BIODIVERSITY POTENTIAL ON EQUESTRIAN YARDS

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ABSTRACT

Currently a worldwide biodiversity crisis is going on and a sixth mass extinction seems to be approaching, because of human actions more than 10.000 species are currently on the brink of extinction (Tilman, Clark, & Williams, 2017). Acting on this crisis is therefore important and restoring biodiversity in rural areas is urgent. Horse yards are often part of the rural areas and could therefore possibly contribute to a restored biodiversity. To understand the biodiversity potential of an area, in this case equestrian yards in the province of Gelderland, research is often focussed on landscape features that support biodiversity, such as hedgerows or ponds. By obtaining a baseline understanding of the landscape features present on equestrian yards, a starting point is provided for evaluating the future biodiversity potential that equestrian yards can contribute to rural areas.

The aim of this study was to collect information about the type and frequency of different landscape features currently present on different types of equestrian yards in the province Gelderland. Twenty stables ranging from small to large were visited to collect information about presence and the number of landscape features. This data was then analysed to identify possible relationships between characteristics of visited yards and the present landscape features.

All landscape features were found on the visited yards except for feed walls. Some features were found on almost all stables, like hedgerows and solitary trees, others were found on three or less, like insect hotels and woodpiles.

Correlations were found between the size of yards and the amount of monocultural grassland in m2 and between the number of horses on yards and amount of nesting areas in m^2. Associations were found between type of horse yard and the amount of heterocultural grassland in m^2 and between type of horse yard and pollard trees.

The overall conclusion is that there is a biodiversity potential on horse yards in the province of Gelderland. Some landscape features are quite common and still have a potential, whereas others leave room for growth, and thus potential, because of their absence.

The findings in this study can be used to set up a measuring and monitoring tool for biodiversity on horse yards, because they show what landscape features could use extra attention and thus where there is potential growth. Furthermore the findings can be used to inform governments and yard owners about the status quo of the biodiversity potential on horse yards in the province of Gelderland.

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CHAPTER 1. INTRODUCTION

The world is currently in a biodiversity crisis, a sixth mass extinction seems to be underway and as a result of human actions more than 10.000 species are on the brink of extinction (Tilman, Clark, & Williams, 2017). Acting on this problem is therefore important for all countries, and restoring biodiversity in rural areas is urgent. Over the decades landscape features such as ponds, bushes and woodland had to make way for pastures of homogeneous productive grassland and agricultural production grounds in the Netherlands, which has led to a decline in the national biodiversity (Zanderink & Andel, 2008). To reverse this process it is necessary to reintegrate the important features into the landscape and thereby boost and maintain biodiversity.

Dutch guidelines suggest improving biodiversity through landscape features and a green-blue network of 10% for the whole agricultural landscape (Rijksdienst voor het Cultureel Erfgoed, 2022). A part of the agricultural landscape in the Netherlands is being used by the equestrian sector and it's yards. Most horse yards have grassland pastures to let horses out during the day and are therefore green spaces (Furtado, et al., 2022). With horse yards being green spaces there should be room for biodiversity, if the necessary landscape features are present.

The equestrian sector, with around 10,000 professional equine yards and an additional 70,000 private addresses where horses are being held, can likely make a significant contribution to the restoration of biodiversity and a nature-based society (Alterra, 2008). At the same time, a healthy, biodiverse environment is essential for a sustainable equine sector. Not only for the health of the horses, it might also be important for the survival of the sector. Especially now the equestrian sector in the Netherlands is under fire because of suspected welfare issues by the public, it might be a good investment from the sector to look into things that can be contributed to "a better world" by the sector in order to have reasons and arguments for the whole industry to survive (Douglas, Owers, & Campbell, 2022). This makes this topic important and interesting for all stake-holders.

Landscape features are used to estimate biodiversity because they play an important role for the flora and fauna (Geller, Halpin, Helmuth, & Hestir, 2017). Different landscape features offer food, shelter and a infrastructure for all kinds of different animals and plants to live (Tilman, Clark, & Williams, 2017). The presence of certain features increase the likelihood that certain types of animals or plants can live in areas given, for example ponds and pools can be a home for frogs and newts, but also for water plants and swamp plants (Hill, Greaves, & Sayer, 2021). Counting landscape features can help indicate what the status quo of the biodiversity is, because present landscape features give an idea of what species might be able to live on equestrian yards (Geller, Halpin, Helmuth, & Hestir, 2017). With this information the biodiversity potential can be estimated: is there a growth in biodiversity possible on equestrian yards? At the moment it is unclear how biodiverse equestrian yards are and which landscape features are present.

CHAPTER 2. PROBLEM DEFINITION

Over the decades the landscape of the Netherlands has changed due to urbanization and intensive farming and with this change certain landscape features that are important for the biodiversity have been lost, which has caused a decrease in the national biodiversity (Zanderink & Andel, 2008). Equestrian yards, that are by their definition green spaces, can likely contribute towards increasing biodiversity in the Netherlands by reintegrating some of the important features into the landscape.

There is currently a lack of knowledge about which landscape features are present on equestrian yards. This information is needed to set a baseline for landscape features on equestrian yards: what features are present, how often are these features present and in which amounts are they present? A baseline is needed to estimate the biodiversity potential of Dutch equestrian yards and to track possible improvements in the future. A baseline understanding of the presence of landscape features on equestrian yards can help in identifying where room for growth is and thereby identify future biodiversity potential.

CHAPTER 3. RESEARCH OBJECTIVES

The main objective of the research is to collect information about the type and frequency of different landscape features currently present on different types of equestrian yards in the province of Gelderland. This information is needed to gain a baseline understanding of landscape features found on equestrian yards. Characteristics of equestrian yards, such as type, size and number of horses, will be taken into account as well, in order to gain an understanding of how landscape features may be influenced by these characteristics. With this baseline knowledge, it will be possible to estimate the biodiverse potential of equestrian yards.

CHAPTER 4. RESEARCH QUESTIONS

MAIN RESEARCH QUESTION

- What is the current status quo of biodiversity potential of equestrian yards in the province of Gelderland, determined by the in situ existence of relevant landscape features ?

SUBQUESTIONS RESEARCH

- Which landscape features that are important for biodiversity are present on equestrian yards?
- How do the characteristics of equestrian yards (such as type, size, number of horses) influence the presence of landscape features that are important for biodiversity?
- How do the types of landscape features present depend upon the characteristics (type/size(ha)/number of horses) of equestrian yards?

CHAPTER 5. LITERATURE REVIEW

Biodiversity and the importance of landscape features

The term biodiversity describes all organisms living in an ecosystem, area or habitat, and it includes numbers and diversity of the present species and all other aspects of the environment like the temperature, oxygen and carbon dioxide levels and the climate. Biodiversity can be measured worldwide as well as in smaller settings, in for example gardens or on a horse yard (Knapp, 2020).

Biodiversity is important because biodiversity is essential for all processes that support the life on planet Earth. Without a high biodiversity , a wide range of species like animals, plants and microorganisms, it is not possible to have healthy ecosystems, ecosystems that we rely on for the supply of fresh air to breathe and food to eat. (Martin-Lopez, 2021) These services, like fresh air and food, provided to humans by ecosystems are called ecosystem services (Kremen, 2005). Humans depend on ecosystem services and thereby on biodiversity in many ways, which makes it crucial to conserve biodiversity. An example of how biodiversity and ecosystem services are intertwined are pollinators like bees, beetles and certain bird species that are very important for the global production of crops (Klein, et al., 2006). Food like most fruits and vegetables and some nuts can not exist without pollinators (Nabhan & Buchmann, 1997). In the process called pollination, pollinators take the pollen from a male flower to a female flower to fertilize egg cells, in order to carry seed carrying fruits (Lerne, 2008). Most types of nut trees are pollinated by the wind, but some specific types, such as the Brazil nut, need pollination by bees to reproduce (Sales, 2020). Besides pollinators agriculture also relies on invertebrates in the ground because they keep the soil that the crops grow in healthy. The microbes that live in the soil enable our food production by freeing nutrients that contribute to the plant growth (Martin-Lopez, 2021). These are just a few examples of how humans rely on ecosystem services and biodiversity foodwise. Another important service provided by green spaces and biodiverse landscapes is the contribution to the wellbeing of humans. Being surrounded by natural elements such as green spaces has a positive impact on both the physical and mental wellbeing of humans (Russel, 2013). Landscape features, which are present in and part of green spaces, are (natural) elements such as ponds, bushes and trees. Landscape features have a vital role in the existence of biodiversity and ecosystem services. Living landscape features such as trees can be part of the local biodiversity, whereas non-living features like ponds or rock formations provide place for flora and fauna to flourish.

An example of how a (in this case living) landscape feature can be of great importance for the biodiversity and thereby ecosystem services are certain trees like solitary old oaks. Old oaks can house over 300 species and subspecies of lichen and lots of invertebrates (Tree, 2018). These invertebrates provide food for birds like woodpeckers, tits, nuthatches and treecreepers, which find places to nest in the oaks as well, on branches, and in holes and cracks in the tree. Bats can use old woodpeckers holes and loose bark as a place to hide. The acorns of the tree provide food for badgers and deer, but also for wood pigeons, jays, squirrels and mice, which will in their turn attract predative birds like owls and hawks than can find a place in the tree to nest as well. In fall, when the leaves of the oak come down to the ground, leave fungus will create a habitat for all kinds of mushrooms (Tree, 2018). With all these processes going on, one single old oak can contribute a rather big share to the biodiversity by itself. Implementing important landscape features like this (back) into the landscape can have a dramatic positive impact on the biodiversity and ecosystem services (Schmidt, et al., 2019).

Threats to biodiversity

At the moment there is a worldwide loss in biodiversity, partially caused by humans taking (natural) green spaces to build cities, factories and to create agricultural production grounds. (Alessandro Filazzola, 2019)Especially in a densely populated country like the Netherlands there is less and less room for nature. Over the decades the architecture of the landscapes has changed and important natural landscape features are being lost (Rossum, Wäckers, Janssen, & Rijn, 2022). For example in rural areas hedges surrounding fields had to make way for barbed wire or other fences with less maintenance, naturally wet terrains were drained to grow crops or house cattle and forests were cut to use the wood and ground for the building of suburbs. With this loss of natural elements the national biodiversity has declined (Zanderink & Andel, 2008). The loss of landscape features often leads directly to the loss of habitats for different species to live in, which leads to a decline in biodiversity.

Many landscape features that have been lost had special functions to humans in the past, functions which are now forgotten or no longer needed (Zanderink & Andel, 2008). With the upcoming industrialization and "modern" farming, starting around 1900, people were able to largen their production field. Furthermore the use of chemicals to kill unwanted weeds and to fertilize the ground, which started around 1950, enabled farmers to have higher yields (Verdonschot, 1980). Now that a farmer had for example large grass yields, they could save enough hay to feed to their cattle on winter days. Before, when yields were lower, farmers often used pollard willows as an extra form of roughage to feed the cattle. The wood and twines of willows that would normally be used to braid baskets and fences, was no longer needed because of industrial products which were easier to use (Tree, 2018). This is just one example of how landscape features were important for human activities before, and there are many more. Humans might no longer need the features for their activities, but for the biodiversity they are still important.

Besides the loss of important landscape features, another problems caused by building cities, highways, factories and agricultural land is the "fragmentation" of the land which splits and isolates habitats (Laurence, 2014) . Species that need larger habitats, or different habitats for different stages of their life, like for example most aquatic amphibians, now have to cross roads, urban areas and other obstacles to get from one habitat to another. With this, many are being killed by traffic but also because of starvation or exhaustion (Ravon, 2023). Furthermore small isolated habitats can become an attractive spot for predators. A field or small forest that seems a good place for, for example, lapwings or mice to nest , might attract a lot of predators from surrounding area's (Tree, 2018). Another factor of isolated habitats is the "border effect", which is the effect of a hostile environment on isolated habitats. If for example a small bush gets stranded in the middle of a wheat field, the possible chemicals used by the farmer can easily drive into the bush, which narrows the habitat (Tree, 2018).

The agricultural sector has factors that are problematic for the national biodiversity as well. Production fields with one type of crop, for example monocultural grasslands, deliver a food source to only a select group of animals. Monocultural grasslands are mainly used to feed cows, because in a monocultural grassland it is easier to have a high yield of proteins in the grass, which is needed for the production of dairy and meat (Dasselaar, Hennessy, & Isselstein, 2020) Most pollinators can not find food on monocultural grassland and need a specific type of plant to feed on (Couvillon, 2015), plants that are often seen as weeds in the agricultural sector. If a monocultural field takes up the space where other species could grow, there is a loss in habitat and less pollinators can live in the area. Weeds can be a problem for the agricultural sector because they can lower the protein yield from the field and they can be poisonous to livestock. Some weeds, like for example ragwort, are a really good feed source for bees (Couvillon, 2015) and a host plant for butterflies, like in this case the Cinnabar moth, which caterpillars only feed on ragwort (Dempster, 1971). Ragwort might be good for the bees and Cinnabar moths but in high amounts it can be fatal to horses and cows (Leids, 2010). Although ragwort is native to the Netherlands, farmers and governments try to eliminate the plant as much as possible (Smittenberg, 2005), which leads to a decline in food sources for bees and scallop butterflies.

Something to counteract problematic factors of the agricultural sector and encourage farmers to let their fields and farms become more biodiverse are the agri-environment schemes (AES), which were introduced to compensate farmers for losses in income that are cause by, or associated with, measures taken that benefit the biodiversity and the environment: farmers receive money to change their practices to contribute to the biodiversity (Kleijn & Sutherland, 2003). The schemes are meant to wipe farmers arguments like "it is too costly to change ” of the table. Although the schemes are a step in the right direction, research shows that the actual contribution to the biodiversity through the implementation of AES might not be as high as thought to be (Kleijn & Sutherland, 2003). A possible reason for this are objectives that are not defined clearly enough (Schramek, 2001) and thereby most AES are not focussed on target species to conservate, which might counteract the conservation of the biodiversity (Rundlöf, 2011). Furthermore AES might cause lower yields, restrict mowing before a certain date and reduce the intensity of farming (Kaphengst, et al., 2011) which can lead to an increased pressure on turning other land into productive land (Balmford, Green, & Phalan, 2012). All of this could lead to less positive effects for the biodiversity (Phalan, Onial, Balmford, & Green, 2011).

The building of for example houses and the expanding of urban area’s itself is unpreventable because all people will need a roof over their head, and some sort of farming is needed because of the need for humans and animals to eat, but the way the land is used could and should be improved. Instead of “housing/farming/producing or green spaces with room for biodiversity” it should be “and and” to re-boost the biodiversity. Green spaces, green infrastructure and thereby landscape features are important factors in the process to make this shift.

Green spaces

A green space can be defined as a land or space with vegetative landscape features, for example a row of tree’s, bushes or hedges (Taylor, 2017). Blue spaces are linked to water, these spaces have a water element such as a pond, river or lake (Grey, 2023). Green infrastructure can be described as several green spaces connected to form a sort of “green road” through the rural or urban landscape (European Environment Agency, 2014). A Green-Blue network is a connection between green and blue spaces, for example a green space such as a park next to a blue space such as a pond with another green space on the other side (Grey, 2023). Green infrastructure is designed to provide humans with ecosystem services such as food, clean water and air, prevention for flooding, regulation of climate and room for recreational activities (European Environment Agency, 2014).

Currently more and more plans to (re)connect green spaces and other important habitats to each other are made in the Netherlands. An example of an effort like this is the use of “wild viaducts” to connect the different parts of the area in Gelderland called “de Veluwe”. De Veluwe is split into parts because of high ways crossing the area. With “wild viaducts” these parts are connected to enable hogs and deer to travel through the area (Pouwels, Bruinderink, & Kuipers, 2002). Habitats can also be connected by landscape features because they can be used as “stepping-stones” through the landscape (Hasall, 2014), which is essentially what green infrastructure in practice is about.

Horses and biodiversity

Green spaces within urban areas are proven to be beneficial for the local biodiversity. (Alessandro Filazzola, 2019). Green spaces provide food and shelter for all kinds of organisms. Equestrian yards are quite often in between urban areas and are green spaces by definition because of their pastures and grassland. Fields in (sub-)urban areas are good for conserving the quality of water, but they are often not useful for agriculture because they are too small, there are houses nearby and, or, there are often conflicts about the land in terms of usage or purpose (Launay, 2014). Because horses are seen as family members and are being used for recreational activities they are often kept in (sub-)urban areas. This way horses form a link between rurality and urbanization, they are often in the zones that are no longer used for agricultural purposes but are not used for urbanization yet (Vial, 2014). The impact of fields with horses on the urban environment is equivalent to the improvement of landscapes by the introduction of green spaces in cities (Elgåker, 2010). Positive changes are noticeable when horses are present in urban areas, like added value to the landscape by adding important landscape features such as grassland and by positive management of the land (Vial, 2014).

The meadows and fields used for horses can also be a valuable element to maintain biodiversity in agricultural landscapes since they can provide a higher ecological value compared to intensively managed grasslands used for cattle (Mennard, 2002). Horses graze in a specific way which leads to the establishment of a heterogeneous grass sward structure. If managed correctly, this can lead to a higher diversity in plants and grasses growing in fields used for horses (Schmitz, 2020). Thereby grazing of horses can have a positive impact on the diversity in insects and birds living in and around meadows (Fleurance, 2019). An example for this is the appearing of the Spoonbill in Dutch pastures after they were grazed by horses (Fleurance, 2008). These pastures, in the Oostvaardersplassen, are grazed by Konik horses, deer and “wild” cows. The grazing and the migrating of the horses through the area has an important role in the diversification of plants and thereby animals that can live on the terrain (Vera, 2009).

Most horse keepers do not rely on their fields to feed the horses, they are more used as an enrichment for the horses. Although lots of equestrian yards have monocultural grassland for their horses (Johnson, 2012), heterocultural, herb-like grasslands, often low-protein, are more beneficial for the health of horses (Cunha, 1991). In this case changing monocultural grassland to heterocultural grassland could be a win-win situation for horse owners and local biodiversity. For intensive cow farmers this is different, they need the grass to be productive and full of nutrients to feed their cows, so instead of fields with a diverse range of vegetations and sorts of grass they want fields with 1 or 2 productive grass breeds (Dasselaar, Hennessy, & Isselstein, 2020).

A heterogeneous vegetation can contribute to the local biodiversity, but it can also lead to destruction of fields and pastures if it is not managed well. Areas of the field that get grazed could get overgrazed, whereas non-grazed areas could become covered in shrubs, bushes or young trees. Grazing of two species of herbivours, for example cows and horses, could prevent this problem (Jouven, 2016). Other benefits of mixed or combined grazing could be that the maintaining of the field will be less labour intensive because of the complementary grazing behaviour of 2 or more species (Bigot, 2015), and a decrease in the risk of getting parasites because of different sensitivities of the different hosts (Jouven, 2016).

Besides grassland, other features of equestrian yards can contribute to biodiversity as well, if a yard has for example hedges with hawthorn around their buildings, there is a safe space for birds to nest and bees can feed on the flowers (Zanderink & Andel, 2008). Hedges often consist of more than one species, and can in some situations be vital for a whole population of animals or plants to survive and thrive (Wolton, 2013). Waters on horse yards, such as natural ponds or small creeks, enable newts and frogs to reproduce and have room for a different type of vegetation that will in its turn feed different pollinators. Waters and hedges are essential landscape features in a green-blue network, because of their function as “stepping stones” for different species to move through landscapes (Hasall, 2014). With important landscape features like this being present, an equestrian yard can contribute to a green-blue network and thereby to biodiversity.

Other possible landscape features that contribute to the biodiversity and can be implemented into equestrian yards are for example clutter corners, because clutter corners enable mammals such as hedgehogs and certain types of insects to hibernate and all kinds of animals to hide in (Neckheim & Mienis, 2010). The native wild flowers that can grow in a clutter corner such as dandelions are a great feed source for pollinators (Firet, 2020).

Brushwood hedges are a good place for animals to hide in and for certain ground birds such as phasants to nest in. Brushwood hedges are mainly found close to the border of a forest, but can also grow next to a fence or the border of a field (RVO, 2022).

Nesting boxes can be a good place to nest in for certain birds like tits or wrens and they can also be a good hibernate place for certain pollinators like bumblebees (Goulson, 2017). Nesting boxes are quite easy to place somewhere, are not expensive and easily available. Therefore 9 out of 20 stables is not a lot, this number could be higher.

Tree lanes are important because they enable birds and small mammals such as squirrels to migrate, fourage and reproduce (Hasall, 2014). Tree lanes become part of the blue-green network of a region. Not all yards have the space for big or long lanes, and ofcourse an old lane can not be planted, but it can be quite easy to plant a lane of a few meters long.

Characteristic trees and pollard trees are places for birds to nest in and for birds and mammals "infrastructure" to be able to migrate. Blooming trees are a feed source for pollinators. Flowerborders are a good feed source for pollinators when they are blooming and after blooming the seeds can be eaten by birds, stems of dead flowers can be used to hibernate by mason bees (Bijenstichting, 2021). Woodpiles provide shelter for insects and small mammals and a food source for certain types of beatles, which in their turn are a feed source for birds, amphibians and small mammals (Onze Natuur, 2022). Characteristic trees can not be planted, but they can be formed when trees get to grow old. Pollard trees can be planted almost everywhere, but the most common type of pollard tree, the pollard willow, asks for some specific conditions such as a wet or moist ground (Bij12, 2022). Feedwalls offer food and shelter for animals (RVO, 2022)and can be build relatively easily, but they do take up space.

For agricultural farms it can be more difficult to implement landscape features and contribute to the biodiversity. Fields used for cows are often bigger than the patches of land used for horses, surrounding them with hedges might be too labour intensive because of all the maintenance involved. Waters in fields take up possible grazing space and, maybe more important, can house water snails that are infected with the liver fluke, which is a parasite that can be lethal to animals that ingest it (Ballweber, 2022). Humans can get infected as well, for example through contact with infected grass (RIVM, 2011). Poultry farmers, especially of free range poultry, probably would rather have as less other birds around their property as possible . Wild birds can bring diseases to their stock (Canadian Vet Journal, 2012) and predative birds could even snatch away a few chickens. Nearby water attracts waterbirds and rats, which both can carry deathly disseases and virusses (Backhans, 2012). Biodiversity is not the main concern of these farmers, their overturn and thereby the health of their livestock, logically, is.

To estimate biodiversity of an area, or sector, the present landscape features are crucial. Because landscape features are important to, and intertwined with, biodiversity, they enable to make a statement about the status quo. With information on the present landscape features it is possible to say something about which specimens **could** live in an area.

CHAPTER 6. METHODOLOGY

6.1 Research design

The research design used in the thesis on biodiversity in equestrian yards was observational. The research was exploratory because there is little to no information available about the biodiversity on equestrian yards. Twenty yards located in the province of Gelderland and ranging from small to large were visited to gain information about the current situation of biodiversity. The presence and differences of important landscape features were investigated. The equestrian yards were all visited physically by the researcher, to ensure a consistent and precise data collection.

The present landscape features were examined on their amount and size. For the “tree landscape features” the types of trees were written down as well.

It has been chosen to conduct the research on equestrian yards in the province of Gelderland, because there was an easy access to different yards because of a relatively large concentration of horse yards. Furthermore this province is a relatively green province with a government that is suspected to be open to hear about possible improvements on biodiversity management.

6.2 Data collection

Twenty equestrian yards were visited in the province of Gelderland to obtain baseline information on landscape features. Only companies were visited, because they are interesting for the government of Gelderland in case of starting with funding landscape features on equestrian yards in the future. The yards were visited in the months April and May. Four of the (randomly) selected yards that are visited are associated with Federatie Paardrijden voor Gehandicapten (FPG), the association for handicapped horse riders. This association agreed to be a partner of the project, and enabled research on equestrian yards in the province of Gelderland connected to them. Six of the remaining yards were found through google, after which they were contacted through e-mail or phone call. Search terms for these google searches were for example “equestrian yards Gelderland”, “riding schools Gelderland”, “pony camp Gelderland” and “boarding stable Gelderland”. Other yards likely willing to participate were found via contacts and via a Facebook post, of which ten were visited. All visited yards were informed about the project and asked for their consent and participation beforehand. An informed consent form was signed afterwards.

This project is part of a larger project to survey the presence of landscape features on equestrian yards. Within the larger project, led by the commissioner, an online survey has been developed containing 85 questions, that identify the type and number of landscape features on equestrian yards. In addition, the survey collects general information about the yard itself, such as size and number of horses. The survey form was used in this research to collect information about the types and number of landscape features found on equestrian yards. The following landscape features were listed in the survey: solitary tree, characteristic tree, pollard tree, tree lane, tree row, high-stemmed fruit orchard, brushwood hedge, hedgerow, flower border, woodbank, feeding wall, monocultural grassland, heterocultural grassland, nesting box, nesting opportunity in stables, cluttered corner and woodpile. This list of important landscape features, originally provided by Stichting Part-Ner, was used in the visits to limit the collection of data and thereby keeping the focus on the right subjects.

Data collection was done by counting landscape features on the different yard, present landscape features were examined on their amount and size. For the landscape features that involved trees the types of trees were written down as well. The nesting areas that were scored, were areas where swallows were proven to be nesting. The data was collected using pen, paper and mobile phone with camera (Apple Iphone 11). The mobile phone was used to collect footage to check the collected data afterwards if needed. After the visits the data was put in the survey provided by the commissioner to properly process it into variables in the same way.

6.3 Data processing

All data was originally managed in Excel and later loaded into IBM SPSS Statistics version 29 to perform statistical analyses. Descriptive statistics such as number of variables, average and standard deviation, were estimated for all variables and all variables were tested for normality using a Kolmogorov-Smirnov test.

6.3.1 Factors influencing the number of landscape features found on equestrian yards

To examine possible correlations between the type, size and number of horses of the companies and the amount of the types of landscape features, two correlation tests were performed. These were the Pearson test for correlation and the Spearman test for correlation for both the normally and non-normally distributed data. The Pearson test is suspected to be most useful for the normally distributed data and the Spearman for the non-normally distributed. Both tests were run on all data for the consistency, because the Spearman test is more strict than the Pearson test and thereby reduces the risk of a false positive, Type I error.

The strength of the correlations was examined using the following criteria: Small correlation r./rho.= 0,10-0,29 , Medium correlation r./rho.= 0,30-0,49 , Large correlation r./rho.= 0,50-1,00 (Pallant, 2020).

To find out if there were differences in the measured landscape features between the types of yards a one-way ANOVA was performed for the formed hypothesis:

Is there a difference in the number of the landscape features on the different types of horse yards?

H0: there is no difference in the number of the landscape features on the different types of horse yards.

H1: there is a difference in the number of the landscape features on the different types of horse yards.

If the H1 would have been supported after the one-way Anova test, the TukeyHSD post-hoc analyis would be performed to test for differences within groups.

Groups were formed for the variable yard type . Only three equestrian yards were in the groups for boarding and breeding stables, and pony club. To have have a sufficient sample size in each group for a sample test, these groups were combined together to form a single group called “Other stable type” (Table 1)

Table 1: Yard type groups

Value	Group name	Criterium	Sample size
1	Riding school	Main activity is riding lessons	10
2	Sports stable	Main activity is training/selling sport horses	7
3	Other stable type	Boarding stable Breeding stable Pony club	3

6.3.2 Factors influencing the types of landscape features found on equestrian yards

During the surveys the presence of landscape features was determined, a categorical yes/no variable. To determine the presence of the landscape features varied between yard characteristics, a chi-square test was performed. To do this, the grouping variables were made for yard size (Table 2) and number of horses (Table 3). There was also tested on the yard type as described in the previous section (Table 1).

Table 2: The grouping for the size of the yard split between three categories

Value	Group name	Criterium	Sample size
1	Small yards	0-2 ha	8
2	Medium yards	2-5 ha	7
3	Large yards	5 or more ha	5

Table 3: The grouping for the amount of horses split between three categories

Value	Group name	Criterium	Sample size
1	Small number	0-20 horses	6
2	Medium number	20-50 horses	9
3	Large number	50-100 horses	5

The Chi-square test is ideally for larger sample sizes, which this research does not have. It was used because it could provide an indication, but to evaluate this more data would be needed. The following hypothesis were tested:

Is the type of horse yard associated with the type of landscape features found?

H0: The type of horse yard is not associated with the type of landscape features found.

H1: The type of horse yard is associated with the type of landscape features found.

Is the size of the horse yards associated with the type of landscape features found?

H0: The size of horse yards is not associated with the type of landscape features found.

H1: The size of horse yards is associated with the type of landscape features found.

Is the number of horses on horse yards associated with the type of landscape features found?

H0: The number of horses on horse yards is not associated with the type of landscape features found.

H1: The number of horses on horse yards is associated with the type of landscape features found.

Significance is (a= 0.05), H0 is rejected when a < 0.05.

CHAPTER 7. RESULTS

In this the chapter the results of the research are presented. The corresponding SPSS output can be found in the ANNEX.

The average size of the yards visited was 4,92 hectares (sd= 5.24 hectares) The average number of horses present on the yards was 30 (sd=23 horses).

On 17 of the visited yards the soil type was sand, on 2 of the visited yards the soil type was sandy clay (zavel) and on 1 of the visited yards the soil type was clay. There was large variation in the number and types of landscape features found on the equestrian yards (Table 4).

Almost all equestrian yards had solitary trees, tree rows and hedgerows with an average of 17,5 trees per yard, 569,45 meters tree rows and 427,4 meters of hedgerows per yard (Table 4). Feedwalls were not found on any of the visited yards and insect hotels and fruittree orchards were only found on one yard. Monocultural grasslands were found on 14 (70%) of the visited yards, and heterocultural grasslands were found on 13 (65%) of the visited yards (Table 4).

Table 4: Variables and their descriptives

Variable	Minimum and maximum number of variable found (range min-max)	Number of yards where variable was present	Percentage of yards where variable was present	Average number of variable per yard	Standard Deviation
Solitary trees	**0-66**	**19**	**95%**	**17.5**	**17.89884**
Characteristic trees	0-3	3	15%	0.25	0.71635
Pollard trees	0-8	3	15%	0.60	1.84676
Tree lanes in m	0-800	7	35%	75 m	186.92808
Tree rows in m	0-3510	**18**	**90%**	569.45 m	**847.04660**
Fruittree orchards	**0-2**	**1**	**5%**	**0.10**	**0.447**
Brushwood hedges	1-5	10	50%	2.50	116.03602
Hedgerows in m	**0-4950**	**19**	**95%**	**427.40 m**	**1098.13202**
Flower borders in m^2	0-320	3	15%	20.80 m^2	72.05378
Woodbanks	0-60	4	20%	5.5 m	14.32
Feed wall	**0-0**	**0**	**0%**	**0**	**0**
Heterocultural grassland in m^2	0-20.000	13	65%	1587.50 m^2	4866.70306
Monocultural grassland in m^2	0-90.000	14	70%	17900 m^2	24259.34437
Pools	0-2	7	35%	0.40	0.59824
Nesting boxes	0-10	9	45%	1.55	2.585
Clutter corners	0-8	15	75%	1.60	1.75919
Woodpiles	0-5	3	15%	0.35	1.137
Insect hotels	**0-1**	**1**	**5%**	**0.05**	**0.22361**
Nesting areas in m^2	0-800	12	60%	63.65 m^2	175.69689

Oaks as solitary trees were found on 17 of the visited yards, whereas birch and beech were found on 15. Linden and chestnuts were found on 3, pine trees were found on 8 yards, maple trees on 16, and poplar and apple trees on 2. The estimated diameters of the solitary trees ranged from 20 to 150 cm.

Beech hedgerows were found on 18 of the visited yards, conifer hedgerows were found on 8 yards and hawthorn hedgerows were found on 4 yards. The estimated width of the hedgerows ranged from 50 -120 cm.

Factors influencing the number of landscape features

The variables solitary trees, tree rows, brushwood hedges, hedgerows and monocultural grassland were normally distributed whilst the remaining variables were non-normally distributed as measured through the Kolmogorov-Smirnov test.

The Pearson test indicated significant correlations between size of the equestrian yards and Hedgerows (r.=0,870 , $p < 0.001$), Heterocultural grassland (r.=0.836, $p < 0.001$), Tree lanes (r.=0.834, $p < 0.001$)), Nesting boxes (r.= 0.611, p = 0.004), Nesting areas (r. = 0.916, $p < 0.001$) and Insect hotels (r. = 0.916, $p < 0.001$) (Table 5).

The Pearson and Spearman tests both indicated significant correlations between size of the equestrian yards and Tree rows (r. = 0.855, $p < 0.001$, rho. = 0.718 , $p < 0.001$), Monocultural grassland (r. = 0.929 , $p < 0.001$, rho.= 0.629, p = 0.003)(Figure 1) and Flower borders (r.= 0.929, $p < 0.001$, rho.= 0.515 , p = 0.020) (Table 5).

Table 5: Pearson and Spearman correlations

Variable	Pearson correlation	Significance of correlation Pearson	Spearman correlation	Significance of correlation Spearman	Strength of correlation
Solitary trees	r. = 0.408	0.074	rho. = 0.226	0.339	Medium positive correlation
Tree rows	r. = 0.855	<0.001	rho. = 0.718	<0.001	Large positive correlation
Brushwood hedges	r. = -0.075	0.754	rho. = 0.147	0.537	Small negative correlation
Hedgerows	r. = 0.870	<0.001	rho. = 0.256	0.276	Large positive correlation
Monocultural grassland	r. = 0.869	<0.001	rho. = 0.629	0.003	Large positive correlation
Heterocultural grassland	r. = 0.836	<0.001	rho. = 0.268	0.254	Large positive correlation
Characteristic trees	r. = 0.028	0.907	rho. = 0.137	0.565	Small positive correlation
Pollard trees	r. = 0.199	0.400	rho. = 0.414	0.070	Medium positive correlation
Treelanes	r. = 0.834	<0.001	rho. = 0.320	0.169	Large positive correlation
Flowerborders	r. = 0.929	<0.001	rho. = 0.515	0.020	Large positive correlation
Woodbanks	r. = -0.157	0.508	rho. = -0.153	0.520	Small negative correlation
Pools	r. = -0.003	0.991	rho. = 0.306	0.190	Medium positive correlation
Nesting boxes	r. = 0.611	0.004	rho. = -0.067	0.779	Large positive correlation
Clutter corners	r. = 0.200	0.397	rho. = 0.141	0.553	Small positive correlation
Woodpiles	r. =-0.144	0.543	rho. =-0.193	0.414	Small positve correlation
Nesting areas	r. = 0.916	<0.001	rho. = 0.406	0.075	Large positive correlation
Insect hotels	r.= 0.916	<0.001	rho. = 0.383	0.095	Large positive correlation

Correlation significant if p < 0,05

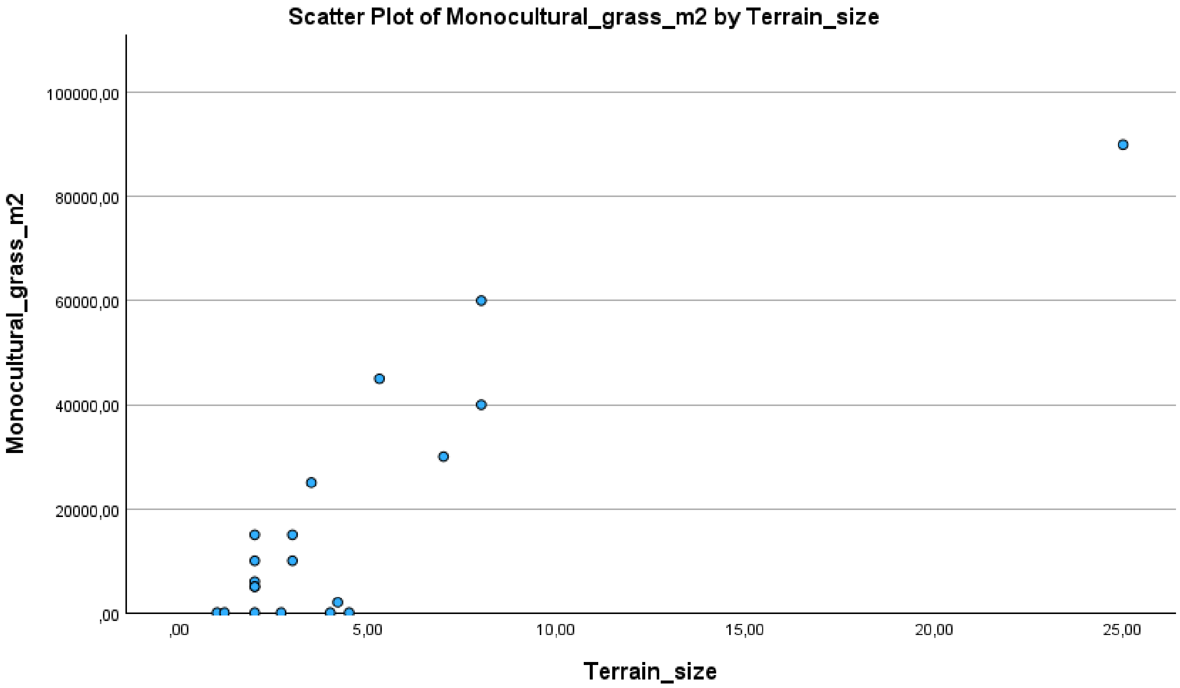
Strength of correlation:

Small r./rho.= 0,10-0,29

Medium r./rho.= 0,30-0,49

Large r./rho.= 0,50-1,00

Figure 1: The correlation between Monocultural grassland and yard size.



The Pearson test indicated a significant large correlation between the number of horses and clutter corners (r.= 0. 513 , p = 0.021) (Table 6).

The Spearman test indicated a significant medium correlation between the number of horses and tree rows (rho.= 0.434, p = 0.072) (Table 6)(Figure 2).

The Pearson and Spearman tests both indicated a significant large correlation between the number of horses and nesting areas (r. = 0.658, p = 0.002, rho. = 0.500, p = 0,025) (Table 6).

Table 6 : Pearson and Spearman correlations between the number of horses and the number of landscape features.

Variable	Pearson correlation	Significance of correlation Pearson	Spearman correlation	Significance of correlation Spearman	Strength of correlation
Solitarytrees	r. = -0.069	0.771	rho. = 0.067	0.778	Small negative correlation
Tree rows	r. = 0.358	0.145	rho. = 0.434	0.072	Medium positive correlation
Brushwood hedges	r. = -0.308	0.387	rho. = -0.372	0.289	Small negative correlation
Hedgerows	r. = -0.021	0.932	rho. = -0.106	0.657	Small negative correlation
Monocultural grassland	r. = 0.139	0.559	rho. = 0.031	0.897	Small positive correlation
Heterocultural grassland	r. = 0.063	0.791	rho. = 0.192	0.416	Small positive correlation
Characteristic trees	r. = -0.203	0.391	rho. = 0.419	0.489	Medium positive correlation
Pollard trees	r. = -0.140	0.556	rho. = -0.038	0.875	Small negative correlation
Treelanes	r. = 0.175	0.460	rho. = 0.122	0.702	Small positive correlation
Flowerborders	r. = 0.055	0.817	rho. = 0.115	0.630	Small positive correlation
Woodbanks	r. =-0.007	0.978	rho. = 0.120	0.615	Small positive correlation
Pools	r. = 0.251	0.286	rho. = 0.240	0.307	Small positive correlation
Nesting boxes	r. = -0.155	0.513	rho. = -0.122	0.609	Small negative correlation
Clutter corners	r. = 0,513	0.021	rho. = 0.086	0.719	Large positive correlation
Woodpiles	r. = -0.210	0.375	rho. = -0.027	0.909	Small negative correlation
Nesting areas	r. = 0.658	0.002	rho. = 0.500	0.025	Large positive correlation
Insect hotels	r. = 0.050	0.834	rho. = 0.120	0.616	Small positive correlation

Correlation significant if p < 0,05

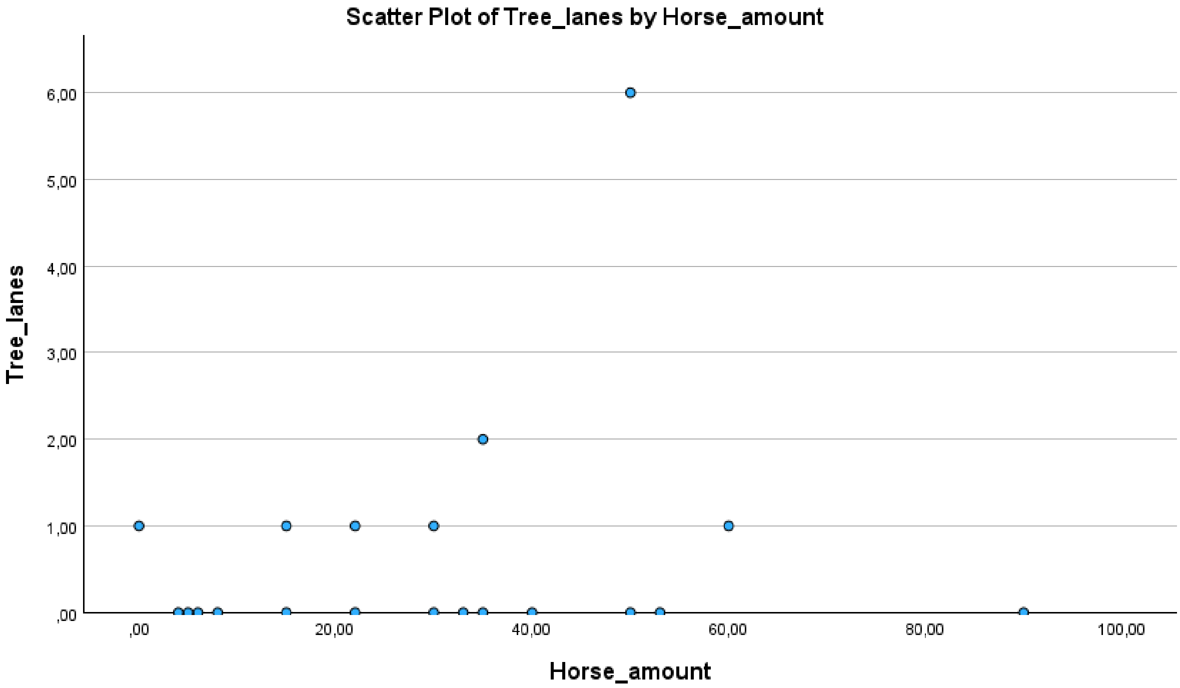
Strength of correlation:

Small r./rho.= 0,10-0,29

Medium r./rho.= 0,30-0,49

Large r./rho.= 0,50-1,00

Figure 2 : The correlation between Tree lanes and the amount of horses



There was no significant difference in the number of landscape features in relation to the type of equestrian yard (Table 7), whereby all significance values were greater that 0.05 thus supporting the null hypothesis (H0).

Table 7 : Differences in the present types of landscape features between types of horse yards.

Variable	F	Sig.
Solitarytrees	1.376	0.279
Characteristic trees	1.250	0.312
Pollard trees	2.210	0.140
Tree lanes	0.561	0.581
Tree rows	1.244	0.313
Fruittree orchards	0.921	0.417
Brushwood hedges	1.278	0.304
Hedgerows	0.815	0.459
Flower borders	1.645	0.221
Woodbanks	0.613	0.553
Feed walls	-	-
Heterocultural grassland	1.794	0.196
Monocultural grassland	0.843	0.448
Pools	0.418	0.665
Nesting boxes	2.079	0.156
Clutter corners	1.186	0,329
Woodpiles	0.942	0,409
Nesting areas	0.866	0.438
Insect hotels	0.921	0.417

Factors influencing the types of landscape features found on equestrian yards

An association was found between the type of horse yard and Pollard trees, Brushwood hedges, Flower borders and Heterocultural grassland, for the Pearson Chi-square test.

For Pollard trees ($X^2(2)$> = 6.555, p = 0.038), Brushwood hedges ($X^2(2)$> = 7.505, p =0.023), Flower borders ($X^2(2)$> = 6.555, p = 0.038) and Heterocultural grassland ($X^2(2)$> = 6.688, p = 0.035)(Table 8) H1 was supported: The type of horse yard is associated with the type of landscape features found.

Table 8: Associations between yard type and landscape features.

Variable	Value	Sig.
Solitarytrees	5.965	0.051
Characteristic trees	3.529	0.171
Pollard trees	6.555	0.038
Tree lanes	0.304	0.859
Tree rows	2.593	0.274
Fruittree orchards	1.955	0.376
Brushwood hedges	7.505	0.023
Hedgerows	5.965	0.051
Flower borders	6.555	0.038
Woodbanks	1.518	0.468
Feed walls	-	-
Heterocultural grassland	6.688	0.035
Monocultural grassland	1.315	0.518
Pools	0.304	0.859
Nesting boxes	3.234	0.199
Clutter corners	2.502	0.286
Woodpiles	3.529	0.171
Nesting areas	3.413	0.182
Insect hotels	1.955	0.376

Brushwood hedges had the highest presence on yard type 1: riding schools, with a presence of 8 out of 10, which equals to 80%. For the other yard types this was 2 out of 7 (28,6 %) for sports stables and 1 out of 3 (33%) for other stables(Figure 3). Heterocultural grassland had the highest presence on yard type 1: riding schools and on yard type 3: other stables (Figure 4). Heterocultural grassland was present on 8 out of 10 riding schools, which equals to 80%. For sports stables this was 2 out of 5, which equals to only 40%. For other stables, i.e. 1 pony club and 2 boarding stables, this was 3 out of 3, which equals to 100%.

Figure 3: The association between yard type and brushwood hedges.

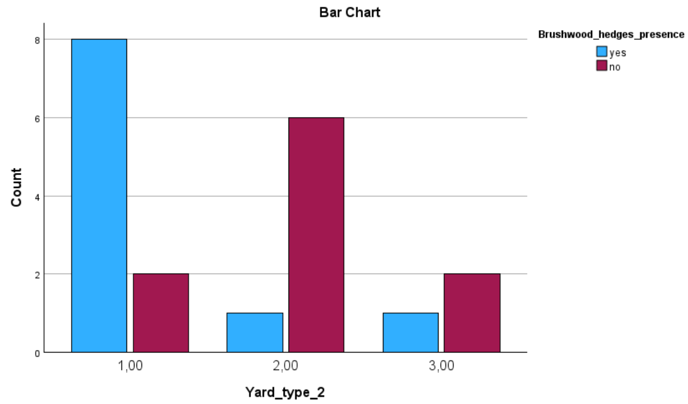
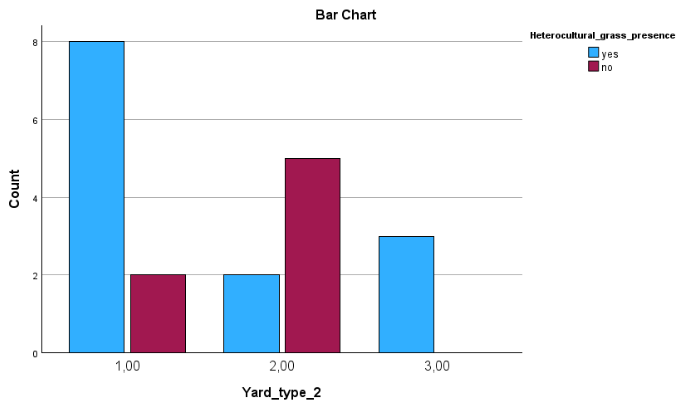


Figure 4: The association between yard type and heterocultural grassland.



No significant associations were found between the size of the horse yards and the type of landscape features found for the Pearson Chi-square test. For all variables H0 was supported: The size of the horse yards is not associated with the type of landscape features found. (Table 9).

Table 9: Associations between yard size and landscape features.

Variable	Value Pearson Chi-square	Sig. Pearson Chi-square
Solitarytrees	1.579	0.454
Characteristic trees	3.725	0.155
Pollard trees	3.866	0.145
Tree lanes	3.344	0.188
Tree rows	3.333	0.189
Fruittree orchards	1.579	0.454
Brushwood hedges	0.343	0.842
Hedgerows	1.579	0.454
Flower borders	3.866	0.145
Woodbanks	1.696	0.428
Feed walls	-	-
Heterocultural grassland	0.597	0.742
Monocultural grassland	2.908	0.234
Pools	1.852	0.396
Nesting boxes	0.706	0.702
Clutter corners	0.114	0.944
Woodpiles	1.513	0.469
Nesting areas	2.902	0.234
Insect hotels	3.158	0.206

No significant associations were found between the number of horses and the type of landscape features found for the Pearson Chi-square test. For all variables H0 was supported: The number of horses on horse yards is not associated with the type of landscape features found. (Table 10).

Table 10: Associations between number of horses and landscape features.

Variable	Value Pearson Chi-square	Sig. Pearson Chi-square
Solitarytrees	2.456	0.293
Characteristic trees	1.264	0.532
Pollard trees	1.264	0.532
Tree lanes	1.294	0.524
Tree rows	1.852	0.396
Fruittree orchards	2.456	0.293
Brushwood hedges	2.578	0.276
Hedgerows	2.456	0.293
Flower borders	4.314	0.116
Woodbanks	1.736	0.420
Feed walls	-	-
Heterocultural grassland	0.855	0.652
Monocultural grassland	0.529	0.768
Pools	1.294	0.524
Nesting boxes	0.855	0.652
Clutter corners	2.222	0.329
Woodpiles	0.218	0.897
Nesting areas	2.778	0.249
Insect hotels	1.287	0.526

CHAPTER 8. DISCUSSION

The main aim of the research was to find out more about the current biodiversity potential of equestrian yards in the province of Gelderland through the use of information on present landscape features. All pre-picked important landscape features have been found on the different yards visited, except for feed walls. Some landscape features like solitary trees, tree rows and hedgerows were found on almost all yards visited.

For the second research question of how the number of landscape features are related to yard characteristics, there were significant relationships found between yard size and the number of landscape features and between the number of horses and the number of landscape features, but a lack of significance for yard type. The most interesting relationships were found between yard size and the amount of monocultural grassland in m^2, and the number of horses and amount of nesting area in m^2. In contrast to the results of the second research question, for the third research question of how yard characteristics influence the presence of landscape features, yard type did have significant associations with the presence of landscape features whereas there were no significant associations for the presence of landscape features and yard size or number of horses.

Presence of Landscape Features on Equestrian yards

Hedgerows were found on 95% of the visited yards. In the past, hedgerows were often found on (semi-)agricultural land (Collier, 2021), and could also be used for equestrian activities such as jumping, besides enclosing fields used for animals (Marshall & Moonen, 2002). With the rise of more intensively managed farms features like hedgerows disappeared from the landscape because of the space they take up and maintenance they need (Gillings & Fuller, 1998). Not all hedgerows found during the research were used for jumping, but horse yards are often (semi-)agricultural land. Hedgerows can have many benefits to the biodiversity, they offer shelter for all kinds of animals and nesting space for birds (Tree, 2018). Some hedgerows, like hawthorn, produce flowers that are a great food source for pollinators like bees (Goulson, 2017). Although hawthorn has a high biodiversity value, they might be not the best option to plant directly near fields used for horses, considering their thorns have a certain danger to them when ingested by horses (Thomas, Dixon, & Fraser, 2018). Finding hedgerows on (semi-)agricultural land, on horse yards, is a good sign because of their importance to the biodiversity, but the type of hedgerow found most during the research, beech, has a lower "score" for biodiversity than other types, because of its inedible leaves and confined blooming (Goudzwaard, 2008). Therefore there is a room for growth on equestrian yards, a growth towards more hedgerows that "score" higher for their contribution to biodiversity, whether or not next to fields used for horses.

Characteristic trees were found on only 3 of the visited yards. This is consistent with findings of earlier research, which shows that there is a loss of characteristic trees in the Benelux (Thomaes & Cr`evecoeur, 2015). Characteristic trees, also known as "habitat trees" (Kraus & Krumm, 2013), have a vital role in maintaining biodiversity. Habitat trees can be homes to many (endangered) species of flora and fauna, and it is estimated that 25% of all live in forests and forest like environments depends on these trees (Kraus & Krumm, 2013). Characteristic trees can not be planted as such, but can grow from planted (young) trees that grow old. The diversity of microhabitats, and thus the contribution to the biodiversity, increases with the thickness of the bark and diameter of the tree and thereby by age (Larrieu, Cabanettes, & Delarue, 2012). Because of the low number found on equestrian yards and the importance of characteristic trees, there could be room for growth. But ,"regular" solitary trees, which were found on most of the yards visited (95%) can turn into characteristic (habitat) trees over time. For example old solitary oaks can have a large function for the biodiversity as habitat and provider of food for a lot of animals (Tree, 2018). Solitary oaks were found on most of the equestrian yards. The biodiversity potential, or room for growth, in this case might not necessarily be to add new trees, but to maintain existing trees and let them grow to an old age.

An association was found between heterocultural grassland and the type of yard. Heterocultural grassland was found on 80% of the visited riding schools, whereas the presence on sports stables was only 40%. The presence on “other stables” visited was 100%. An explanation for the difference between the presence on riding schools and the presence on sports stables could be found in the idea that horses used for sports need a much higher amount of protein and starch in their diet than horses used for riding lessons (Cunha, 1991). It is easier to ensure high amounts of protein in monocultural grassland than in heterocultural grassland (Dasselaar, Hennessy, & Isselstein, 2020). It is most likely that the percentage of heterocultural grassland on “other stables” was this high because of the low amount of yards of these types visited. This group consisted out of 3 yards, of which 2 were boarding stables and 1 was a pony club.

Number of Landscape Features on Equestrian Yards

Besides the numbers of present landscape features, a correlation between the size of the yard and the amount of monocultural grassland in m^2 was found. The first correlation can be explained by the fact that horse yards often tend to grow high productive monocultural grassland for their horses (Johnson, 2012), and the bigger the yard, the more room for (monocultural) grassland. Monocultural grassland was found on 14 out of 20 yards visited, which means that 70% of the yards had monocultural grassland. Monocultural grassland is less beneficial for the biodiversity because it offers a feed source to only a select group of animals by its leaves, it produces hardly any to no flowers for pollinators (Hector, Bazeley-White, Loreau, Otway, & Schmid, 2002) and is often highly fertilized which damages vital invertebrate soil life (Hasall, 2014) and mycorrhizal fungi (Tree, 2018). The high amount of monocultural grassland is thereby a direct indication for room for growth, i.e. biodiversity potential.

A correlation between the amount of nesting areas in m^2 the number of horses was found as well, which can be explained by the facts that barn swallows like to nest underneath roofs of manmade (agricultural) structures (Lubbe, Kragten, Reinstra, & Snoo, 2007) and that the presence of livestock attracts larger groups of these birds and has a positive effect on their breeding results (Bakker, Hagemeier, & Tulp, 1996). (Sport) horses are often stabled in barns, and the more horses, the more roof space for the birds. The situation for Barn swallows is seen as critical, partially due to a loss of breeding grounds (Turner, 2006). Nesting areas were found on 60% (n= 12) of the visited horse yards. Earlier research that focussed on both biological and intensive dairy farming showed that Barn swallows were found on 89% of the dairy farms (Lubbe, Kragten, Reinstra, & Snoo, 2007). This information shows that there may be room to improve the biodiversity potential for nesting birds on equestrian yards. But, what the research on dairy farms took into account, which this research did not, is the opinion of the farmers about having the swallows nest in their barns. Most dairy farmers have a positive attitude towards swallows nesting in their barn (Lubbe, Kragten, Reinstra, & Snoo, 2007). For equestrian yard owners this might be different, because of factors like the desire to have a clean and neat appearance of for example sports stables, and the fact that the dust produced by birds can have negative effects on the respiratory system of horses (Carpenter, 1986). Another thing to keep in mind when comparing the data of the research on dairy farms, is that although this was the most recent research found, this information could be outdated because it has been performed 15 years ago, in 2007. It was thus be informative for a follow-up study to assess the attitude of horse yard owners towards nesting barn swallows in their stables.

Points of attention

There may be certain limitations in the study. One of them is that the research does not take into account that all different horse yards have different owners with different backgrounds (for example farmers vs people from the city), thoughts about greenery and nature and different budgets to plant or maintain features such as trees, hedges or borders, which could lead to a difference in landscape features. Although people might have all the knowledge about the importance of landscape features, it does not mean that they want to or are able to implement them on their yards. Furthermore there are different types of people and different types of yards, but at the moment it is not possible to say that there is a certain type of person for each type of yard, which makes it hard to draw conclusions on this. Future research on the attitude of yard owners towards the implementation of landscape features might be interesting.

Another thing to keep in mind is that some of the stables visited are located in forests or forest-like environments, whereas others are located in less green environments. The stables located in forest-like areas have an advantage over the stables out of less green areas because some landscape features are there already naturally and cost therefore less to no effort. This study did not take into account what the influence of the surrounding environment was, but it might be interesting to further investigate this. What is worth investigating as well is what the importance of yards is in different environments. Yards that are in the middle of a forest might for example be of lower importance for the green infrastructure and biodiversity than yards that are in between agricultural production fields or rural areas, which means that the biodiversity potential for yards might differ.

CHAPTER 9. SUSTAINABILITY

The results of the research can contribute to a greener, more biodiverse landscape because they can be used to inform governments, yard owners and horse keepers about possibilities and problems concerning biodiversity within the sector. The results show that the visited yards contain diverse landscape features at the moment, but that there are possibilities on Dutch equestrian yards to contribute to a growth in the national biodiversity by reintegrating more of these important features into the landscape. The results of the research can be used to set up a scoring and monitoring tool for yards owners to be able to make their yards more biodiverse, by counting, adding and maintaining the different landscape features on their properties. With this, the equestrian sector can actively contribute to an increase in the biodiversity in the Netherlands and thereby have a positive impact on the environment. By implementing and maintaining landscape features such as trees, hedgerows and grasslands equestrian yards can, besides be of value for the biodiversity, also contribute to the take up of carbon dioxide out of the air, and thereby potentially help reduce climate change by the greenhouse effect (Furtado, et al., 2022). For example grasslands can take up high amounts of carbon dioxide (Migliavacca, Calvagno, Cremonese, Rossini, & Meroni, 2011), and can store these for long times when the top layer of the soil remains intact and is not disturbed by for example ploughing or intensive grazing (Conant, Six, & Paustian, 2003). Nature, biodiversity and a healthy environment are important for society in many ways, and for the horse society in particular it could be good to have a "new image" of the sector, to be of importance for the biodiversity. A new image like this could contribute to the sustainability of the sector.

Besides using the results to make equestrian yards more biodiverse, they can also be used to identify where ecosystem services can be improved or restored. With knowledge on the number and presence of landscape features, it is possible to say which services are currently "offered" on equestrian yards and which ones are absent. An example of this is an absence of flowering hedges or flower borders, which leads to a lower number of places for pollinators to find food, which in the end leads to less pollination, which in its turn could lead to less food for humans (Klein, et al., 2006).

An example of economic impact of the results is that the results can be used to inform governments on where certain funding is needed to help yard owners in their task of making their yards more biodiverse. Furthermore certain companies like landscape architects might find new markets because of the new awareness of the biodiversity potential of equestrian yards, like for example planting native species on equestrian yards or making blueprints for horse companies of their terrains with extra landscape features implemented. Breeders of native plants might find extra clients in the equestrian sector as well.

CHAPTER 10. CONCLUSION

The research performed delivered new information about present landscape features and about the biodiversity potential of equestrian yards in the province of Gelderland. All landscape features except for feed walls were found, but the numbers of the types differed, and with this information a baseline has been set.

Although some landscape features can be considered "common" after the research, they still have additional potential. For the hedgerows this is that they could become more diverse and rich of flowering species, whether or not used next to fields used for horses, in order to provide a higher biodiverse value. The solitary trees have the potential to grow into characteristic or habitat trees with a high biodiverse value, if they are maintained and grown old.

Other landscapes features like insect hotels, wood banks and woodpiles were not so common, although all three of them are rather easy to install. Adding these landscape features can contribute a fair share to biodiversity, and their absence from most of the visited yards is an example of the biodiversity potential of equestrian yards. Another example are pollard trees, which were found on three of the visited yards. For example pollard willows have a rather high biodiverse score and are easy to grow and maintain. Furthermore they can deliver additional feed to the diet of horses.

Some interesting correlations were found, like the positive correlation between monocultural grassland and yard size. Although the correlation sounds quite logical, more space means more room for monocultural grassland, it is interesting because monocultural grassland can be turned into heterocultural grassland. Heterocultural grassland is not only a "win" for biodiversity, but in the end also for the health of the horses. Sports stables had the lowest presence of heterocultural grassland. Combining this knowledge with the positive correlation of monocultural grassland and yard size could suggest that the contribution of large sports stables in the province of Gelderland could grow a lot if they would turn their monocultural grassland into heterocultural grassland thus providing a high future biodiversity potential. With this information it can be concluded that there is a biodiversity potential for the sports stables in the province of Gelderland. But, because monocultural grasslands were found on 70% of the yards visited, it can also be stated that there is a room for growth for all yards, where bigger yards might become of bigger biodiverse value than smaller ones when it comes to heterocultural grassland.

The overall conclusion is that whilst numerous landscape features important for biodiversity were found on equestrian yards, this research shows that there is a room for growth, i.e. a biodiversity potential, on equestrian yards in the province of Gelderland.

CHAPTER 11. RECOMMENDATION

For the biodiversity measuring tool that the commissioner wants to set up there are some features that might need more attention than others, for example the landscape features such as characteristic trees, pollard trees, flower borders, woodpiles and feed walls are not common and might need extra attention in a monitoring tool or campaign. Informing people about their value and showing them how easy it can be to add these features might be helpful.

The more common landscape features, tree rows, solitary trees and hedgerows, might need less attention than others, although it might be good to include some specific information about for example types of hedgerows and their biodiverse values, and the potential of solitary trees to grow into characteristic trees.

The landscape features that are relatively common but have room for growth like pools, nesting areas, tree lanes, brushwood, nesting boxes and clutter corners, could use extra attention as well. Most of them are relatively easy and budget friendly to implement on yards, and with a little extra attention they might become far more common and thereby enable the biodiversity level to rise. For nesting areas in particular it might be interesting to find out what the attitude of yard owners is towards the nesting of swallows, considering that this has been done for dairy farmers.

This research focused mainly on whether the landscape features were present on equestrian yards, in a future study it might also be interesting to look more closely at the number of present landscape features in order to see if yards meet a certain threshold, for example 10 solitary trees per hectare.

Furthermore it might be interesting to investigate the relations between types of yard owners and the willingness to invest in important landscape features and thereby the biodiversity. And besides willingness, to find out if there is a possible knowledge gap. Perhaps sometimes the willingness is there, but not enough knowledge. This research did not include these aspects, whereas these might be one of the most important parts for actually establishing the biodiverse potential of the region. Yard owners might have all the means to make their place more biodiverse, but this does not mean that they want to. Informing people on possible improvements is a (good) step to fill a possible knowledge gap, but finding out what stops or motivates them to improve might be even more important.

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TABLE OF ANNEXES

ANNEX 1: Discriptives landscape features.

		Solitair_trees	Characteristic_trees	Pollard_trees	Tree_lanes	Tree_rows	Fruittree_orchards	Brushwood_hedges	Hedgerows
N	Valid	20	20	20	20	18	20	10	20
	Missing	1	1	1	1	3	1	11	1
Mean		17,5000	,2500	,6000	,6500	4,9444	,10	2,5000	5,2500
Minimum		,00	,00	,00	,00	1,00	0	1,00	,00
Maximum		66,00	3,00	8,00	6,00	13,00	2	5,00	30,00

		Flower_borders	Woodbanks	Feed_wall	Heterocultural_grass_m2	Monocultural_grass_m2	Pools	Nesting_boxes	Clutter_corner	Woodpiles	Nesting_areas
N	Valid	20	20	20	20	20	20	20	20	20	20
	Missing	1	1	1	1	1	1	1	1	1	1
Mean		,25	,30	,0000	1587,5000	17900,0000	,4000	1,55	1,6000	,35	1,0500
Minimum		0	0	,00	,00	,00	,00	0	,00	0	,00
Maximum		2	2	,00	20000,00	90000,00	2,00	10	8,00	5	5,00

Descriptive Statistics

	Mean	Std. Deviation	N
Terrain_size	4,6200	5,23687	20
Solitair_trees	17,5000	17,89884	20
Characteristic_trees	,2500	,71635	20
Pollard_trees	,6000	1,84676	20
Tree_lanes_m	75,0000	186,92808	20
tree_rows_m	569,4500	847,04660	20
Fruittree_orchards	,10	,447	20
Brushwood_hedges_m	58,4000	116,03602	20
Hedgerow_meters	427,4000	1098,13202	20
Flower_borders_m2	20,8000	72,05378	20
Feed_wall	,0000	,00000	20
Heterocultural_grass_m2	1587,5000	4866,70306	20
Monocultural_grass_m2	17900,0000	24259,34437	20
Pools	,4000	,59824	20
Nesting_boxes	1,55	2,585	20
Clutter_corner	1,6000	1,75919	20
Woodpiles	,35	1,137	20
Nesting_areas_m2	63,6500	175,69689	20
Insect_hotel	,0500	,22361	20

ANNEX 2: Correlations between the size of the companies and the amount of the types of landscape features.

		Terrain_size
Terrain_size	Pearson Correlation	1
	Sig. (2-tailed)	
	N	20
Solitair_trees	Pearson Correlation	,408
	Sig. (2-tailed)	,074
	N	20
Characteristic_trees	Pearson Correlation	,028
	Sig. (2-tailed)	,907
	N	20
Pollard_trees	Pearson Correlation	,199
	Sig. (2-tailed)	,400
	N	20
Tree_lanes_m	Pearson Correlation	,834**
	Sig. (2-tailed)	<,001
	N	20
tree_rows_m	Pearson Correlation	,855**
	Sig. (2-tailed)	<,001
	N	20
Fruittree_orchards	Pearson Correlation	-,118
	Sig. (2-tailed)	,621
	N	20
Brushwood_hedges_m	Pearson Correlation	-,075
	Sig. (2-tailed)	,754
	N	20
Hedgerow_meters	Pearson Correlation	,870**
	Sig. (2-tailed)	<,001
	N	20
Flower_borders_m2	Pearson Correlation	,929**
	Sig. (2-tailed)	<,001
	N	20
Feed_wall	Pearson Correlation	.b
	Sig. (2-tailed)	.
	N	20
Heterocultural_grass_m2	Pearson Correlation	,836**
	Sig. (2-tailed)	<,001
	N	20
Monocultural_grass_m2	Pearson Correlation	,869**
	Sig. (2-tailed)	<,001
	N	20
Pools	Pearson Correlation	-,003
	Sig. (2-tailed)	,991
	N	20
Nesting_boxes	Pearson Correlation	,611**
	Sig. (2-tailed)	,004
	N	20
Clutter_corner	Pearson Correlation	,200
	Sig. (2-tailed)	,397
	N	20
Woodpiles	Pearson Correlation	-,144
	Sig. (2-tailed)	,543
	N	20
Nesting_areas_m2	Pearson Correlation	,916**
	Sig. (2-tailed)	<,001
	N	20
Insect_hotel	Pearson Correlation	,916**
	Sig. (2-tailed)	<,001
	N	20

			Terrain_size
Spearman's rho	Terrain_size	Correlation Coefficient	1,000
		Sig. (2-tailed)	.
		N	20
	Solitair_trees	Correlation Coefficient	,226
		Sig. (2-tailed)	,339
		N	20
	Characteristic_trees	Correlation Coefficient	,137
		Sig. (2-tailed)	,565
		N	20
	Pollard_trees	Correlation Coefficient	,414
		Sig. (2-tailed)	,070
		N	20
	Tree_lanes_m	Correlation Coefficient	,320
		Sig. (2-tailed)	,169
		N	20
	tree_rows_m	Correlation Coefficient	,718**
		Sig. (2-tailed)	<,001
		N	20
	Fruittree_orchards	Correlation Coefficient	-,202
		Sig. (2-tailed)	,394
		N	20
	Brushwood_hedges_m	Correlation Coefficient	,147
		Sig. (2-tailed)	,537
		N	20
	Hedgerow_meters	Correlation Coefficient	,256
		Sig. (2-tailed)	,276
		N	20
	Flower_borders_m2	Correlation Coefficient	,515*
		Sig. (2-tailed)	,020
		N	20
	Feed_wall	Correlation Coefficient	.
		Sig. (2-tailed)	.
		N	20
	Heterocultural_grass_m2	Correlation Coefficient	,268
		Sig. (2-tailed)	,254
		N	20
	Monocultural_grass_m2	Correlation Coefficient	,629**
		Sig. (2-tailed)	,003
		N	20
	Pools	Correlation Coefficient	,306
		Sig. (2-tailed)	,190
		N	20
	Nesting_boxes	Correlation Coefficient	-,067
		Sig. (2-tailed)	,779
		N	20
	Clutter_corner	Correlation Coefficient	,141
		Sig. (2-tailed)	,553
		N	20
	Woodpiles	Correlation Coefficient	-,193
		Sig. (2-tailed)	,414
		N	20
	Nesting_areas_m2	Correlation Coefficient	,406
		Sig. (2-tailed)	,075
		N	20
	Insect_hotel	Correlation Coefficient	,383
		Sig. (2-tailed)	,095
		N	20

ANNEX 3: Correlations between the number of horses and the amount of the types of landscape features.

Correlations

		Horse_amount			Horse_amount
Horse_amount	Pearson Correlation	1	Horse_amount	Correlation Coefficient	1,000
	Sig. (2-tailed)			Sig. (2-tailed)	.
	N	20		N	20
Solitair_trees	Pearson Correlation	-,069	Solitair_trees	Correlation Coefficient	,067
	Sig. (2-tailed)	,771		Sig. (2-tailed)	,778
	N	20		N	20
Characteristic_trees	Pearson Correlation	-,203	Characteristic_trees	Correlation Coefficient	-,164
	Sig. (2-tailed)	,391		Sig. (2-tailed)	,489
	N	20		N	20
Pollard_trees	Pearson Correlation	-,140	Pollard_trees	Correlation Coefficient	-,038
	Sig. (2-tailed)	,556		Sig. (2-tailed)	,875
	N	20		N	20
Tree_lanes	Pearson Correlation	,175	Tree_lanes	Correlation Coefficient	,091
	Sig. (2-tailed)	,460		Sig. (2-tailed)	,702
	N	20		N	20
Tree_rows	Pearson Correlation	,358	Tree_rows	Correlation Coefficient	,434
	Sig. (2-tailed)	,145		Sig. (2-tailed)	,072
	N	18		N	18
Fruittree_orchards	Pearson Correlation	-,250	Fruittree_orchards	Correlation Coefficient	-,259
	Sig. (2-tailed)	,288		Sig. (2-tailed)	,270
	N	20		N	20
Brushwood_hedges	Pearson Correlation	-,308	Brushwood_hedges	Correlation Coefficient	-,372
	Sig. (2-tailed)	,387		Sig. (2-tailed)	,289
	N	10		N	10
Hedgerows	Pearson Correlation	-,021	Hedgerows	Correlation Coefficient	-,106
	Sig. (2-tailed)	,932		Sig. (2-tailed)	,657
	N	20		N	20
Flower_borders	Pearson Correlation	,055	Flower_borders	Correlation Coefficient	,115
	Sig. (2-tailed)	,817		Sig. (2-tailed)	,630
	N	20		N	20
Woodbanks	Pearson Correlation	-,007	Woodbanks	Correlation Coefficient	,120
	Sig. (2-tailed)	,978		Sig. (2-tailed)	,615
	N	20		N	20
Feed_wall	Pearson Correlation	.a	Feed_wall	Correlation Coefficient	.
	Sig. (2-tailed)	.		Sig. (2-tailed)	.
	N	20		N	20
Monocultural_grass_m2	Pearson Correlation	,139	Monocultural_grass_m2	Correlation Coefficient	,031
	Sig. (2-tailed)	,559		Sig. (2-tailed)	,897
	N	20		N	20
Pools	Pearson Correlation	,251	Pools	Correlation Coefficient	,240
	Sig. (2-tailed)	,286		Sig. (2-tailed)	,307
	N	20		N	20
Nesting_boxes	Pearson Correlation	-,155	Nesting_boxes	Correlation Coefficient	-,122
	Sig. (2-tailed)	,513		Sig. (2-tailed)	,609
	N	20		N	20
Clutter_corner	Pearson Correlation	,513*	Clutter_corner	Correlation Coefficient	,086
	Sig. (2-tailed)	,021		Sig. (2-tailed)	,719
	N	20		N	20
Woodpiles	Pearson Correlation	-,210	Woodpiles	Correlation Coefficient	-,027
	Sig. (2-tailed)	,375		Sig. (2-tailed)	,909
	N	20		N	20
Nesting_areas	Pearson Correlation	,658**	Nesting_areas	Correlation Coefficient	,500*
	Sig. (2-tailed)	,002		Sig. (2-tailed)	,025
	N	20		N	20
Heterocultural_grass_m2	Pearson Correlation	,063	Heterocultural_grass_m2	Correlation Coefficient	,192
	Sig. (2-tailed)	,791		Sig. (2-tailed)	,416
	N	20		N	20

Insect_hotel	Pearson Correlation	,050	1
	Sig. (2-tailed)	,834	
	N	20	20

Insect_hotel	Correlation Coefficient	,120
	Sig. (2-tailed)	,616
	N	20

ANNEX 4: Difference in the present types of landscape features between the types of horse yards.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Solitair_trees	Between Groups	848,219	2	424,110	1,376	,279
	Within Groups	5238,781	17	308,164		
	Total	6087,000	19			
Characteristic_trees	Between Groups	1,250	2	,625	1,250	,312
	Within Groups	8,500	17	,500		
	Total	9,750	19			
Pollard_trees	Between Groups	13,371	2	6,686	2,210	,140
	Within Groups	51,429	17	3,025		
	Total	64,800	19			
Tree_lanes_m	Between Groups	41101,905	2	20550,952	,561	,581
	Within Groups	622798,095	17	36635,182		
	Total	663900,000	19			
tree_rows_m	Between Groups	1739889,026	2	869944,513	1,244	,313
	Within Groups	11892381,924	17	699551,878		
	Total	13632270,950	19			
Fruittree_orchards	Between Groups	,371	2	,186	,921	,417
	Within Groups	3,429	17	,202		
	Total	3,800	19			
Brushwood_hedges_m	Between Groups	33442,871	2	16721,436	1,278	,304
	Within Groups	222379,929	17	13081,172		
	Total	255822,800	19			
Hedgerow_meters	Between Groups	2003842,400	2	1001921,200	,815	,459
	Within Groups	20908142,400	17	1229890,729		
	Total	22911984,800	19			
Flower_borders_m2	Between Groups	16069,486	2	8034,743	1,654	,221
	Within Groups	82573,714	17	4857,277		
	Total	98643,200	19			
Flower_borders_m2	Between Groups	16069,486	2	8034,743	1,654	,221
	Within Groups	82573,714	17	4857,277		
	Total	98643,200	19			
Woodbanks_m	Between Groups	262,143	2	131,071	,613	,553
	Within Groups	3632,857	17	213,697		
	Total	3895,000	19			
Heterocultural_grass_m2	Between Groups	78416976,905	2	39208488,452	1,794	,196
	Within Groups	371594198,10	17	21858482,241		
	Total	450011175,00	19			
Monocultural_grass_m2	Between Groups	1008676190,5	2	504338095,24	,843	,448
	Within Groups	10173123810	17	598419047,62		
	Total	11181800000	19			
Pools	Between Groups	,319	2	,160	,418	,665
	Within Groups	6,481	17	,381		
	Total	6,800	19			
Nesting_boxes	Between Groups	24,950	2	12,475	2,079	,156
	Within Groups	102,000	17	6,000		
	Total	126,950	19			
Clutter_corner	Between Groups	7,200	2	3,600	1,186	,329
	Within Groups	51,600	17	3,035		
	Total	58,800	19			
Woodpiles	Between Groups	2,450	2	1,225	,942	,409
	Within Groups	22,100	17	1,300		
	Total	24,550	19			
Nesting_areas_m2	Between Groups	54227,426	2	27113,713	,866	,438
	Within Groups	532291,124	17	31311,243		
	Total	586518,550	19			
Insect_hotel	Between Groups	,093	2	,046	,921	,417
	Within Groups	,857	17	,050		
	Total	,950	19			

ANNEX 5: Associations between type of yard and the type of landscape features present.

Yard_type_2 * Brushwood_hedges_presence

Crosstab

Count

		Brushwood_hedges_presence		
		yes	no	Total
Yard_type_2	1,00	8	2	10
	2,00	1	6	7
	3,00	1	2	3
Total		10	10	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	7,505[a]	2	,023
Likelihood Ratio	8,157	2	,017
Linear-by-Linear Association	4,412	1	,036
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is 1,50.

Yard_type_2 * Characterstic_trees_presence

Crosstab

Count

		Characterstic_trees_presence		Total
		yes	no	
Yard_type_2	1,00	3	7	10
	2,00	0	7	7
	3,00	0	3	3
Total		3	17	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3,529[a]	2	,171
Likelihood Ratio	4,691	2	,096
Linear-by-Linear Association	2,686	1	,101
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,45.

Yard_type_2 * Clutter_corner_presence

Crosstab

Count

		Clutter_corner_presence		Total
		yes	no	
Yard_type_2	1,00	9	1	10
	2,00	4	3	7
	3,00	2	1	3
Total		15	5	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2,502[a]	2	,286
Likelihood Ratio	2,612	2	,271
Linear-by-Linear Association	1,471	1	,225
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,75.

Yard_type_2 * Flower_borders_presence

Crosstab

Count

		Flower_borders_presence		Total
		yes	no	
Yard_type_2	1,00	0	10	10
	2,00	3	4	7
	3,00	0	3	3
Total		3	17	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6,555[a]	2	,038
Likelihood Ratio	7,348	2	,025
Linear-by-Linear Association	,779	1	,378
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,45.

Yard_type_2 * Fruittree_orchards_presence

Crosstab

Count

		Fruittree_orchards_presence		Total
		yes	no	
Yard_type_2	1,00	0	10	10
	2,00	1	6	7
	3,00	0	3	3
Total		1	19	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,955[a]	2	,376
Likelihood Ratio	2,199	2	,333
Linear-by-Linear Association	,232	1	,630
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,15.

Yard_type_2 * Hedgerows_presence

Crosstab

Count

		Hedgerows_presence		
		yes	no	Total
Yard_type_2	1,00	10	0	10
	2,00	7	0	7
	3,00	2	1	3
Total		19	1	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5,965[a]	2	,051
Likelihood Ratio	4,122	2	,127
Linear-by-Linear Association	3,455	1	,063
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,15.

Yard_type_2 * Heterocultural_grass_presence

Crosstab

Count

		Heterocultural_grass_presence		
		yes	no	Total
Yard_type_2	1,00	8	2	10
	2,00	2	5	7
	3,00	3	0	3
Total		13	7	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6,688[a]	2	,035
Likelihood Ratio	7,514	2	,023
Linear-by-Linear Association	,080	1	,777
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,05.

Yard_type_2 * Insecthotel_presence

Crosstab

Count

		Insecthotel_presence		
		1,00	2,00	Total
Yard_type_2	1,00	0	10	10
	2,00	1	6	7
	3,00	0	3	3
Total		1	19	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,955[a]	2	,376
Likelihood Ratio	2,199	2	,333
Linear-by-Linear Association	,232	1	,630
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,15.

Yard_type_2 * Tree_lanes_presence

Crosstab

Count

		Tree_lanes_presence		
		yes	no	Total
Yard_type_2	1,00	3	7	10
	2,00	3	4	7
	3,00	1	2	3
Total		7	13	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	,304[a]	2	,859
Likelihood Ratio	,301	2	,860
Linear-by-Linear Association	,080	1	,777
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,05.

Yard_type_2 * Monocultural_grass_presence

Crosstab

Count

		Monocultural_grass_presence		
		yes	no	Total
Yard_type_2	1,00	6	4	10
	2,00	6	1	7
	3,00	2	1	3
Total		14	6	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,315[a]	2	,518
Likelihood Ratio	1,414	2	,493
Linear-by-Linear Association	,347	1	,556
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is ,90.

Yard_type_2 * Nesting_boxes_presence

Crosstab

Count

		Nesting_boxes_presence		
		yes	no	Total
Yard_type_2	1,00	3	7	10
	2,00	4	3	7
	3,00	0	3	3
Total		7	13	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3,234[a]	2	,199
Likelihood Ratio	4,120	2	,127
Linear-by-Linear Association	,120	1	,729
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,05.

Yard_type_2 * Nesting_areas_presence

Crosstab

Count

		Nesting_areas_presence		
		yes	no	Total
Yard_type_2	1,00	8	2	10
	2,00	3	4	7
	3,00	1	2	3
Total		12	8	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3,413[a]	2	,182
Likelihood Ratio	3,533	2	,171
Linear-by-Linear Association	2,942	1	,086
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,20.

Yard_type_2 * Pollard_trees_presence

Crosstab

Count

		Pollard_trees_presence		
		yes	no	Total
Yard_type_2	1,00	0	10	10
	2,00	3	4	7
	3,00	0	3	3
Total		3	17	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6,555[a]	2	,038
Likelihood Ratio	7,348	2	,025
Linear-by-Linear Association	,779	1	,378
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,45.

Yard_type_2 * Pools_presence

Crosstab

Count

		Pools_presence		Total
		yes	no	
Yard_type_2	1,00	3	7	10
	2,00	3	4	7
	3,00	1	2	3
Total		7	13	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	,304[a]	2	,859
Likelihood Ratio	,301	2	,860
Linear-by-Linear Association	,080	1	,777
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,05.

Yard_type_2 * Tree_rows_presence

Crosstab

Count

		Tree_rows_presence		Total
		yes	no	
Yard_type_2	1,00	9	1	10
	2,00	7	0	7
	3,00	2	1	3
Total		18	2	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2,593[a]	2	,274
Likelihood Ratio	2,683	2	,262
Linear-by-Linear Association	,490	1	,484
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,30.

Yard_type_2 * Solitair_trees_presence

Crosstab

Count

		Solitair_trees_presence		
		Yes	No	Total
Yard_type_2	1,00	10	0	10
	2,00	7	0	7
	3,00	2	1	3
Total		19	1	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	5,965[a]	2	,051
Likelihood Ratio	4,122	2	,127
Linear-by-Linear Association	3,455	1	,063
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,15.

Yard_type_2 * Woodbanks_presence

Crosstab

Count

		Woodbanks_presence		
		yes	no	Total
Yard_type_2	1,00	3	7	10
	2,00	1	6	7
	3,00	0	3	3
Total		4	16	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,518[a]	2	,468
Likelihood Ratio	2,057	2	,358
Linear-by-Linear Association	1,441	1	,230
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,60.

Yard_type_2 * Woodpiles_presence

Crosstab

Count

		Woodpiles_presence		
		yes	no	Total
Yard_type_2	1,00	3	7	10
	2,00	0	7	7
	3,00	0	3	3
Total		3	17	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3,529[a]	2	,171
Likelihood Ratio	4,691	2	,096
Linear-by-Linear Association	2,686	1	,101
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,45.

ANNEX 6: Associations between size of yard and type of landscape features present.

sze_category * Brushwood_hedges_presence

Crosstab

Count

		Brushwood_hedges_presence		
		yes	no	Total
sze_category	small	4	4	8
	medium	3	4	7
	large	3	2	5
Total		10	10	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	,343[a]	2	,842
Likelihood Ratio	,345	2	,842
Linear-by-Linear Association	,076	1	,783
N of Valid Cases	20		

a. 6 cells (100,0%) have expected count less than 5. The minimum expected count is 2,50.

sze_category * Characterstic_trees_presence

Crosstab

Count

		Characterstic_trees_presence		
		yes	no	Total
sze_category	small	1	7	8
	medium	0	7	7
	large	2	3	5
Total		3	17	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3,725[a]	2	,155
Likelihood Ratio	4,150	2	,126
Linear-by-Linear Association	1,248	1	,264
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,75.

sze_category * Clutter_corner_presence

Crosstab

Count

		Clutter_corner_presence		
		yes	no	Total
sze_category	small	6	2	8
	medium	5	2	7
	large	4	1	5
Total		15	5	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	,114[a]	2	,944
Likelihood Ratio	,116	2	,944
Linear-by-Linear Association	,025	1	,874
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is 1,25.

sze_category * Flower_borders_presence

Crosstab

Count

		Flower_borders_presence yes	no	Total
sze_category	small	0	8	8
	medium	1	6	7
	large	2	3	5
Total		3	17	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3,866[a]	2	,145
Likelihood Ratio	4,437	2	,109
Linear-by-Linear Association	3,564	1	,059
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,75.

sze_category * Fruittree_orchards_presence

Crosstab

Count

		Fruittree_orchards_presence yes	no	Total
sze_category	small	1	7	8
	medium	0	7	7
	large	0	5	5
Total		1	19	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,579[a]	2	,454
Likelihood Ratio	1,912	2	,384
Linear-by-Linear Association	1,151	1	,283
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,25.

sze_category * Hedgerows_presence

Crosstab

Count

		Hedgerows_presence		Total
		yes	no	
sze_category	small	7	1	8
	medium	7	0	7
	large	5	0	5
Total		19	1	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,579[a]	2	,454
Likelihood Ratio	1,912	2	,384
Linear-by-Linear Association	1,151	1	,283
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,25.

sze_category * Heterocultural_grass_presence

Crosstab

Count

		Heterocultural_grass_presence		Total
		yes	no	
sze_category	small	6	2	8
	medium	4	3	7
	large	3	2	5
Total		13	7	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	,597[a]	2	,742
Likelihood Ratio	,610	2	,737
Linear-by-Linear Association	,367	1	,545
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,75.

sze_category * Insecthotel_presence Crosstabulation

Count

		Insecthotel_presence		Total
		1,00	2,00	
sze_category	small	0	8	8
	medium	0	7	7
	large	1	4	5
Total		1	19	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3,158[a]	2	,206
Likelihood Ratio	2,937	2	,230
Linear-by-Linear Association	2,108	1	,147
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,25.

sze_category * Tree_lanes_presence

Crosstab

Count

		Tree_lanes_presence		Total
		yes	no	
sze_category	small	1	7	8
	medium	3	4	7
	large	3	2	5
Total		7	13	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3,344[a]	2	,188
Likelihood Ratio	3,579	2	,167
Linear-by-Linear Association	3,095	1	,079
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,75.

sze_category * Monocultural_grass_presence

Crosstab

Count

		Monocultural_grass_presence		
		yes	no	Total
sze_category	small	5	3	8
	medium	4	3	7
	large	5	0	5
Total		14	6	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2,908[a]	2	,234
Likelihood Ratio	4,289	2	,117
Linear-by-Linear Association	1,590	1	,207
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,50.

sze_category * Nesting_areas_presence

Crosstab

Count

		Nesting_areas_presence		
		yes	no	Total
sze_category	small	3	5	8
	medium	5	2	7
	large	4	1	5
Total		12	8	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2,902[a]	2	,234
Likelihood Ratio	2,956	2	,228
Linear-by-Linear Association	2,473	1	,116
N of Valid Cases	20		

a. 6 cells (100,0%) have expected count less than 5. The minimum expected count is 2,00.

sze_category * Nesting_boxes_presence

Crosstab

Count

		Nesting_boxes_presence		
		yes	no	Total
sze_category	small	3	5	8
	medium	3	4	7
	large	1	4	5
Total		7	13	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	,706[a]	2	,702
Likelihood Ratio	,748	2	,688
Linear-by-Linear Association	,300	1	,584
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,75.

sze_category * Pollard_trees_presence

Crosstab

Count

		Pollard_trees_presence		
		yes	no	Total
sze_category	small	0	8	8
	medium	1	6	7
	large	2	3	5
Total		3	17	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3,866[a]	2	,145
Likelihood Ratio	4,437	2	,109
Linear-by-Linear Association	3,564	1	,059
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,75.

sze_category * Pools_presence

Crosstab

Count

		Pools_presence yes	no	Total
sze_category	small	2	6	8
	medium	2	5	7
	large	3	2	5
Total		7	13	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,852[a]	2	,396
Likelihood Ratio	1,795	2	,408
Linear-by-Linear Association	1,398	1	,237
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,75.

sze_category * Tree_rows_presence

Crosstab

Count

		Tree_rows_presence yes	no	Total
sze_category	small	6	2	8
	medium	7	0	7
	large	5	0	5
Total		18	2	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3,333[a]	2	,189
Likelihood Ratio	4,006	2	,135
Linear-by-Linear Association	2,431	1	,119
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,50.

sze_category * Solitair_trees_presence

Crosstab

Count

		Solitair_trees_presence Yes	No	Total
sze_category	small	7	1	8
	medium	7	0	7
	large	5	0	5
Total		19	1	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,579[a]	2	,454
Likelihood Ratio	1,912	2	,384
Linear-by-Linear Association	1,151	1	,283
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,25.

sze_category * Woodbanks_presence

Crosstab

Count

		Woodbanks_presence yes	no	Total
sze_category	small	2	6	8
	medium	2	5	7
	large	0	5	5
Total		4	16	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,696[a]	2	,428
Likelihood Ratio	2,643	2	,267
Linear-by-Linear Association	,927	1	,336
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is 1,00.

sze_category * Woodpiles_presence

Crosstab

Count

		Woodpiles_presence		
		yes	no	Total
sze_category	small	2	6	8
	medium	1	6	7
	large	0	5	5
Total		3	17	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,513[a]	2	,469
Likelihood Ratio	2,169	2	,338
Linear-by-Linear Association	1,426	1	,232
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,75.

ANNEX 7: Associations between horse groups of yards and type of landscape features present.

horse_groups * Brushwood_hedges_presence

Crosstab

Count

		Brushwood_hedges_presence		
		yes	no	Total
horse_groups	small yards	2	4	6
	medium yards	4	5	9
	big yards	4	1	5
Total		10	10	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2,578[a]	2	,276
Likelihood Ratio	2,718	2	,257
Linear-by-Linear Association	2,169	1	,141
N of Valid Cases	20		

a. 6 cells (100,0%) have expected count less than 5. The minimum expected count is 2,50.

horse_groups * Characterstic_trees_presence

Crosstab

Count

		Characterstic_trees_presence		
		yes	no	Total
horse_groups	small yards	1	5	6
	medium yards	2	7	9
	big yards	0	5	5
Total		3	17	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,264[a]	2	,532
Likelihood Ratio	1,967	2	,374
Linear-by-Linear Association	,492	1	,483
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,75.

horse_groups * Clutter_corner_presence

Crosstab

Count

		Clutter_corner_presence		
		yes	no	Total
horse_groups	small yards	4	2	6
	medium yards	6	3	9
	big yards	5	0	5
Total		15	5	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2,222[a]	2	,329
Likelihood Ratio	3,398	2	,183
Linear-by-Linear Association	1,417	1	,234
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,25.

horse_groups * Flower_borders_presence

Crosstab

Count

		Flower_borders_presence		
		yes	no	Total
horse_groups	small yards	0	6	6
	medium yards	3	6	9
	big yards	0	5	5
Total		3	17	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	4,314[a]	2	,116
Likelihood Ratio	5,451	2	,066
Linear-by-Linear Association	,015	1	,902
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,75.

horse_groups * Fruittree_orchards_presence

Crosstab

Count

		Fruittree_orchards_presence		Total
		yes	no	
horse_groups	small yards	1	5	6
	medium yards	0	9	9
	big yards	0	5	5
Total		1	19	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2,456[a]	2	,293
Likelihood Ratio	2,534	2	,282
Linear-by-Linear Association	1,648	1	,199
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,25.

horse_groups * Hedgerows_presence

Crosstab

Count

		Hedgerows_presence		Total
		yes	no	
horse_groups	small yards	5	1	6
	medium yards	9	0	9
	big yards	5	0	5
Total		19	1	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2,456[a]	2	,293
Likelihood Ratio	2,534	2	,282
Linear-by-Linear Association	1,648	1	,199
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,25.

horse_groups * Heterocultural_grass_presence

Crosstab

Count

		Heterocultural_grass_presence		
		yes	no	Total
horse_groups	small yards	4	2	6
	medium yards	5	4	9
	big yards	4	1	5
Total		13	7	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	,855[a]	2	,652
Likelihood Ratio	,890	2	,641
Linear-by-Linear Association	,161	1	,688
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,75.

horse_groups * Insecthotel_presence

Crosstab

Count

		Insecthotel_presence		
		1,00	2,00	Total
horse_groups	small yards	0	6	6
	medium yards	1	8	9
	big yards	0	5	5
Total		1	19	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,287[a]	2	,526
Likelihood Ratio	1,662	2	,436
Linear-by-Linear Association	,005	1	,946
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,25.

horse_groups * Tree_lanes_presence

Crosstab

Count

		Tree_lanes_presence		Total
		yes	no	
horse_groups	small yards	1	5	6
	medium yards	4	5	9
	big yards	2	3	5
Total		7	13	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,294[a]	2	,524
Likelihood Ratio	1,396	2	,498
Linear-by-Linear Association	,695	1	,404
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,75.

horse_groups * Monocultural_grass_presence

Crosstab

Count

		Monocultural_grass_presence		Total
		yes	no	
horse_groups	small yards	4	2	6
	medium yards	7	2	9
	big yards	3	2	5
Total		14	6	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	,529[a]	2	,768
Likelihood Ratio	,532	2	,767
Linear-by-Linear Association	,037	1	,847
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,50.

horse_groups * Nesting_areas_presence

Crosstab

Count

		Nesting_areas_presence		Total
		yes	no	
horse_groups	small yards	2	4	6
	medium yards	6	3	9
	big yards	4	1	5
Total		12	8	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2,778[a]	2	,249
Likelihood Ratio	2,821	2	,244
Linear-by-Linear Association	2,444	1	,118
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 2,00.

horse_groups * Nesting_boxes_presence

Crosstab

Count

		Nesting_boxes_presence yes	no	Total
horse_groups	small yards	2	4	6
	medium yards	4	5	9
	big yards	1	4	5
Total		7	13	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	,855[a]	2	,652
Likelihood Ratio	,890	2	,641
Linear-by-Linear Association	,161	1	,688
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,75.

horse_groups * Pollard_trees_presence

Crosstab

Count

		Pollard_trees_presence		
		yes	no	Total
horse_groups	small yards	1	5	6
	medium yards	2	7	9
	big yards	0	5	5
Total		3	17	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,264[a]	2	,532
Likelihood Ratio	1,967	2	,374
Linear-by-Linear Association	,492	1	,483
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,75.

horse_groups * Pools_presence

Crosstab

Count

		Pools_presence		
		yes	no	Total
horse_groups	small yards	1	5	6
	medium yards	4	5	9
	big yards	2	3	5
Total		7	13	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,294[a]	2	,524
Likelihood Ratio	1,396	2	,498
Linear-by-Linear Association	,695	1	,404
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,75.

horse_groups * Tree_rows_presence

Crosstab

Count

		Tree_rows_presence		
		yes	no	Total
horse_groups	small yards	5	1	6
	medium yards	9	0	9
	big yards	4	1	5
Total		18	2	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,852[a]	2	,396
Likelihood Ratio	2,593	2	,274
Linear-by-Linear Association	,010	1	,922
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,50.

horse_groups * Solitair_trees_presence

Crosstab

Count

		Solitair_trees_presence		
		Yes	No	Total
horse_groups	small yards	5	1	6
	medium yards	9	0	9
	big yards	5	0	5
Total		19	1	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2,456[a]	2	,293
Likelihood Ratio	2,534	2	,282
Linear-by-Linear Association	1,648	1	,199
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,25.

horse_groups * Woodbanks_presence

Crosstab

Count

		Woodbanks_presence		
		yes	no	Total
horse_groups	small yards	1	5	6
	medium yards	1	8	9
	big yards	2	3	5
Total		4	16	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1,736[a]	2	,420
Likelihood Ratio	1,600	2	,449
Linear-by-Linear Association	,781	1	,377
N of Valid Cases	20		

a. 5 cells (83,3%) have expected count less than 5. The minimum expected count is 1,00.

horse_groups * Woodpiles_presence

Crosstab

Count

		Woodpiles_presence		Total
		yes	no	
horse_groups	small yards	1	5	6
	medium yards	1	8	9
	big yards	1	4	5
Total		3	17	20

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	,218[a]	2	,897
Likelihood Ratio	,219	2	,896
Linear-by-Linear Association	,015	1	,902
N of Valid Cases	20		

a. 4 cells (66,7%) have expected count less than 5. The minimum expected count is ,75.