. https: and/or and/or doi.org and/or 10.1016 and/or j.mehy.2011.02.040

Koek, M. (2020, December 1). Massaal op zoek naar natuur tijdens coronacrisis. Retrieved from https: and/or and/or www.natuurmonumenten.nl and/or nieuws and/or massaal-op-zoek-naar-natuur-tijdens-coronacrisis

Lawton, J. H., & Gaston, K. J. (2001). Indicator Species. *Encyclopedia of Biodiversity*, 253–263. https: and/or and/or doi.org and/or 10.1016 and/or b978-0-12-384719-5.00074-5

Marselle, M. R., Lindley, S. J., Cook, P. A., & Bonn, A. (2021). Biodiversity and Health in the Urban Environment. *Current Environmental Health Reports*, *8*(2), 146–156. https: and/or and/or doi.org and/or 10.1007 and/or s40572-021-00313-9

Natura 2000 | natura 2000. (2022, June 8). Retrieved 23 September 2022, from https: and/or and/or www.natura2000.nl and/or

Netherlands, S. (2019, April 9). SEEA ecosystem condition account for The Netherlands. Retrieved 23 September 2022, from https: and/or and/or www.cbs.nl and/or en-gb and/or custom and/or 2019 and/or 15 and/or seea-ecosystem-condition-account-for-the-netherlands

Rappe, E., & Topo, P. (2007a). Contact with Outdoor Greenery Can Support Competence Among People with Dementia. *Journal of Housing for the Elderly*, *21*(3–4), 229–248. https: and/or and/or doi.org and/or 10.1300 and/or j081v21n03_12

Rappe, E., & Topo, P. (2007b). Contact with Outdoor Greenery Can Support Competence Among People with Dementia. *Journal of Housing for the Elderly*, *21*(3–4), 229–248. https: and/or and/or doi.org and/or 10.1300 and/or j081v21n03_12

Russell, R., Guerry, A. D., Balvanera, P., Gould, R. K., Basurto, X., Chan, K. M., . . . Tam, J. (2013a). Humans and Nature: How Knowing and Experiencing Nature Affect Well-Being. *Annual Review of Environment and Resources*, *38*(1), 473–502. https: and/or and/or doi.org and/or 10.1146 and/or annurev-environ-012312-110838

Russell, R., Guerry, A. D., Balvanera, P., Gould, R. K., Basurto, X., Chan, K. M., . . . Tam, J. (2013b). Humans and Nature: How Knowing and Experiencing Nature Affect Well-Being. *Annual Review of Environment and Resources*, *38*(1), 473–502. https: and/or and/or doi.org and/or 10.1146 and/or annurev-environ-012312-110838

Staring, K. (2020, December 11). Wat is de groenste stad ter wereld en van Nederland ⋆. Retrieved from https: and/or and/or dailygreenspiration.nl and/or groenste-stad-wereld-nederland and/or

TEEB. (2020, November 12). Approach. Retrieved from http: and/or and/or teebweb.org and/or about and/or approach and/or

W.Gotink, W. (2021, June 28). ‘Vanaf vijftig procent verstedelijking stijgt mentale problematiek versneld’. Retrieved from https: and/or and/or www.ggztotaal.nl and/or nw-29166-7-

3889935 and/or nieuws and/or vanaf_vijftig_procent_verstedelijking_stijgt_mentale_problematiek_versneld.html

World Health Organization. Regional Office for Europe. (2021, July 22). Green and blue spaces and mental health: new evidence and perspectives for action. Retrieved 23 September 2022, from https: and/or and/or apps.who.int and/or iris and/or handle and/or 10665 and/or 342931

Appendix one: Reflection

In this part of the document a reflection is given on the process and the results. Reflecting on these aspects of essential when performing research. When someone is performing research, they are contributing to the overall knowledge on that subject. With that in mind the researchers has the obligation to perform their research with the goal of providing a result that is without external influences. By reflecting the researcher can objectively observe their process and product. This will be done by observing a couple of aspects. The first aspect is the relation between the research topic and the graduation track. The second aspect is the scientific relevance. The third aspect is the process of data collection. The fourth aspect is the applicability of the results. The last aspect is ethics.

Relation of the research topic to graduation track

The master of the build environment contains a variety of subject. This is designed to give the students are broader understanding of the different fields. With this broad understanding the student can than further develop its qualities during the remainder of their career. One of these subjects is CREM (corporate real estate management). This subject involves the management of areas and buildings. A way to measure the success of these location is with KPI's (key performance indicators). This could for example be the state of the buildings, the rentability of a building, a certain level of attractiveness, healthy environments, etc. This research focusses on healthy environments. The literature has established that greenery has a positive influence on the health of humans. This study has the goal of supporting CREM by providing additional knowledge. This has led to the following research goal: To search for a relation between the quality of nature. With a positive relation the CREM could implement it in their overall plan.

Scientific relevance

During the pre-research phase a significant amount of literature has been read in order to formulate a research question and goal that can contribute to the already existing information. It became apparent that nature as a whole has been thoroughly researched. However multiple types of vegetations are grouped together and called nature while there is a real difference between a forest in Gelderland, dunes on Vlieland and a typical grassland found al across the Netherlands. This study sets itself apart by analysing the effect of all the individual landscapes and areas with a combination of multiple landscapes.

Process of data collection

The task of collecting the data concerning the determination of the quality of the nature started with establishing which indicator species were used. Since the quality of nature is related to the variety and richness of the species located in the area the use of keystone species would be most useful. A list of keystone species is presented in a document called the *natura 2000*. With the list of keystone species per landscape it is possible to search for a data source. The National databank of flora and fauna (NDFF) would be the most logical starting point. This organization monitors and verifies data concerning the amount of flora and fauna in the Netherlands. Since this is a private organization, the information is not published for free. Instead, an arrangement is made for students who can access a selection of the available data. However, during the conversations with the NDFF the only information available for students contained the information for roughly one middle large city in the Netherlands. Since the scale of this study contains the whole of the Netherlands solely the information provided to students would not be enough. The remaining data could be bought but due to the scale of this research the price would exceeded a normal budget. Making the usage of this source not possible. With a lack of a reliable data source the original idea required a modification.

Instead of using a variety of different animals and plants only birds are selected as indicator species. The same organization that provided the data about the indicator species to determine the landscape also provides information concerning the keystone species. Birds already make up the majority of the keystone species list. Therefore, the use of birds alone would not reduce the reliability with a critical amount.

Applicability of the results

At the start of the process the end product was expected to consist of a list that provided the reader with the number of benefits that can be obtained from the different landscapes and the different quality of nature. The reader could use this data base to determine the effect of improving an area by either increasing the amount of biodiversity or applying a particular landscape. At the time of summiting the P4 document the goal of creating this end product was not yet achieved. During the period between the P4 submission and the P5 submission I was able to perform an additional analysis that would conclude whether or not a relation could be found between the total amount of biodiversity and health. This new analysis has shown that this effect is real. The results provided by this study provide planners, designers, and health care organization with the knowledge about an increase in health benefits if the biodiversity is higher. This research also provides a general guide line about the effect of a landscape on the different aspects of health.

Ethics

It is essential that the researchers has an ethical mindset. More than ones have there been institutions in the news that have falsified the results. This research has during the entire process tried to stay objective. There were two moments where an ethical dilemma has presented itself. The first moment happened in May. Since I could not access the database from NDFF the data had to be collected and reviewed manually. With only a week till the first P4 moment there the first dilemma. The choice that I could make was to use the amounts of indicator species from the municipality for the neighbourhoods. This would save an incredible amount of time. Since the data file is quite large the chance that someone could find out about the distortion of the data was small. However, by doing this the integrity of the whole document could be lost. Even though this research is part of graduating and could not be viewed by anyone other than the mentors there is still the obligation to be professional and act ethical. The second dilemma arose when the results of the first analysis came in. Since I have a profound interest in greenery in cities I would preference a result that would without a doubt prove that cities should implement more greenery. A choice that I could make was to focus heavily on the effect size. This was shown to have a far larger effect. This would be in conflict with being honest in your research since the truth is distorted. Again, there is the obligation of the student and researchers to act professional. The second analysis did show that there is a relation between the amount of biodiversity and health. This is not done by tweaking the data ,but using a different analysis. During the period between the P4 and the P5 the students can finalise their document and prepare for the presentation. I would argue that using this time to perform an additional analysis was the only moral option. This research has the potential to inspire additional research documents and provide planners and architects with the knowledge that nature provide a variety of health benefits. Finalizing this research would have been the only ethical option. If this research had the potential to alter even one live for the better the additional work and time should be invested in this study.

Appendix two: SPSS output

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Mean Difference (I-J)	Std. Error	df
1	2	1,580	0,986	12620,440
	3	1,506	0,990	12594,204
	4	1,444	0,962	12538,735
	5	1,198	0,960	12547,564
	6	0,694	0,951	12516,232
	7	1,333	0,961	12547,181
	8	1,525	0,962	12534,462
	9	2,194*	0,981	12526,010
	10	0,933	1,069	12524,439
	0 is ref	1,299	0,946	12501,276
2	1	-1,580	0,986	12620,440
	3	-0,075	0,383	12227,143
	4	-0,136	0,313	12055,464
	5	-0,382	0,319	11733,948
	6	-0,886*	0,311	12080,729
	7	-0,247	0,332	11912,252
	8	-0,055	0,344	12357,948
	9	0,614	0,386	12712
	10	-0,648	0,616	12712
	0 is ref	-0,281	0,272	11619,799
3	1	-1,506	0,990	12594,204
	2	0,075	0,383	12227,143
	4	-0,061	0,313	12615,279
	5	-0,307	0,325	12352,764
	6	-0,812*	0,330	12387,094
	7	-0,173	0,345	12270,300
	8	0,019	0,361	12506,020
	9	0,688	0,436	12699,831
	10	-0,573	0,628	12712
	0 is ref	-0,207	0,289	12281,498
4	1	-1,444	0,962	12538,735
	2	0,136	0,313	12055,464
	3	0,061	0,313	12615,279
	5	-0,246	0,227	12500,264
	6	-0,751*	0,226	12656,980
	7	-0,111	0,243	12535,157
	8	0,080	0,273	12694,059
	9	0,750*	0,367	12712
	10	-0,512	0,582	12685,487
	0 is ref	-0,145	0,167	12648,871

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Sig.[c]	95% Confidence Interval for Difference[c] Lower Bound	Upper Bound
1	2	0,109	-0,353	3,514
	3	0,128	-0,435	3,447
	4	0,133	-0,440	3,329
	5	0,212	-0,684	3,080
	6	0,466	-1,171	2,559
	7	0,166	-0,552	3,218
	8	0,113	-0,361	3,410
	9	0,025	0,271	4,117
	10	0,383	-1,164	3,029
	0 is ref	0,170	-0,555	3,153
2	1	0,109	-3,514	0,353
	3	0,846	-0,826	0,677
	4	0,664	-0,748	0,477
	5	0,232	-1,008	0,244
	6	0,004	-1,496	-0,277
	7	0,457	-0,898	0,404
	8	0,872	-0,729	0,619
	9	0,112	-0,142	1,370
	10	0,293	-1,856	0,560
	0 is ref	0,300	-0,814	0,251
3	1	0,128	-3,447	0,435
	2	0,846	-0,677	0,826
	4	0,845	-0,674	0,552
	5	0,344	-0,944	0,329
	6	0,014	-1,459	-0,165
	7	0,616	-0,849	0,503
	8	0,958	-0,688	0,726
	9	0,114	-0,166	1,543
	10	0,362	-1,805	0,659
	0 is ref	0,474	-0,773	0,359
4	1	0,133	-3,329	0,440
	2	0,664	-0,477	0,748
	3	0,845	-0,552	0,674
	5	0,278	-0,690	0,198
	6	<0,001	-1,194	-0,307
	7	0,647	-0,588	0,365
	8	0,768	-0,454	0,615
	9	0,041	0,030	1,470
	10	0,380	-1,653	0,630
	0 is ref	0,385	-0,474	0,183

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Mean Difference (I-J)	Std. Error	df
5	1	-1,198	0,960	12547,564
	2	0,382	0,319	11733,948
	3	0,307	0,325	12352,764
	4	0,246	0,227	12500,264
	6	-0,505*	0,223	12503,224
	7	0,135	0,252	12094,526
	8	0,326	0,276	12529,636
	9	0,996*	0,372	12712
	10	-0,266	0,584	12712
	0 is ref	0,101	0,175	11863,956
6	1	-0,694	0,951	12516,232
	2	0,886*	0,311	12080,729
	3	0,812*	0,330	12387,094
	4	0,751*	0,226	12656,980
	5	0,505*	0,223	12503,224
	7	0,639*	0,247	12395,620
	8	0,831*	0,265	12709,540
	9	1,500*	0,358	12712
	10	0,239	0,576	12680,551
	0 is ref	0,605*	0,167	12516,086
7	1	-1,333	0,961	12547,181
	2	0,247	0,332	11912,252
	3	0,173	0,345	12270,300
	4	0,111	0,243	12535,157
	5	-0,135	0,252	12094,526
	6	-0,639*	0,247	12395,620
	8	0,192	0,267	12712
	9	0,861*	0,362	12712
	10	-0,400	0,578	12670,833
	0 is ref	-0,034	0,200	12077,026
8	1	-1,525	0,962	12534,462
	2	0,055	0,344	12357,948

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Sig.[c]	95% Confidence Interval for Difference[c] Lower Bound	Upper Bound
5	1	0,212	-3,080	0,684
	2	0,232	-0,244	1,008
	3	0,344	-0,329	0,944
	4	0,278	-0,198	0,690
	6	0,024	-0,941	-0,068
	7	0,593	-0,359	0,628
	8	0,237	-0,215	0,868
	9	0,007	0,266	1,725
	10	0,649	-1,411	0,879
	0 is ref	0,564	-0,241	0,443
6	1	0,466	-2,559	1,171
	2	0,004	0,277	1,496
	3	0,014	0,165	1,459
	4	<0,001	0,307	1,194
	5	0,024	0,068	0,941
	7	0,010	0,156	1,123
	8	0,002	0,312	1,350
	9	<0,001	0,799	2,202
	10	0,678	-0,889	1,367
	0 is ref	<0,001	0,279	0,932
7	1	0,166	-3,218	0,552
	2	0,457	-0,404	0,898
	3	0,616	-0,503	0,849
	4	0,647	-0,365	0,588
	5	0,593	-0,628	0,359
	6	0,010	-1,123	-0,156
	8	0,472	-0,331	0,714
	9	0,017	0,152	1,570
	10	0,489	-1,533	0,733
	0 is ref	0,865	-0,425	0,357
8	1	0,113	-3,410	0,361
	2	0,872	-0,619	0,729

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Mean Difference (I-J)	Std. Error	df
	3	-0,019	0,361	12506,020
	4	-0,080	0,273	12694,059
	5	-0,326	0,276	12529,636
	6	-0,831*	0,265	12709,540
	7	-0,192	0,267	12712
	9	0,669	0,358	12673,555
	10	-0,592	0,579	12647,135
	0 is ref	-0,226	0,232	12607,710
9	1	-2,194*	0,981	12526,010
	2	-0,614	0,386	12712
	3	-0,688	0,436	12699,831
	4	-0,750*	0,367	12712
	5	-0,996*	0,372	12712
	6	-1,500*	0,358	12712
	7	-0,861*	0,362	12712
	8	-0,669	0,358	12673,555
	10	-1,261*	0,589	12564,826
	0 is ref	-0,895*	0,335	12712
10	1	-0,933	1,069	12524,439
	2	0,648	0,616	12712
	3	0,573	0,628	12712
	4	0,512	0,582	12685,487
	5	0,266	0,584	12712
	6	-0,239	0,576	12680,551
	7	0,400	0,578	12670,833
	8	0,592	0,579	12647,135
	9	1,261*	0,589	12564,826
	0 is ref	0,366	0,561	12666,840
0 is ref	1	-1,299	0,946	12501,276
	2	0,281	0,272	11619,799
	3	0,207	0,289	12281,498
	4	0,145	0,167	12648,871
	5	-0,101	0,175	11863,956
	6	-0,605*	0,167	12516,086
	7	0,034	0,200	12077,026
	8	0,226	0,232	12607,710
	9	0,895*	0,335	12712
	10	-0,366	0,561	12666,840

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Sig.[c]	95% Confidence Interval for Difference[c] Lower Bound	Upper Bound
	3	0,958	-0,726	0,688
	4	0,768	-0,615	0,454
	5	0,237	-0,868	0,215
	6	0,002	-1,350	-0,312
	7	0,472	-0,714	0,331
	9	0,061	-0,032	1,370
	10	0,306	-1,727	0,543
	0 is ref	0,330	-0,680	0,228
9	1	0,025	-4,117	-0,271
	2	0,112	-1,370	0,142
	3	0,114	-1,543	0,166
	4	0,041	-1,470	-0,030
	5	0,007	-1,725	-0,266
	6	<0,001	-2,202	-0,799
	7	0,017	-1,570	-0,152
	8	0,061	-1,370	0,032
	10	0,032	-2,416	-0,107
	0 is ref	0,008	-1,552	-0,238
10	1	0,383	-3,029	1,164
	2	0,293	-0,560	1,856
	3	0,362	-0,659	1,805
	4	0,380	-0,630	1,653
	5	0,649	-0,879	1,411
	6	0,678	-1,367	0,889
	7	0,489	-0,733	1,533
	8	0,306	-0,543	1,727
	9	0,032	0,107	2,416
	0 is ref	0,514	-0,734	1,467
0 is ref	1	0,170	-3,153	0,555
	2	0,300	-0,251	0,814
	3	0,474	-0,359	0,773
	4	0,385	-0,183	0,474
	5	0,564	-0,443	0,241
	6	<0,001	-0,932	-0,279
	7	0,865	-0,357	0,425
	8	0,330	-0,228	0,680
	9	0,008	0,238	1,552
	10	0,514	-1,467	0,734

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Dependent Variable: HealthRIVM.

c. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Pairwise Comparisons[a]

(I) Bossen	(J) Bossen	Mean Difference (I-J)	Std. Error	df	Sig.[c]	95% Confidence Interval for [c]... Lower Bound
1	2	0,067	0,102	12383,660	0,510	-0,133
	3	0,452*	0,156	12274,678	0,004	0,147
	0 is ref	-0,310*	0,079	12420,821	<0,001	-0,465
2	1	-0,067	0,102	12383,660	0,510	-0,267
	3	0,385*	0,161	12493,300	0,017	0,069
	0 is ref	-0,377*	0,113	12356,606	<0,001	-0,599
3	1	-0,452*	0,156	12274,678	0,004	-0,758
	2	-0,385*	0,161	12493,300	0,017	-0,701
	0 is ref	-0,762*	0,164	12251,785	<0,001	-1,084
0 is ref	1	0,310*	0,079	12420,821	<0,001	0,155
	2	0,377*	0,113	12356,606	<0,001	0,155
	3	0,762*	0,164	12251,785	<0,001	0,440

Pairwise Comparisons[a]

(I) Bossen	(J) Bossen	95% Confidence Interval for [c]... Upper Bound
1	2	0,267
	3	0,758
	0 is ref	-0,155
2	1	0,133
	3	0,701
	0 is ref	-0,155
3	1	-0,147
	2	-0,069
	0 is ref	-0,440
0 is ref	1	0,465
	2	0,599
	3	1,084

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Dependent Variable: HealthRIVM.

c. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Mean Difference (I-J)	Std. Error	df
1	2	1,580	0,986	12620,440
	3	1,506	0,990	12594,204
	4	1,444	0,962	12538,735
	5	1,198	0,960	12547,564
	6	0,694	0,951	12516,232
	7	1,333	0,961	12547,181
	8	1,525	0,962	12534,462
	9	2,194*	0,981	12526,010
	10	0,933	1,069	12524,439
	0 is ref	1,299	0,946	12501,276
2	1	-1,580	0,986	12620,440
	3	-0,075	0,383	12227,143
	4	-0,136	0,313	12055,464
	5	-0,382	0,319	11733,948
	6	-0,886*	0,311	12080,729
	7	-0,247	0,332	11912,252
	8	-0,055	0,344	12357,948
	9	0,614	0,386	12712
	10	-0,648	0,616	12712
	0 is ref	-0,281	0,272	11619,799
3	1	-1,506	0,990	12594,204
	2	0,075	0,383	12227,143
	4	-0,061	0,313	12615,279
	5	-0,307	0,325	12352,764
	6	-0,812*	0,330	12387,094
	7	-0,173	0,345	12270,300
	8	0,019	0,361	12506,020
	9	0,688	0,436	12699,831
	10	-0,573	0,628	12712
	0 is ref	-0,207	0,289	12281,498
4	1	-1,444	0,962	12538,735
	2	0,136	0,313	12055,464
	3	0,061	0,313	12615,279
	5	-0,246	0,227	12500,264
	6	-0,751*	0,226	12656,980
	7	-0,111	0,243	12535,157
	8	0,080	0,273	12694,059
	9	0,750*	0,367	12712
	10	-0,512	0,582	12685,487
	0 is ref	-0,145	0,167	12648,871

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Sig.[c]	95% Confidence Interval for Difference[c] Lower Bound	Upper Bound
1	2	0,109	-0,353	3,514
	3	0,128	-0,435	3,447
	4	0,133	-0,440	3,329
	5	0,212	-0,684	3,080
	6	0,466	-1,171	2,559
	7	0,166	-0,552	3,218
	8	0,113	-0,361	3,410
	9	0,025	0,271	4,117
	10	0,383	-1,164	3,029
	0 is ref	0,170	-0,555	3,153
2	1	0,109	-3,514	0,353
	3	0,846	-0,826	0,677
	4	0,664	-0,748	0,477
	5	0,232	-1,008	0,244
	6	0,004	-1,496	-0,277
	7	0,457	-0,898	0,404
	8	0,872	-0,729	0,619
	9	0,112	-0,142	1,370
	10	0,293	-1,856	0,560
	0 is ref	0,300	-0,814	0,251
3	1	0,128	-3,447	0,435
	2	0,846	-0,677	0,826
	4	0,845	-0,674	0,552
	5	0,344	-0,944	0,329
	6	0,014	-1,459	-0,165
	7	0,616	-0,849	0,503
	8	0,958	-0,688	0,726
	9	0,114	-0,166	1,543
	10	0,362	-1,805	0,659
	0 is ref	0,474	-0,773	0,359
4	1	0,133	-3,329	0,440
	2	0,664	-0,477	0,748
	3	0,845	-0,552	0,674
	5	0,278	-0,690	0,198
	6	<0,001	-1,194	-0,307
	7	0,647	-0,588	0,365
	8	0,768	-0,454	0,615
	9	0,041	0,030	1,470
	10	0,380	-1,653	0,630
	0 is ref	0,385	-0,474	0,183

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Mean Difference (I-J)	Std. Error	df
5	1	-1,198	0,960	12547,564
	2	0,382	0,319	11733,948
	3	0,307	0,325	12352,764
	4	0,246	0,227	12500,264
	6	-0,505*	0,223	12503,224
	7	0,135	0,252	12094,526
	8	0,326	0,276	12529,636
	9	0,996*	0,372	12712
	10	-0,266	0,584	12712
	0 is ref	0,101	0,175	11863,956
6	1	-0,694	0,951	12516,232
	2	0,886*	0,311	12080,729
	3	0,812*	0,330	12387,094
	4	0,751*	0,226	12656,980
	5	0,505*	0,223	12503,224
	7	0,639*	0,247	12395,620
	8	0,831*	0,265	12709,540
	9	1,500*	0,358	12712
	10	0,239	0,576	12680,551
	0 is ref	0,605*	0,167	12516,086
7	1	-1,333	0,961	12547,181
	2	0,247	0,332	11912,252
	3	0,173	0,345	12270,300
	4	0,111	0,243	12535,157
	5	-0,135	0,252	12094,526
	6	-0,639*	0,247	12395,620
	8	0,192	0,267	12712
	9	0,861*	0,362	12712
	10	-0,400	0,578	12670,833
	0 is ref	-0,034	0,200	12077,026
8	1	-1,525	0,962	12534,462
	2	0,055	0,344	12357,948

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Sig.[c]	95% Confidence Interval for Difference[c] Lower Bound	Upper Bound
5	1	0,212	-3,080	0,684
	2	0,232	-0,244	1,008
	3	0,344	-0,329	0,944
	4	0,278	-0,198	0,690
	6	0,024	-0,941	-0,068
	7	0,593	-0,359	0,628
	8	0,237	-0,215	0,868
	9	0,007	0,266	1,725
	10	0,649	-1,411	0,879
	0 is ref	0,564	-0,241	0,443
6	1	0,466	-2,559	1,171
	2	0,004	0,277	1,496
	3	0,014	0,165	1,459
	4	<0,001	0,307	1,194
	5	0,024	0,068	0,941
	7	0,010	0,156	1,123
	8	0,002	0,312	1,350
	9	<0,001	0,799	2,202
	10	0,678	-0,889	1,367
	0 is ref	<0,001	0,279	0,932
7	1	0,166	-3,218	0,552
	2	0,457	-0,404	0,898
	3	0,616	-0,503	0,849
	4	0,647	-0,365	0,588
	5	0,593	-0,628	0,359
	6	0,010	-1,123	-0,156
	8	0,472	-0,331	0,714
	9	0,017	0,152	1,570
	10	0,489	-1,533	0,733
	0 is ref	0,865	-0,425	0,357
8	1	0,113	-3,410	0,361
	2	0,872	-0,619	0,729

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Mean Difference (I-J)	Std. Error	df
	3	-0,019	0,361	12506,020
	4	-0,080	0,273	12694,059
	5	-0,326	0,276	12529,636
	6	-0,831*	0,265	12709,540
	7	-0,192	0,267	12712
	9	0,669	0,358	12673,555
	10	-0,592	0,579	12647,135
	0 is ref	-0,226	0,232	12607,710
9	1	-2,194*	0,981	12526,010
	2	-0,614	0,386	12712
	3	-0,688	0,436	12699,831
	4	-0,750*	0,367	12712
	5	-0,996*	0,372	12712
	6	-1,500*	0,358	12712
	7	-0,861*	0,362	12712
	8	-0,669	0,358	12673,555
	10	-1,261*	0,589	12564,826
	0 is ref	-0,895*	0,335	12712
10	1	-0,933	1,069	12524,439
	2	0,648	0,616	12712
	3	0,573	0,628	12712
	4	0,512	0,582	12685,487
	5	0,266	0,584	12712
	6	-0,239	0,576	12680,551
	7	0,400	0,578	12670,833
	8	0,592	0,579	12647,135
	9	1,261*	0,589	12564,826
	0 is ref	0,366	0,561	12666,840
0 is ref	1	-1,299	0,946	12501,276
	2	0,281	0,272	11619,799
	3	0,207	0,289	12281,498
	4	0,145	0,167	12648,871
	5	-0,101	0,175	11863,956
	6	-0,605*	0,167	12516,086
	7	0,034	0,200	12077,026
	8	0,226	0,232	12607,710
	9	0,895*	0,335	12712
	10	-0,366	0,561	12666,840

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Sig.[c]	95% Confidence Interval for Difference[c] Lower Bound	Upper Bound
	3	0,958	-0,726	0,688
	4	0,768	-0,615	0,454
	5	0,237	-0,868	0,215
	6	0,002	-1,350	-0,312
	7	0,472	-0,714	0,331
	9	0,061	-0,032	1,370
	10	0,306	-1,727	0,543
	0 is ref	0,330	-0,680	0,228
9	1	0,025	-4,117	-0,271
	2	0,112	-1,370	0,142
	3	0,114	-1,543	0,166
	4	0,041	-1,470	-0,030
	5	0,007	-1,725	-0,266
	6	<0,001	-2,202	-0,799
	7	0,017	-1,570	-0,152
	8	0,061	-1,370	0,032
	10	0,032	-2,416	-0,107
	0 is ref	0,008	-1,552	-0,238
10	1	0,383	-3,029	1,164
	2	0,293	-0,560	1,856
	3	0,362	-0,659	1,805
	4	0,380	-0,630	1,653
	5	0,649	-0,879	1,411
	6	0,678	-1,367	0,889
	7	0,489	-0,733	1,533
	8	0,306	-0,543	1,727
	9	0,032	0,107	2,416
	0 is ref	0,514	-0,734	1,467
0 is ref	1	0,170	-3,153	0,555
	2	0,300	-0,251	0,814
	3	0,474	-0,359	0,773
	4	0,385	-0,183	0,474
	5	0,564	-0,443	0,241
	6	<0,001	-0,932	-0,279
	7	0,865	-0,357	0,425
	8	0,330	-0,228	0,680
	9	0,008	0,238	1,552
	10	0,514	-1,467	0,734

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Dependent Variable: HealthRIVM.

c. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Pairwise Comparisons[a]

(I) Moeras	(J) Moeras	Mean Difference (I-J)	Std. Error	df	Sig.[c]	95% Confidence Interval for [c]... Lower Bound	95% Confidence Interval for [c]... Upper Bound
1	2	0,778*	0,275	9248,020	0,005	0,238	1,317
	0 is ref	0,695*	0,270	9269,854	0,010	0,167	1,224
2	1	-0,778*	0,275	9248,020	0,005	-1,317	-0,238
	0 is ref	-0,082	0,091	9097,661	0,367	-0,260	0,096
0 is ref	1	-0,695*	0,270	9269,854	0,010	-1,224	-0,167
	2	0,082	0,091	9097,661	0,367	-0,096	0,260

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Dependent Variable: SmokingRIVM.

c. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Pairwise Comparisons[a]

(I) Bossen	(J) Bossen	Mean Difference (I-J)	Std. Error	df	Sig.[c]	95% Confidence Interval for ...[c] Lower Bound
1	2	0,221	0,124	10023,681	0,076	-0,023
	3	0,615*	0,190	9493,765	0,001	0,243
	0 is ref	-0,017	0,097	10094,907	0,859	-0,206
2	1	-0,221	0,124	10023,681	0,076	-0,465
	3	0,394*	0,197	10394,840	0,046	0,007
	0 is ref	-0,238	0,138	9873,585	0,084	-0,509
3	1	-0,615*	0,190	9493,765	0,001	-0,986
	2	-0,394*	0,197	10394,840	0,046	-0,780
	0 is ref	-0,632*	0,200	9416,251	0,002	-1,023
0 is ref	1	0,017	0,097	10094,907	0,859	-0,172
	2	0,238	0,138	9873,585	0,084	-0,032
	3	0,632*	0,200	9416,251	0,002	0,241

Pairwise Comparisons[a]

(I) Bossen	(J) Bossen	95% Confidence Interval for ...[c] Upper Bound
1	2	0,465
	3	0,986
	0 is ref	0,172
2	1	0,023
	3	0,780
	0 is ref	0,032
3	1	-0,243
	2	-0,007
	0 is ref	-0,241
0 is ref	1	0,206
	2	0,509
	3	1,023

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Dependent Variable: SmokingRIVM.

c. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Pairwise Comparisons[a]

(I) strand	(J) strand	Mean Difference (I-J)	Std. Error	df	Sig.[c]	95% Confidence Interval for [c]... Lower Bound
1	2	-0,300	0,302	12712	0,321	-0,892
	3	-0,674*	0,261	12712	0,010	-1,185
	0 is ref	-1,047*	0,208	12712	<0,001	-1,455
2	1	0,300	0,302	12712	0,321	-0,292
	3	-0,374	0,278	12698,596	0,179	-0,919
	0 is ref	-0,747*	0,247	12712	0,002	-1,231
3	1	0,674*	0,261	12712	0,010	0,163
	2	0,374	0,278	12698,596	0,179	-0,171
	0 is ref	-0,373*	0,175	12712	0,033	-0,716
0 is ref	1	1,047*	0,208	12712	<0,001	0,640
	2	0,747*	0,247	12712	0,002	0,264
	3	0,373*	0,175	12712	0,033	0,031

Pairwise Comparisons[a]

(I) strand	(J) strand	95% Confidence Interval for [c]... Upper Bound
1	2	0,292
	3	-0,163
	0 is ref	-0,640
2	1	0,892
	3	0,171
	0 is ref	-0,264
3	1	1,185
	2	0,919
	0 is ref	-0,031
0 is ref	1	1,455
	2	1,231
	3	0,716

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Dependent Variable: LonlinessServereRIVM.

c. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Pairwise Comparisons[a]

(I) Bossen	(J) Bossen	Mean Difference (I-J)	Std. Error	df	Sig.[c]	95% Confidence Interval for Difference[c] Lower Bound
1	2	0,029	0,059	12666,124	0,617	-0,086
	3	0,052	0,090	12630,785	0,562	-0,124
	0 is ref	0,163*	0,045	12679,985	<0,001	0,074
2	1	-0,029	0,059	12666,124	0,617	-0,144
	3	0,023	0,093	12704,981	0,807	-0,159
	0 is ref	0,134*	0,065	12657,083	0,040	0,006
3	1	-0,052	0,090	12630,785	0,562	-0,228
	2	-0,023	0,093	12704,981	0,807	-0,204
	0 is ref	0,111	0,094	12621,141	0,238	-0,074
0 is ref	1	-0,163*	0,045	12679,985	<0,001	-0,252
	2	-0,134*	0,065	12657,083	0,040	-0,262
	3	-0,111	0,094	12621,141	0,238	-0,296

Pairwise Comparisons[a]

(I) Bossen	(J) Bossen	95% Confidence Interval for Difference[c] Upper Bound
1	2	0,144
	3	0,228
	0 is ref	0,252
2	1	0,086
	3	0,204
	0 is ref	0,262
3	1	0,124
	2	0,159
	0 is ref	0,296
0 is ref	1	-0,074
	2	-0,006
	3	0,074

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Dependent Variable: LonlinessServereRIVM.

c. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Mean Difference (I-J)	Std. Error	df
1	2	-1,475*	0,604	12544,780
	3	-1,152	0,606	12524,346
	4	-1,011	0,588	12480,825
	5	-1,236*	0,588	12488,602
	6	-1,118	0,582	12465,227
	7	-1,301*	0,588	12488,260
	8	-0,938	0,589	12478,397
	9	-1,079	0,600	12471,572
	10	-1,139	0,654	12468,859
	0 is ref	-1,252*	0,579	12453,795
2	1	1,475*	0,604	12544,780
	3	0,323	0,237	12686,288
	4	0,464*	0,194	12650,967
	5	0,239	0,198	12557,708
	6	0,357	0,192	12655,036
	7	0,174	0,206	12611,741
	8	0,537*	0,212	12712
	9	0,396	0,237	12703,918
	10	0,336	0,378	12656,540
	0 is ref	0,223	0,169	12526,754
3	1	1,152	0,606	12524,346
	2	-0,323	0,237	12686,288
	4	0,142	0,193	12712
	5	-0,084	0,201	12705,199
	6	0,035	0,204	12712
	7	-0,148	0,213	12688,697
	8	0,214	0,223	12712
	9	0,073	0,268	12712
	10	0,014	0,386	12659,865
	0 is ref	-0,099	0,179	12689,875
4	1	1,011	0,588	12480,825
	2	-0,464*	0,194	12650,967
	3	-0,142	0,193	12712
	5	-0,226	0,140	12712
	6	-0,107	0,140	12712
	7	-0,290	0,150	12712
	8	0,073	0,168	12712
	9	-0,068	0,226	12684,446
	10	-0,128	0,357	12594,563
	0 is ref	-0,241*	0,103	12712

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Sig.[c]	95% Confidence Interval for Difference[c] Lower Bound	Upper Bound
1	2	0,015	-2,659	-0,291
	3	0,057	-2,341	0,036
	4	0,086	-2,164	0,143
	5	0,035	-2,388	-0,085
	6	0,055	-2,259	0,023
	7	0,027	-2,454	-0,148
	8	0,111	-2,092	0,216
	9	0,072	-2,256	0,098
	10	0,082	-2,421	0,144
	0 is ref	0,031	-2,386	-0,117
2	1	0,015	0,291	2,659
	3	0,174	-0,142	0,787
	4	0,016	0,085	0,844
	5	0,228	-0,150	0,627
	6	0,063	-0,020	0,735
	7	0,398	-0,229	0,577
	8	0,012	0,120	0,953
	9	0,095	-0,069	0,861
	10	0,374	-0,405	1,078
	0 is ref	0,185	-0,107	0,554
3	1	0,057	-0,036	2,341
	2	0,174	-0,787	0,142
	4	0,462	-0,236	0,520
	5	0,676	-0,477	0,309
	6	0,865	-0,365	0,435
	7	0,486	-0,566	0,270
	8	0,336	-0,222	0,651
	9	0,784	-0,453	0,600
	10	0,971	-0,742	0,770
	0 is ref	0,579	-0,449	0,251
4	1	0,086	-0,143	2,164
	2	0,016	-0,844	-0,085
	3	0,462	-0,520	0,236
	5	0,107	-0,500	0,049
	6	0,443	-0,380	0,166
	7	0,053	-0,584	0,004
	8	0,665	-0,256	0,402
	9	0,762	-0,511	0,374
	10	0,720	-0,828	0,572
	0 is ref	0,020	-0,443	-0,039

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Mean Difference (I-J)	Std. Error	df
5	1	1,236*	0,588	12488,602
	2	-0,239	0,198	12557,708
	3	0,084	0,201	12705,199
	4	0,226	0,140	12712
	6	0,119	0,138	12712
	7	-0,064	0,156	12644,626
	8	0,298	0,171	12712
	9	0,157	0,229	12712
	10	0,098	0,358	12628,405
	0 is ref	-0,015	0,108	12572,591
6	1	1,118	0,582	12465,227
	2	-0,357	0,192	12655,036
	3	-0,035	0,204	12712
	4	0,107	0,140	12712
	5	-0,119	0,138	12712
	7	-0,183	0,152	12712
	8	0,180	0,163	12712
	9	0,039	0,220	12670,555
	10	-0,021	0,353	12590,079
	0 is ref	-0,134	0,103	12712
7	1	1,301*	0,588	12488,260
	2	-0,174	0,206	12611,741
	3	0,148	0,213	12688,697
	4	0,290	0,150	12712
	5	0,064	0,156	12644,626
	6	0,183	0,152	12712
	8	0,363*	0,164	12710,792
	9	0,222	0,222	12678,553
	10	0,162	0,354	12580,929
	0 is ref	0,049	0,124	12642,478
8	1	0,938	0,589	12478,397
	2	-0,537*	0,212	12712
	3	-0,214	0,223	12712
	4	-0,073	0,168	12712
	5	-0,298	0,171	12712
	6	-0,180	0,163	12712
	7	-0,363*	0,164	12710,792
	9	-0,141	0,219	12584,666
	10	-0,200	0,355	12558,808
	0 is ref	-0,313*	0,143	12712

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Sig.[c]	95% Confidence Interval for Difference[c] Lower Bound	Upper Bound
5	1	0,035	0,085	2,388
	2	0,228	-0,627	0,150
	3	0,676	-0,309	0,477
	4	0,107	-0,049	0,500
	6	0,388	-0,151	0,388
	7	0,679	-0,370	0,241
	8	0,080	-0,036	0,633
	9	0,492	-0,292	0,606
	10	0,785	-0,605	0,800
	0 is ref	0,889	-0,227	0,197
6	1	0,055	-0,023	2,259
	2	0,063	-0,735	0,020
	3	0,865	-0,435	0,365
	4	0,443	-0,166	0,380
	5	0,388	-0,388	0,151
	7	0,229	-0,482	0,115
	8	0,271	-0,140	0,499
	9	0,860	-0,392	0,469
	10	0,953	-0,712	0,671
	0 is ref	0,193	-0,335	0,068
7	1	0,027	0,148	2,454
	2	0,398	-0,577	0,229
	3	0,486	-0,270	0,566
	4	0,053	-0,004	0,584
	5	0,679	-0,241	0,370
	6	0,229	-0,115	0,482
	8	0,027	0,042	0,684
	9	0,318	-0,214	0,657
	10	0,647	-0,532	0,857
	0 is ref	0,690	-0,193	0,292
8	1	0,111	-0,216	2,092
	2	0,012	-0,953	-0,120
	3	0,336	-0,651	0,222
	4	0,665	-0,402	0,256
	5	0,080	-0,633	0,036
	6	0,271	-0,499	0,140
	7	0,027	-0,684	-0,042
	9	0,520	-0,571	0,289
	10	0,572	-0,896	0,495
	0 is ref	0,028	-0,593	-0,033

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Mean Difference (I-J)	Std. Error	df
9	1	1,079	0,600	12471,572
	2	-0,396	0,237	12703,918
	3	-0,073	0,268	12712
	4	0,068	0,226	12684,446
	5	-0,157	0,229	12712
	6	-0,039	0,220	12670,555
	7	-0,222	0,222	12678,553
	8	0,141	0,219	12584,666
	10	-0,060	0,361	12495,153
	0 is ref	-0,173	0,206	12680,668
10	1	1,139	0,654	12468,859
	2	-0,336	0,378	12656,540
	3	-0,014	0,386	12659,865
	4	0,128	0,357	12594,563
	5	-0,098	0,358	12628,405
	6	0,021	0,353	12590,079
	7	-0,162	0,354	12580,929
	8	0,200	0,355	12558,808
	9	0,060	0,361	12495,153
	0 is ref	-0,113	0,344	12576,655
0 is ref	1	1,252*	0,579	12453,795
	2	-0,223	0,169	12526,754
	3	0,099	0,179	12689,875
	4	0,241*	0,103	12712
	5	0,015	0,108	12572,591
	6	0,134	0,103	12712
	7	-0,049	0,124	12642,478
	8	0,313*	0,143	12712
	9	0,173	0,206	12680,668
	10	0,113	0,344	12576,655

Pairwise Comparisons[a]

(I) Heidehoogveenenstuifzand	(J) Heidehoogveenenstuifzand	Sig.[c]	95% Confidence Interval for Difference[c] Lower Bound	Upper Bound
9	1	0,072	-0,098	2,256
	2	0,095	-0,861	0,069
	3	0,784	-0,600	0,453
	4	0,762	-0,374	0,511
	5	0,492	-0,606	0,292
	6	0,860	-0,469	0,392
	7	0,318	-0,657	0,214
	8	0,520	-0,289	0,571
	10	0,869	-0,766	0,647
	0 is ref	0,402	-0,576	0,231
10	1	0,082	-0,144	2,421
	2	0,374	-1,078	0,405
	3	0,971	-0,770	0,742
	4	0,720	-0,572	0,828
	5	0,785	-0,800	0,605
	6	0,953	-0,671	0,712
	7	0,647	-0,857	0,532
	8	0,572	-0,495	0,896
	9	0,869	-0,647	0,766
	0 is ref	0,742	-0,787	0,561
0 is ref	1	0,031	0,117	2,386
	2	0,185	-0,554	0,107
	3	0,579	-0,251	0,449
	4	0,020	0,039	0,443
	5	0,889	-0,197	0,227
	6	0,193	-0,068	0,335
	7	0,690	-0,292	0,193
	8	0,028	0,033	0,593
	9	0,402	-0,231	0,576
	10	0,742	-0,561	0,787

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Dependent Variable: StressRIVM.

c. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Pairwise Comparisons[a]

(I) Openagrarischgebied	(J) Openagrarischgebied	Mean Difference (I-J)	Std. Error	df
1	2	0,163*	0,060	12712
	3	0,136	0,099	12712
	0 is ref	-0,096	0,051	12507,909
2	1	-0,163*	0,060	12712
	3	-0,027	0,094	12689,018
	0 is ref	-0,259*	0,070	12356,713
3	1	-0,136	0,099	12712
	2	0,027	0,094	12689,018
	0 is ref	-0,232*	0,106	12691,391
0 is ref	1	0,096	0,051	12507,909
	2	0,259*	0,070	12356,713
	3	0,232*	0,106	12691,391

Pairwise Comparisons[a]

(I) Openagrarischgebied	(J) Openagrarischgebied	Sig.[c]	95% Confidence Interval for Difference[c]	
			Lower Bound	Upper Bound
1	2	0,007	0,045	0,281
	3	0,172	-0,059	0,330
	0 is ref	0,061	-0,197	0,004
2	1	0,007	-0,281	-0,045
	3	0,772	-0,211	0,157
	0 is ref	<0,001	-0,396	-0,122
3	1	0,172	-0,330	0,059
	2	0,772	-0,157	0,211
	0 is ref	0,029	-0,439	-0,024
0 is ref	1	0,061	-0,004	0,197
	2	<0,001	0,122	0,396
	3	0,029	0,024	0,439

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Dependent Variable: StressRIVM.

c. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Pairwise Comparisons[a]

(I) strand	(J) strand	Mean Difference (I-J)	Std. Error	df	Sig.[c]	95% Confidence Interval for ...[c] Lower Bound	95% Confidence Interval for ...[c] Upper Bound
1	2	-0,276	0,325	12712	0,394	-0,913	0,360
	3	-0,446	0,280	12712	0,112	-0,995	0,103
	0 is ref	-1,132*	0,223	12692,258	<0,001	-1,569	-0,694
2	1	0,276	0,325	12712	0,394	-0,360	0,913
	3	-0,169	0,299	12712	0,571	-0,755	0,417
	0 is ref	-0,855*	0,265	12712	0,001	-1,375	-0,336
3	1	0,446	0,280	12712	0,112	-0,103	0,995
	2	0,169	0,299	12712	0,571	-0,417	0,755
	0 is ref	-0,686*	0,188	12712	<0,001	-1,054	-0,318
0 is ref	1	1,132*	0,223	12692,258	<0,001	0,694	1,569
	2	0,855*	0,265	12712	0,001	0,336	1,375
	3	0,686*	0,188	12712	<0,001	0,318	1,054

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Dependent Variable: StressRIVM.

c. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Pairwise Comparisons[a]

(I) Halfopenengeslotenagrarischgebied	(J) Halfopenengeslotenagrarischgebied	Mean Difference (I-J)	Std. Error	df
1	2	0,426	0,371	12511,981
	0 is ref	0,149*	0,046	12689,318
2	1	-0,426	0,371	12511,981
	0 is ref	-0,277	0,372	12511,014
0 is ref	1	-0,149*	0,046	12689,318
	2	0,277	0,372	12511,014

Pairwise Comparisons[a]

(I) Halfopenengeslotenagrarischgebied	(J) Halfopenengeslotenagrarischgebied	Sig.[c]	95% Confidence Interval for Difference[c]	
			Lower Bound	Upper Bound
1	2	0,250	-0,301	1,154
	0 is ref	0,001	0,059	0,239
2	1	0,250	-1,154	0,301
	0 is ref	0,455	-1,006	0,451
0 is ref	1	0,001	-0,239	-0,059
	2	0,455	-0,451	1,006

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Dependent Variable: StressRIVM.

c. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Pairwise Comparisons[a]

(I) strand	(J) strand	Mean Difference (I-J)	Std. Error	df	Sig.[c]	95% Confidence Interval for [c]... Lower Bound
1	2	-1,747*	0,551	12681,034	0,002	-2,827
	3	-1,000*	0,475	12656,194	0,035	-1,931
	0 is ref	-1,051*	0,378	12618,079	0,005	-1,793
2	1	1,747*	0,551	12681,034	0,002	0,668
	3	0,747	0,508	12712	0,141	-0,249
	0 is ref	0,696	0,450	12712	0,122	-0,187
3	1	1,000*	0,475	12656,194	0,035	0,069
	2	-0,747	0,508	12712	0,141	-1,744
	0 is ref	-0,052	0,319	12700,929	0,871	-0,677
0 is ref	1	1,051*	0,378	12618,079	0,005	0,310
	2	-0,696	0,450	12712	0,122	-1,578
	3	0,052	0,319	12700,929	0,871	-0,573

Pairwise Comparisons[a]

(I) strand	(J) strand	95% Confidence Interval for [c]... Upper Bound
1	2	-0,668
	3	-0,069
	0 is ref	-0,310
2	1	2,827
	3	1,744
	0 is ref	1,578
3	1	1,931
	2	0,249
	0 is ref	0,573
0 is ref	1	1,793
	2	0,187
	3	0,677

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Dependent Variable: ExcerciseNormRIVM.

c. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Pairwise Comparisons[a]

(I) Duinen	(J) Duinen	Mean Difference (I-J)	Std. Error	df	Sig.[c]	95% Confidence Interval for ...[c]
						Lower Bound
1	2	-1,230*	0,404	12712	0,002	-2,021
	3	-3,622*	0,609	12712	<0,001	-4,815
	4	-3,075*	1,049	12214,631	0,003	-5,131
	0 is ref	0,688*	0,346	12712	0,047	0,011
2	1	1,230*	0,404	12712	0,002	0,438
	3	-2,392*	0,552	12712	<0,001	-3,475
	4	-1,845	1,015	12180,124	0,069	-3,835
	0 is ref	1,918*	0,278	12558,371	<0,001	1,374
3	1	3,622*	0,609	12712	<0,001	2,429
	2	2,392*	0,552	12712	<0,001	1,310
	4	0,547	0,983	12668,702	0,578	-1,379
	0 is ref	4,311*	0,546	12669,204	<0,001	3,241
4	1	3,075*	1,049	12214,631	0,003	1,018
	2	1,845	1,015	12180,124	0,069	-0,145
	3	-0,547	0,983	12668,702	0,578	-2,474
	0 is ref	3,763*	1,019	12040,597	<0,001	1,765
0 is ref	1	-0,688*	0,346	12712	0,047	-1,366
	2	-1,918*	0,278	12558,371	<0,001	-2,463
	3	-4,311*	0,546	12669,204	<0,001	-5,380
	4	-3,763*	1,019	12040,597	<0,001	-5,761

Pairwise Comparisons[a]

(I) Duinen	(J) Duinen	95% Confidence Interval for [c]... Upper Bound
1	2	-0,438
	3	-2,429
	4	-1,018
	0 is ref	1,366
2	1	2,021
	3	-1,310
	4	0,145
	0 is ref	2,463
3	1	4,815
	2	3,475
	4	2,474
	0 is ref	5,380
4	1	5,131
	2	3,835
	3	1,379
	0 is ref	5,761
0 is ref	1	-0,011
	2	-1,374
	3	-3,241
	4	-1,765

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Dependent Variable: ExcerciseNormRIVM.

c. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Pairwise Comparisons[a]

(I) Halfopenengeslotenagrarischgebied	(J) Halfopenengeslotenagrarischgebied	Mean Difference (I-J)	Std. Error	df
1	2	1,349*	0,628	12454,809
	0 is ref	0,119	0,078	12712
2	1	-1,349*	0,628	12454,809
	0 is ref	-1,229	0,629	12454,020
0 is ref	1	-0,119	0,078	12712
	2	1,229	0,629	12454,020

Pairwise Comparisons[a]

(I) Halfopenengeslotenagrarischgebied	(J) Halfopenengeslotenagrarischgebied	Sig.[c]	95% Confidence Interval for Difference[c]	
			Lower Bound	Upper Bound
1	2	0,032	0,118	2,579
	0 is ref	0,128	-0,034	0,273
2	1	0,032	-2,579	-0,118
	0 is ref	0,051	-2,462	0,003
0 is ref	1	0,128	-0,273	0,034
	2	0,051	-0,003	2,462

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Dependent Variable: ExcerciseNormRIVM.

c. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Pairwise Comparisons[a]

(I) Halfopenengeslotenagrarischgebied	(J) Halfopenengeslotenagrarischgebied	Mean Difference (I-J)	Std. Error	df
1	2	1,349*	0,628	12454,809
	0 is ref	0,119	0,078	12712
2	1	-1,349*	0,628	12454,809
	0 is ref	-1,229	0,629	12454,020
0 is ref	1	-0,119	0,078	12712
	2	1,229	0,629	12454,020

Pairwise Comparisons[a]

(I) Halfopenengeslotenagrarischgebied	(J) Halfopenengeslotenagrarischgebied	Sig.[c]	95% Confidence Interval for Difference[c]	
			Lower Bound	Upper Bound
1	2	0,032	0,118	2,579
	0 is ref	0,128	-0,034	0,273
2	1	0,032	-2,579	-0,118
	0 is ref	0,051	-2,462	0,003
0 is ref	1	0,128	-0,273	0,034
	2	0,051	-0,003	2,462

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Dependent Variable: ExcerciseNormRIVM.

c. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).