MASTERARBEIT | MASTER'S THESIS

Titel | Title

Quantitative descriptive analysis of the social behavior and movements of wild sows in European nature

verfasst von | submitted by

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angestrebter akademischer Grad | in partial fulfilment of the requirements for the degree of

Master of Science (MSc)

Wien | Vienna, 2024

Studienkennzahl lt. Studienblatt | Degree programme code as it appears on the student record sheet:	UA 066 977
Studienrichtung lt. Studienblatt | Degree programme as it appears on the student record sheet:	Masterstudium Business Analytics
Betreut von | Supervisor:	Univ.-Prof. Dipl.-Inform.Univ. Dr. Claudia Plant

Contents

1 Abstract:

1.1 Abstract (English):

In recent years, the development of technologies that allow the study and analysis of big data sets has been impressive, including the application of these technologies to movement ecology. Now there are a lot more tools and techniques that can be used to study this type of data.

Movement ecology is rapidly turning into a data-rich discipline, taking advantage of developments in areas such as genomics and environmental monitoring. These revolutionary advances can in part be attributed to improvements in cost-effective automated high-throughput wildlife tracking systems that generate massive amounts of relevant information in a biological and environmental context (Nathan, 2022). Recent advances in data collection and management have transformed "movement ecology" (the integrated study of organismal movement), creating a big data-oriented discipline that benefits from cost-effective improvements in data collection to achieve more complete and effective results (Nathan, 2022).

The area of opportunity available to use these techniques and tools is consequently very broad. I therefore believe that it will take many years until good use is made of these technologies and until they are applied in projects in a general way around the world. For this very reason, there are many areas of science in which a lot of these tools have not yet been applied (or at least not in many topics) to understand and analyze data that was already collected and now requires the extraction of relevant information in order to contribute to the scientific knowledge growth.

This thesis focuses on the analysis of location and movement data of wild boar kept under semi-natural conditions within nature reserves located in Europe. Wild boar populations are strongly increasing across Europe. Details about their population dynamics and reproductive potential are known, but our knowledge about social structures and the possible impact hunting has on these structures is still very limited (Sebastian G. Vetter, 2016, p. 193).

Keywords: Big data of wild animals, semi-natural conditions, Boars in Europe, group structures of wild boars, behavior analysis of wild boars, impact of hunting.

1.2 Abstract (German)- Zusammenfassung

In den letzten Jahren haben sich Technologien zur Untersuchung und Analyse großer Datenmengen auf beeindruckende Art und Weise entwickelt, auch im Bereich der Bewegungsökologie. Heute gibt es eine Vielzahl an Werkzeugen und Techniken, die für die Analyse von Big Data verwendet werden können.

Die Bewegungsökologie entwickelt sich rasch zu einer datenreichen Disziplin, die von Entwicklungen in Bereichen wie der Genomik und der Umweltüberwachung profitiert. Diese revolutionären Fortschritte sind zum Teil auf Verbesserungen von kosteneffizienten, automatisierten Wildtierverfolgungssystemen zurückzuführen, die beeindruckende Mengen an relevanten Informationen in einem biologischen und ökologischen Kontext erzeugen (Nathan, 2022). Die jüngsten Fortschritte im Bereich der Datenerfassung und -verwaltung haben die "Bewegungsökologie" (die integrierte Untersuchung der Bewegungen von Organismen) umfassend verändert und eine Big-Data-orientierte Disziplin geschaffen, die von kosteneffizienten Verbesserungen der Datenerfassung profitiert, um vollständigere und effektivere Ergebnisse zu erzielen (Nathan, 2022).

Die Möglichkeiten, diese Techniken und Instrumente zu nutzen, sind folglich sehr breit gefächert. Daher bin ich der Meinung, dass es noch viele Jahre dauern wird, bis diese Technologien sinnvoll genutzt werden und weltweit in Projekten zum Einsatz kommen können. Aus diesem Grund gibt es einige Bereiche der Wissenschaft, in denen viele dieser Werkzeuge bis jetzt nicht angewandt wurden (oder zumindest nicht in vielen Themenbereichen), um Daten zu verstehen und zu analysieren, die bereits gesammelt wurden und nun die Extraktion relevanter Informationen erfordern, um zum wissenschaftlichen Wissenszuwachs beizutragen.

Diese Arbeit fokussiert sich auf die Analyse von Standort- und Bewegungsdaten von Wildschweinen, die unter naturnahen Bedingungen in Naturschutzgebieten in Europa gehalten werden. Wildschweinpopulationen nehmen in ganz Europa stark zu. Informationen über ihre Populationsdynamik und ihr Fortpflanzungspotenzial sind bekannt, aber unser Wissen über ihre sozialen Strukturen und die möglichen Auswirkungen der Jagd auf diese Strukturen ist noch sehr begrenzt (Sebastian G. Vetter, 2016, S. 193).

Schlagwörter: Big Data von Wildtieren, naturnahe Bedingungen, Wildschweine in Europa, Gruppenstrukturen von Wildschweinen, Verhaltensanalyse von Wildschweinen, Auswirkungen der Jagd.

2 Introduction

The main center of this research is to understand and explain in a quantitative general way, in what way and how much the movement and positioning of wild boars happens in semi-natural conditions in a European climate. To do this, data on position and distance traveled in specific periods of time are taken as the main bases, and it is ground on the premise that: Understanding the movement of animals is essential to be able to explain the interaction and survival of animals (Nathan, 2022). Of course, the weather plays an important role too, so it will be an integral part of the analysis, since the weather conditions can be triggers to behavior changes.

Because the wild boar Sus scrofa is an important wildlife in the economic and ecological sense, its widespread population in Europe during the last 50 years has raised doubts and concerns about how the situation should be managed by dealing with this species effectively. To develop strategies for its proper management there are biological aspects that must be taken into account, one of the most important is its social behavior (Iacolina, 2009). It is important to mention that demographic and extrinsic factors, which can affect the composition and social stability of groups, have not been systematically investigated (Iacolina, 2009).

The changes in the population of these animals in Europe are having economic consequences (Oliver Keuling, 2009, págs. 159-167). Therefore, it is necessary to understand in great detail the behavior of wild boars.

The social organization of wild boar groups is centered mainly on adult females, who are efficient and cooperative in raising offspring (Iacolina, 2009). This can be also confirmed by a different study claiming: The wild boars Sus scrofa have a social structure that is based on groups of females, and these can include different generations of adults and offspring, so they are considered a matrilineal social structure (Poteaux C. e., 2009). But even though this is known, not much is understood yet about these animals living in these types of groups and occupying the same common area to live (Poteaux C. e., 2009).

Social contact patterns in groups of wild animals can have a large impact on the spread of infectious diseases among these animals (Salathé, 2010). This can be used for different purposes, but in the specific case of wild boars, which are already considered a pest, it could have population control applications. The results provided by this analysis could also be helpful for subsequent analyzes related to the control of wild animal populations, since understanding the spread of infectious diseases in populations is vital for the control of these diseases, whatever their purpose (Salathé, 2010). So, the quantitative results provide a very good overview.

This species has a great growth and abundance in European territory, which is a serious threat to the health of other species of animals and also to human beings, it can carry parasitic, viral and bacterial pathogens such as African swine fever (Rossi, 2005), and zoonoses such as brucellosis, hepatitis B and leptospirosis (Vicente, 2002), (Meng, 2009), (Caruso, 2015).

One of the most common methods for controlling the population of these animals is hunting. However, the methods and the number of animals hunted vary depending on the location and the number of animals present in the area (Keuling, 2021). Until today, private hunting is not enough for total control of this species; more population control methods are needed (Keuling, 2021).

Modern systems for wildlife tracking today allow very detailed investigation and analysis of the individuals of a species across space and time, the nature of their biological interactions and their behavioral responses to stimuli in their environment (Nathan, 2022). Movement ecology is rapidly expanding the limits of science in a broad interdisciplinary framework, opening the way to new opportunities for the understanding and study of wild animal movements, their causes and consequences (Nathan, 2022).

Data in general, whether in statistics or big data, alone represent facts, however, this is not enough for the correct understanding of events. The data is also surrounded by a context that gives it meaning and form, and this context must be explained, explored and understood, so that the data is useful when understanding the complete story of an event. This is the way this research was done, from a perspective that could tell the data in a comprehensible resumed way, almost like telling a story.

An important principle on which the construction of this thesis is based is that; it can be considered that the spatial proximity of females in this species implies a significantly inter-relationship (Poteaux C. B., 2009). This is why this analysis begins with the exploration and analysis of spatial positioning of these animals over the time.

One of the biggest advantages of this study is that it is based on very high amounts of data, with main datasets with more than 100 million rows (stored instances of data providing valuable information about features of our interest for the topic, such as positions in cartesian coordinates, time stamps, animals ID, weather, etc.). This allows the interaction and social behavior of animals to be quantified in a very correct and approximate way, unlike, for example, cases in which social behavior and interactions have to be quantified through observations a few times a day. (Nathan, 2022)

As a final comment to the introduction, let's keep in mind that the final target of this thesis is to analyze the big data set, and not to approach the general discussion of the outcome.

2.1 Research Questions:

This section describes the research questions that are intended to be addressed and a short description of their development.

- How are animals grouped? quantitative description of how much of their time each animal spent with other animals in the enclosure and in the same group of animals.
- How was the positioning of the groups depending on the climatic or temporal conditions in the enclosure?
- What climatic environmental factors have a greater or lesser influence on the movement and positioning of animals?
- What is the movement of animals like (in terms of displacement magnitude) under different temporal or climatic conditions?
- How does the structure and stability of groups change over time? Chronological and quantitative description of the formation of groups over time, considering the distances among all of them.

2.2 Abbreviations

There are 2 basic abbreviations crucial to follow the whole work. Both refer to areas of the research enclosure where the animals were, which are explained in detail in the following sections.

FG: area of the map with the 1st group of animals under study, it includes a pond on the reach of the telemetry.

VG: area on the map with the 2nd group of animals under study.

3 Method and materials

3.1 Methodology: Secondary data analysis

For the methodology, secondary data analysis has been used, since this methodology is the one that best adapts to the type of research that is desired to be done with the type of data available. The information available consists of a group of datasets of different types and sizes, all of them captured in a period of 3 years (2017-2019). Data collection was carried out in an enclosure in Austria in semi-natural conditions, with sensors in a group of 67 wild boars Sus Scrofa. The sensors were both in and on the animals, but also there were some sensors in the enclosure itself. It is understood then that the data was not collected by the author of this work, but was collected by third parties and the datasets are part of the material with which this work could be developed.

Heatmaps: heatmaps are used in different ways in this work. There are heatmaps showing magnitude of values in tables and there are heatmaps showing magnitude of time in different positions.

In the field of biology and some other related fields, heatmaps are widely used as a tool to find or identify hierarchical clusters in data sets (Engle, 2017).

Heatmaps have been used for more than a century (Engle, 2017). They visualize a data matrix by drawing or projecting a grid of columns and rows with values from the data matrix in it and coloring these cells according to the numerical value (Engle, 2017). Heatmaps allow the user to represent a large amount of data in a compact and understandable space (Engle, 2017).

For visualization, the heatmap is the most popular tool today by far. Since their use began to be implemented, until 2008, heatmaps had already been used in more than 4000 biological and biomedical publications (Weinstein, 2008). This tool is the result of more than a century of evolution of graphic visualization tools used and reviewed by statisticians, before and after the computational era (Wilkinson, 2009).

3.2 Materials

- ### 3.2.1 Overview and description of the enclosure

The information and datasets that were available consist of data on 2 different separated areas in 1 enclosure, one area that will be called FG and other area VG, both inside the research enclosure.

The data was collected within the FFG-project 855666 “Wildlife Management under climate change” for which a total of 67 sows were closely monitored between 2016 and 2019 (but the analysis goes from 2017-2019 due to the data amount and quality) via a Smartbow © telemetry system installed around the feeding zones of the 2 areas in the enclosure.

Research enclosure: The image is only a reference, part of the material that was supplied to carry out the research. The image shows the areas labels and their locations on the map as well as some elements in the enclosure.

The image is a map (aerial view) of the "research" enclosure. The orange circles show where there were sensor receptors towers.

Animals’ description: In the enclosure there were a total of 67 animals. Most of them were brought to the research enclosure at the approximate age of 6 months in the fall of 2011, they were born in April 2011 (Sebastian G. Vetter, 2016). Some animals from subsequent generations were left inside the enclosure. The number in the animal ID indicates the year of birth.

All animals were individually marked with ear tags (left ear: colored and numbered ear tag (Supertag Hog 55 mm x 50 mm) for visual observation; right ear: RFID I-Tag Button (diameter 25 mm) for recognition via an RFID reading station, both from Dalton, Lichtenvoorde, Netherlands) upon arrival. Both tags were applied with specific marking-pliers (Dalton, Lichtervoorde, Netherlands). Additionally, ID ISO-transponders (2 x 12 mm Virbac, Barnevelden, Netherlands or Dasmann Tecklenburg, Germany) were injected subcutaneously caudal/dorsal in the abdomen for life-long identification (Sebastian G. Vetter, 2016).

After 8 weeks of habituation, the animals were released pseudo randomly and only with respect to origin, body mass and stocking density into the two large experimental areas (FG, about 33 ha; VG, about 22 ha) In both areas, water, shelter and trees were available. Additionally, all animals had continuous access to an open water body allowing wallowing. Animals were monitored and supplementary fed on a daily basis (Sebastian G. Vetter, 2016).

The two experimental enclosures were very similar with respect to vegetation: an oak, Quercus cerris, dominated forest interspersed by some open areas (Sebastian G. Vetter, 2016).

As mentioned before, the data analysis for this study is from 2017-2019, when these introduced animals were adults already and had some subsequent generations.

Telemetry system: The enclosure was equipped with telemetry systems (Smartbow GmbH Austria, 2018) installed around the foraging areas. The telemetry system consisted of 10 receivers and, ear tags (34 g; 52 mm x 36 mm x 17 mm) collecting 3D- acceleration and temperature data at 1 Hz. The transmission was done through a wireless local area network (WIFI).

Each wild boar was identified by ear tag or, if lost, by scanning the RFID implant. After removing the old ear tag in the right ear, the Smartbow ear tag with a unique ID number and MAC-address was applied in the same place with special pliers.

The locations of the animals were recorded every 4 seconds if the animal was in reach of a receiver and active, and every 16 seconds when it was inactive.

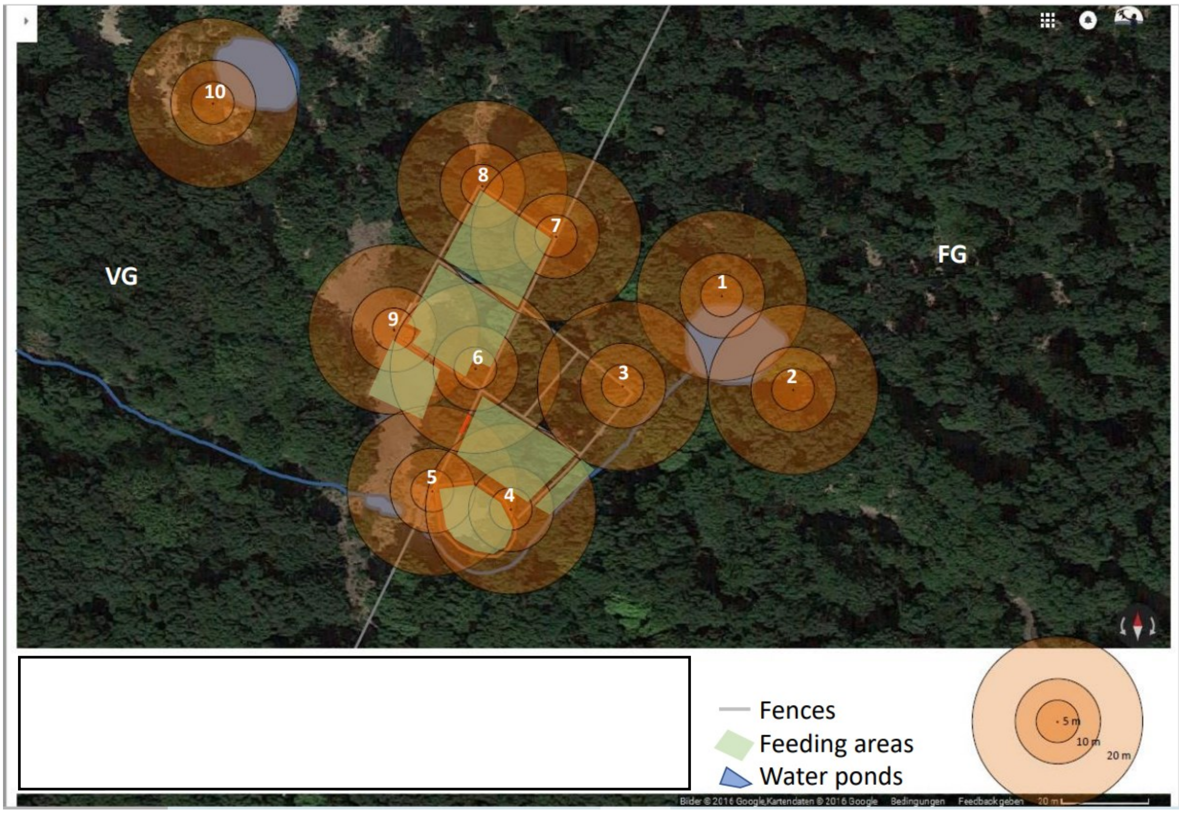


Figure 1: Research enclosure.

3.2.2 Description of the software used (Knime).

Knime is a data analysis tool that can be used with different objectives. It is a no-code tool that is very practical for data analysis without some of the technical complications that the use of a programming language represents. Despite having some disadvantages compared to the use of a programming language, Knime also has some features that could be taken advantage of for this research. Some of them are:

Operations: Data operations are managed as nodes, and these nodes are ready-made operations in which the parameters for the data operation can be changed or adjusted. In conjunction with the diagrams (explained below), the management of long projects is quite simple and visually light.

Flow diagrams: With the nodes, diagrams are built of the operations that are carried out step by step on the data, giving an excellent overview of how the operations are carried out and in what order, something that is visually very practical, since in this project the number of operations carried out with data was very large.

Disadvantage: being based on nodes that are prefabricated operations, sometimes it lacks some flexibility to do very specific operations with the data, however most of the time this can be resolved in some alternative way, although more operations may be needed than if only one operation was carried out with code in a personalized way.

3.2.3 Positions dataset (research enclosure)

This dataset contains information about the position of animals at a moment in time. The positions of the animals are given in “x” and “y” coordinates, and there is no identification of areas (where the animals are) in a discrete manner, so part of the work developed in this project consists of doing 3 different approaches to discretize the map in different areas and facilitate the task of observing and understanding positions in a more general and visible way.

Each of the 3 different approaches will be described in detail below, but it can be briefly mentioned that one is very general (the approach 1), it was done by creating a grid on the map and naming each of the areas, while the other 2 consider this same grid, but details of areas considered as feeding areas and eating areas are added.

The datasets shown in the materials section already show their final version after adding the discretization attributes. However, it is worth explaining this process, why it was done and how it was done, since the discretization is a very powerful tool in data analysis, easy to apply, and that greatly reduces the technical difficulty of an analysis with continuous data, providing realistic, easy to interpret, practical and useful solutions.

Size reduction: This dataset consisted of approximately 60 million records, with animals from the FG and VG areas. As mentioned before, the locations of the animals were recorded (frequency) every 4 seconds if the animal was in reach of a receiver and active, and every 16 seconds when it was inactive.

The first step to handle the dataset, was to make a reduction in its size, since this size represented a challenge for fast computational processing. According to the computational power available at the time of the analysis, the size of the dataset had to be approximately 10 times smaller than the original size.

There are several techniques to reduce the size of the data, most of them are based on statistical sampling that avoids losing much valuable information. But due to the nature of this study, and the level of detail and accuracy sought in data, it was better to develop our own technique to apply in this specific case, so that it would be known exactly, which information Is being discarded.

The technique works in this way; to reduce the size in an order of 10 times, it was considered appropriate to keep only 1 record every 10 minutes, since in the dataset there was approximately 1 record for every minute, for each animal (when there was good data quality). Thus, the position of the animal is known in average every 10 minutes, which is more than enough to plot its positions in an easily analyzable way. Thus, every 10 minutes the first record found is taken and kept, and the following records (if any) in those 10 minutes are discarded.

Example: in the following records, only Record 1 and 4 are kept in the final data set, 2 and 3 are discarded, since they are considered to already have their information and therefore are redundant.

Record 1 - Hour 17:20 - Animal X - Position X1Y1

Record 2 - Hour 17:23 - Animal X - Position X1Y1

Record 3 - Hour 17:25 - Animal X - Position X1Y1

Record 4 - Hour 17:30 - Animal X - Position X2Y2

Although it is true that periods of information are lost with this technique, its use was considered necessary. One option was to take into account all the information, all the rows of each instant of time, but this represents 2 problems, 1; The computational power was not enough to process all the data efficiently and quickly at the time of analysis. 2; The number of points (positions) obtained in periods of 10 minutes is not uniform in any way, that is, sometimes there is 1 record in 10 minutes, and other times there are many more, in no predictable order. Taking into account all the instances recorded in 10 minutes may have errors just by the adding of measurements. For example, to calculate the distance on a path with a curve, if only the beginning and end are taken, the distance will be that of a straight line, and if intermediate points are added along the curved path, the measurement becomes more accurate, but the magnitude of the measurement increases, this means that the greater the number of points, the magnitude of the measurement is affected, so the number of measurements taken into account has to be standardized to avoid it having an influence on the final value. A discussion could be hold about the most correct way to execute this operation, however, for practicality purposes, and due to the amount of data, it was decided to apply the technique in this way, thus homogenizing the number of measurements every 10 minutes to only 1 value.

The final size of the positions dataset of FG is 419770 instances (rows), and VG 615365 instances (rows).

Positions datasets FG and VG: The following description is of the FG area dataset, but is also valid for the VG area dataset, since their attributes are the same and they had the same data processing.

Columns	Value 1	Value 2	Value 3	Value 4	Value 5
timestampms	2017-02-13 17:23:00	2017-02-13 17:30:00	2017-02-13 17:40:00	2017-02-13 17:50:00	2017-02-13 18:00:00
tagid	44	44	44	44	44
MACadresse	147197	147197	147197	147197	147197
x-value	-63.35	-10.02	-10.52	-11.17	-9.45
y-value	23.66	36.16	42.23	42.28	38.93
ID	DE.2011.14	DE.2011.14	DE.2011.14	DE.2011.14	DE.2011.14
timedate	2017-02-13	2017-02-13	2017-02-13	2017-02-13	2017-02-13
hour	17:23:00	17:30:00	17:40:00	17:50:00	18:00:00
Time period	00:07	00:10	00:10	00:10	00:10
Minutes	6.999999991	10	10	10	10
Hours	0.116666667	0.166666667	0.166666667	0.166666667	0.166666667
Days	0.004861111	0.006944444	0.006944444	0.006944444	0.006944444
2-D (Distance)	54.77534938	6.090558267	0.651920241	3.765753577	3.89185046
Grid Areas	CD	AC	AC	AC	AC
Areas + Polygons+tri	CD	PO1.2	PO1.1	PO1.1	PO1.2
A+P+t general	CD	PO1	PO1	PO1	PO1
In/out grid areas	0	0	1	1	1
In/out A+P+t general	0	0	1	1	1
FA(ALL)	Out of FA	FA (2)	FA (2)	FA (2)	FA (2)
In/out FA	0	0	1	1	1

Figure 2: R.E. (FG) positions dataset

Description of the features from the position's datasets:

- Timestamps: date including year, month, day, hour and minute of the register. In the case of this set, these values may include minutes in the range from 1-10, and not only multiples of 10.
- Tagid: number referred to the tag of the animal.
- MACadresse: number referred to the tag of the animal.
- X value: coordinate x, position of the animal in a moment of time.
- Y value: coordinate y, position of the animal in a moment of time.
- ID: main id value used to identify the animal by name.
- Timedate: Date including year, month and day of the register.
- Hour: hour of the register
- Time period: Time period from the actual register, to the next register in chronological order, with no outliers (long periods of time due to missing data are not included). This Time period indicate also that the animal was in this area for this amount of time.

- Outliers found: periods of time too long, from where the animal was not detected a long period of time. These values were not taken into account, a period of 24 hours is the maximum span of time with no data before considering as missing data, if the span of time is bigger than this, the value was discarded.
- Minutes: Time period in units of minutes.
- Hours: Time period in units of hours.
- Days: Time period in units of days (unit used to calculate the heatmaps of positions).
- Grid areas: Areas from the discretization of the approach #1.
- Areas + Polygons + tri: Grid areas + the irregular polygons from the feeding areas of the discretization approach #2. This feature shows the parts of the polygon, not only the full polygon, for a more detailed analysis.
- A+P+t general: The Grid areas + the feeding areas (polygons). The polygons are 3, in this feature they are not detailed, the parts of the polygons are not indicated here.
- In/out Grid areas: Binary variable to indicate if the animal is still in the same area or it changed from area.
- In/out A+P+t general: Binary variable to indicate if the animal is still in the same area or it changed from area.
- 2-D distance: distance in Meters from current position to the next one.
- FA (ALL): Eating areas (exactly where the animals were eating) from the discretization approach #3.
- In/out FA (ALL): Binary variable to indicate if the animal is still in the same area or it changed from area.

- ### 3.2.4 Acceleration dataset

This is the largest dataset analyzed. It consisted of around 500 million rows, with information on the acceleration (changes in the speed of movement) of the animals in the 3 axis; x, y and z, as well as one absolute value, this information provided by a sensor. The biggest technical challenge was working with such a large amount of data, so to begin with, it was decided to reduce the data to a size that would be possible to work with at normal processing speed.

Size reduction: For the reduction, a logic similar to that of the "positions" dataset reduction was followed. It was reduced to have 1 data record for each animal, every 10 minutes (there were many more every 10 minutes). The difference with the positions is that the acceleration is a more dynamic measure, the acceleration at different moments of each 10 minutes is meaningful and can be very different from each other, depending on the moment of those 10 minutes that is taken into account.

Unlike the position dataset, with acceleration it was not the best option to allow the intermediate information between each of the records every 10 minutes to be lost. On the contrary, to achieve a better description, it was necessary to accumulate the information in some way so that it was a more continuous description and with the least loss of information possible. For this reason, it was concluded that the best way was to collect the information from each of the recorded moments and contain it in 1 record for every 10 minutes, but these 10 minutes record contain the information of everything that occurred within those 10 minutes.

The only feature taken into account for the reduction was the **absolute acceleration**, to ease the calculations and processing for an initial overview.

Basic statistical calculations were used that help contain information from several events in a single measurement. This is the case of mean, median, mode, min, max, variance, standard deviation and range. This calculation was the one that took the longest to execute in this entire study.

It is to be mentioned that, for this reduction were only the absolute acceleration was taken into account and not with the single axis's accelerations, that might contain valuable information also. This was done with the purpose of easing the calculations and processing for an initial overview.

Columns	Value 1	Value 2	Value 3	Value 4	Value 5
Groupby	1174182017-01-3118:0	1174182017-01-3121:1	1174182017-01-3121:2	1174182017-01-3122:4	1174182017-01-3122:5
ID	JG.2011.01	JG.2011.01	JG.2011.01	JG.2011.01	JG.2011.01
Tagmac	117418	117418	117418	117418	117418
Date	2017-01-31	2017-01-31	2017-01-31	2017-01-31	2017-01-31
Hour (+ 10min)	18:00	21:10	21:20	22:40	22:50
Mean(absoluteAcc)	1198.38075	1099.691944	1129.271277	1068.8065	1010.901
Median(absoluteAcc)	1238.247	1092.344	1077.835	1021.0755	1015.0805
Mode(absoluteAcc)	1295.308	1078.191	1069.609	938.151	951.159
Max(absoluteAcc)	1363.853	2388.399	2243.483	1315.897	1062.284
Min(absoluteAcc)	953.176	264.363	131.939	917.178	951.159
Range(absoluteAcc)	410.677	2124.036	2111.544	398.719	111.125
Variance(absoluteAcc)	32398.99539	40000.90135	119594.7736	34118.11978	2089.145645
Standard deviation(absoluteAcc)	179.9972094	200.0022534	345.824773	184.7109087	45.70717279

Figure 3: Acceleration dataset after its reduction

Description of the features from the acceleration's datasets:

- Groupby: Data key, used to handle the dataset, it provides the time stamp.
- ID: ID from the animal.
- Mean to Standard deviation: statistical measurements.
- Tagmac: Key used only to handling purposes.

- Date: date information.
- Hour (+10min): to which instance of every 10 min the record belongs to. The calculation of values takes into account all the values found in the hour indicated xx:xx and the next 10 minutes.

3.2.5 Climate dataset

The climate dataset is the smallest of the sets in terms of data size. Due to this, with this set it was not necessary to do any reduction. A join with the other sets was done to be able to add these attributes to the information of the other datasets.

However, data quality, speaking specifically of continuity in the existence of data over time, does present some problems, there are gaps in time without data. This can be seen in the results section, in heatmaps created to see distances traveled by animals and the weather at that time. Despite this, there is enough data to be able to do more specific analyzes with it. In the case of repeated features measured with different sensors, the ones with better data quality were taken for the heatmaps, the name of the feature considered is shown in every heatmap on the weather part.

Climate dataset for all the enclosures					
Columns	Value 1	Value 2	Value 3	Value 4	Value 5
Day of the Week	Sun	Sun	Sun	Sun	Sun
Date Time	2016/12/11 00:50:00	2016/12/11 01:00:00	2016/12/11 01:10:00	2016/12/11 01:20:00	2016/12/11 01:30:00
Outside Temperature TX4 (°C)	20.5	20.5	20.5	20.5	20.5
Outside Humidity TX4 (%)	35	35	35	35	35
Wind Speed TX4 (k/hr)	0	0	0	0	0
Dominant Wind Dir TX4					
Rain Amount TX4 (mm)	0	0	0	0	0
Solar Radiation TX4	0	0	0	0	0
Radio RSSI TX4	58	58	58	58	58
Outside Temperature TX5 (°C)	20.6	20.6	20.6	20.6	20.6
Radio RSSI TX5	58	58	58	58	58
Outside Temperature TX6 (°C)	20.3	20.3	20.3	20.3	20.3
Outside Humidity TX6 (%)	36	36	36	36	36
Radio RSSI TX6	58	58	58	58	58
Inside Temperature (°C)	20.6	20.6	20.6	20.6	20.6
Inside Humidity (%)	36	36	36	36	36
Barometric Pressure (mb)	1020.6	1020.5	1020.3	1020.2	1020
Receiver Battery Voltage (volts)	4.131	4.131	4.131	4.131	4.131

Figure 4: Climate dataset

- ### 3.2.6 Animals' general information document

In addition to the datasets, general information on the animals, biological data and historical records was used for the analysis. This information is of vital importance as it has a descriptive information of the animals and is key to being able to link, analyze and understand the datasets.

Columns	Value 1	Value 2	Value 3	Value 4	Value 5
ID	IS.2011.29	IS.2011.29	IS.2011.29	IS.2011.29	IS.2011.33
tag	rt02	rt02	rt02	rt02	rt06
color	rot	rot	rot	rot	rot
no.	2	2	2	2	6
implant-RFID	040098100291394	040098100291394	040098100291394	040098100291394	040098100302745
ear-RIFD	900002000215002	900024000684654	900024000684580		900002000215006
Smartbow No				0041	
Smartbow Mac				148743	
tag changed	2013-09	2014-09	2016-10		2016-11
origin	Confidential	Confidential	Confidential	Confidential	Confidential
born year	2011	2011	2011	2011	2011
born week	19	19	19	19	19
Datum weight					
dead/out	2020-01	2020-01	2020-01	2020-01	2018-12
Idfather	FI15	FI15	FI15	FI15	FI15
Idmother	MI1	MI1	MI1	MI1	MI1
sex	f	f	f	f	f
KG	12	12	12	12	12
enclosure	FG	FG	FG	FG	FG
in enclosure since	2011-12	2011-12	2011-12	2011-12	2011-12
hair	x	x	x	x	x
gen no.	48	48	48	48	52
notes					

Figure 5: General biological/historical information

Description of the features of the biological/historical data:

- ID: identification number of the animal. The number after the 1st point is the year of birth.
- Tag: is the short version of the visual ear tag consisting of the color (in German red=rot=rt) of the ear tag and the number printed on it.
- Implant RFID: It gives the RFID of the implanted RFID chip which was used to identify the animals if they lost their ear tags.
- Ear RFID: It is the RFID ear tag the animals had before it was exchanged with the Smartbow ear tag for the telemetry system.
- Smartbow No.: It is the 4-digit number printed on the telemetry ear tags.
- Smartbow MAC: It is the unique Media-Access-Control identifier of the hardware of the telemetry ear tag.
- Tag changed: date when a tag was changed. Important to know there is a change when this feature is used as a key to link tables.
- Origin: where the animals come from. Useful to know which animals are used to each other from the beginning.
- Death/out: date when the animal died or was taken out of the enclosure.
- ID father/mother: keys to identify the ascendency of the animal.
- Enclosure: area where the animal is, FG or VG.
- Gen no: key to genetics information (not used for this analysis).

3.3 Data preparation for the analysis

- ### 3.3.1 Positions data availability of the research area by individual in time.

A general observation of data quality was made, to understand how many animals there are with data, what time periods can be analyzed and what considerations must be taken at the time of analysis.

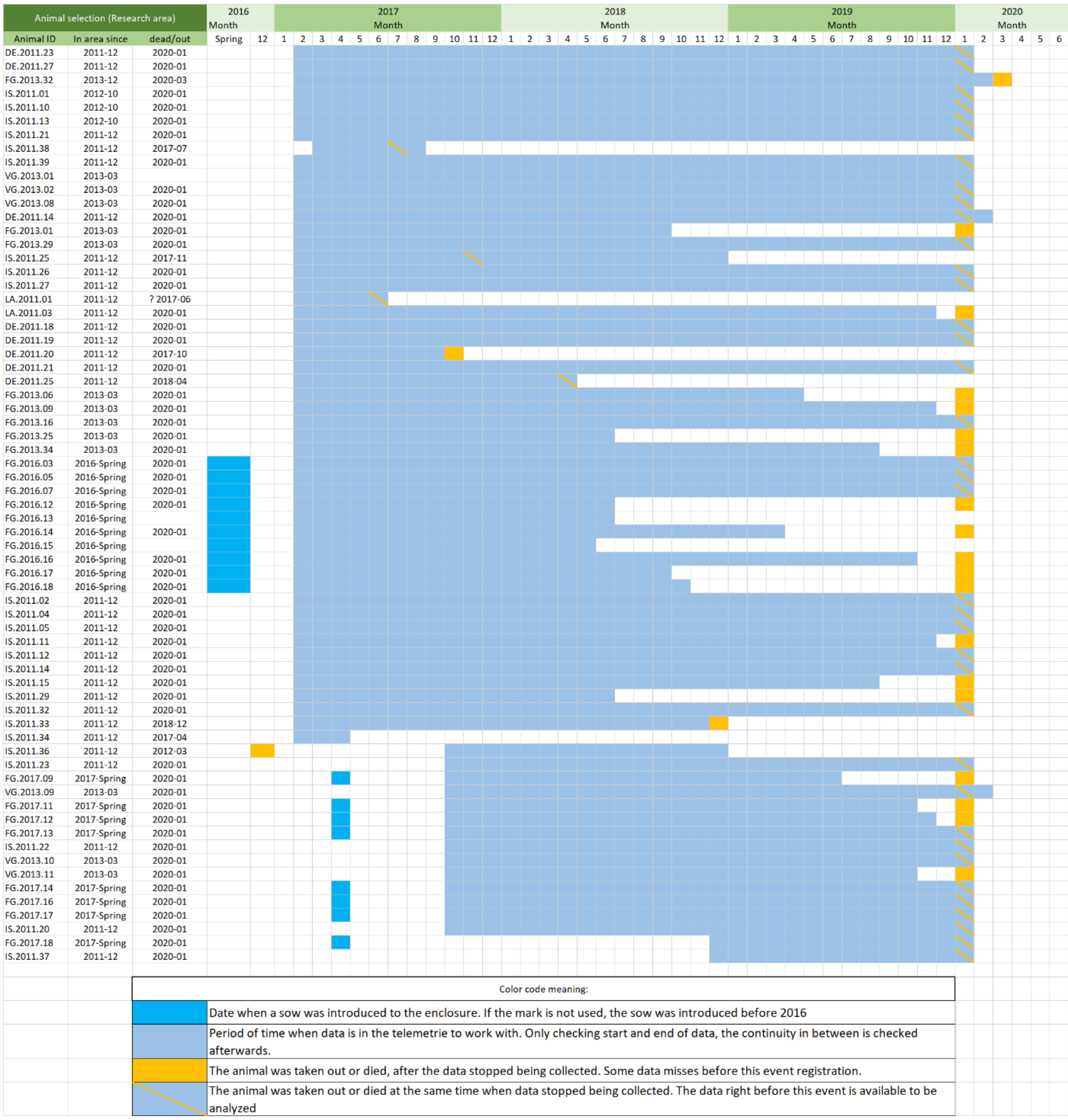


Figure 7: The figure shows all the animals (ID) registered in the research enclosure, record of entry and exit date and a timeline where the period of time each of the animals were in the enclosure can be seen and a contrast between the official in and out. This is the first general overview obtained from the data, made specifically to observe how the data quality and the content look like. The detailed analysis is done with other tools and approaches.

There are some discrepancies between official entry and exit records and the reality of data existence. There are too few cases that seem optimal for a "hunting effect" analysis. For this, in theory, the official date of the animal's death/exit record must coincide with the last date of data existence. But it is also ideal that the animal in this case has had a considerable permanence of time and good quality of data behind this event, in order to be able to visualize more about this animal before the event.

Many animals complete the 3-year cycle with good quality data, but not all, there are several cases where data is no longer available without the animal having been officially extracted. These are cases that are taken into account later, in the "group stability" section, to take certain animals into account only when data is available.

3.4 Discretizing the map by 3 different approaches

The justification to do a discretization of position's data is that it allows us to transform data or information that is available continuously, into discrete type information, which is much easier for the human mind to visualize.

The discretization in this work consists of 3 different approaches, the 1st is the most basic and general. The information on animal positions is given in the form of "x" and "y" coordinates in the position's dataset and the domain of the coordinate values is a rectangular area (the research enclosure). The first approach consists of dividing the map into smaller areas or zones, in order to assign a name to the area of the map where an animal is at a moment in time. The following approaches also use this process as a basis.

After assigning a name to the exact area of the map where an animal is located at a moment in time, this data is included in the positions dataset and is linked to the coordinates and to that specific time record. Thus, in any processing for subsequent analysis, the work can be done directly with the names (discrete data) of the zones instead of the coordinate values.

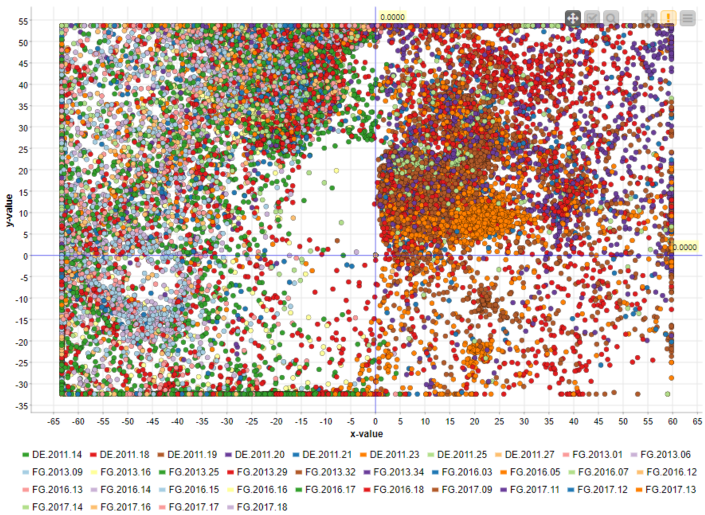


Figure 8: Animals positions with no filters. How the position's look in the raw dataset.

- ### 3.4.1 Overview of the map on the cartesian plane

To ease the visualization of the map, it was positioned on the cartesian plane using given coordinates as reference.

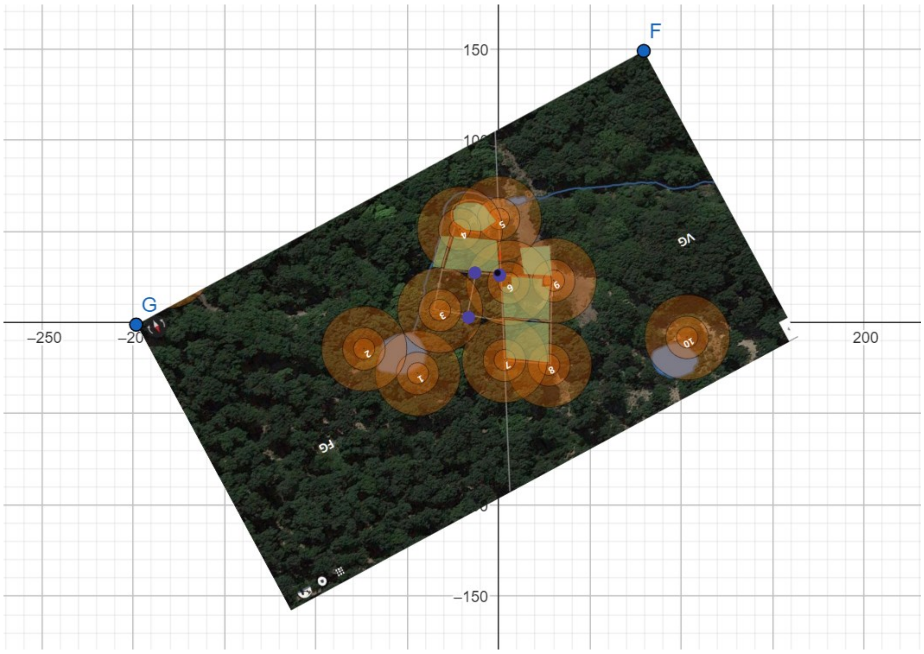


Figure 9: Research map over cartesian plane, only for reference.

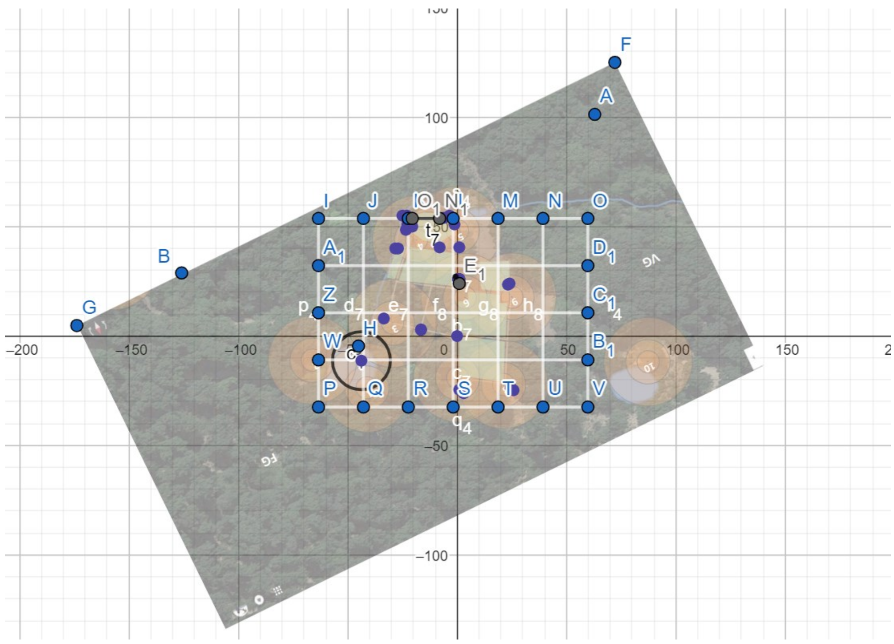


Figure 10: Grid on the cartesian plane. The figure shows the result of what the 1st approach grid looks like on the given map.

- ### 3.4.2 Discretization of the map approach 1 (Basic Grid):

Approach #1 is the most general of the 3, applying a simple division of the entire map to have zones of the same size. The advantage of this approach compared to the next two is that the results do not depend on the polygon traces and their accuracy with respect to the real feeding areas, but rather it allows a general visualization of the map, regardless of the traces made with fences in the enclosure. The disadvantage is the lack of accuracy in terms of more specific areas, however there are solutions to this.

Description of the grid on the map: There are coordinates and records of positions only within the white rectangle. The black circle is the position of the pond of the FG zone and the points indicated with letters and numbers are only objects that were used for the construction of the grid, they do not have a meaning of greater importance for this work.

The zones created and their assigned names are used throughout this thesis to perform position-based analyses. Each instant recorded in the datasets that include the positions coordinates, are linked to these areas, which record the position of an animal, in a specific area, according to the position given by "x" and "y".

Nomenclature of the zones:

Grid measurements:

B = 123 m, H = 86 m

Zones (24 in total) measurements:

B = 20.5 m, H = 21.5 m

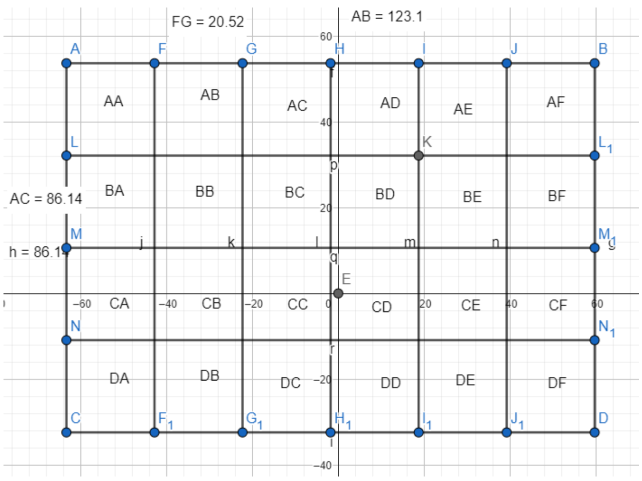


Figure 11: Discretization grid showing the names of the zones created.

Knime process: This section shows in detail what the process was to create the Grid of approach 1 (basic grid) in the position's dataset. Knime nodes were used, following the next steps:

NOTE: only this process in Knime is shown, as a sample of how the whole work was done. This is a crucial part, that's why it is shown in here, most of the rest of the works are described but not shown due to the size that it would need on the document.

Description: Both figures are part of the same flow of nodes, but the central part is not shown due to the space on the screen for the image. However, each row, or line, starts with a node named after one zone of the grid. This means we have 1 row of nodes, per each zone of the grid.

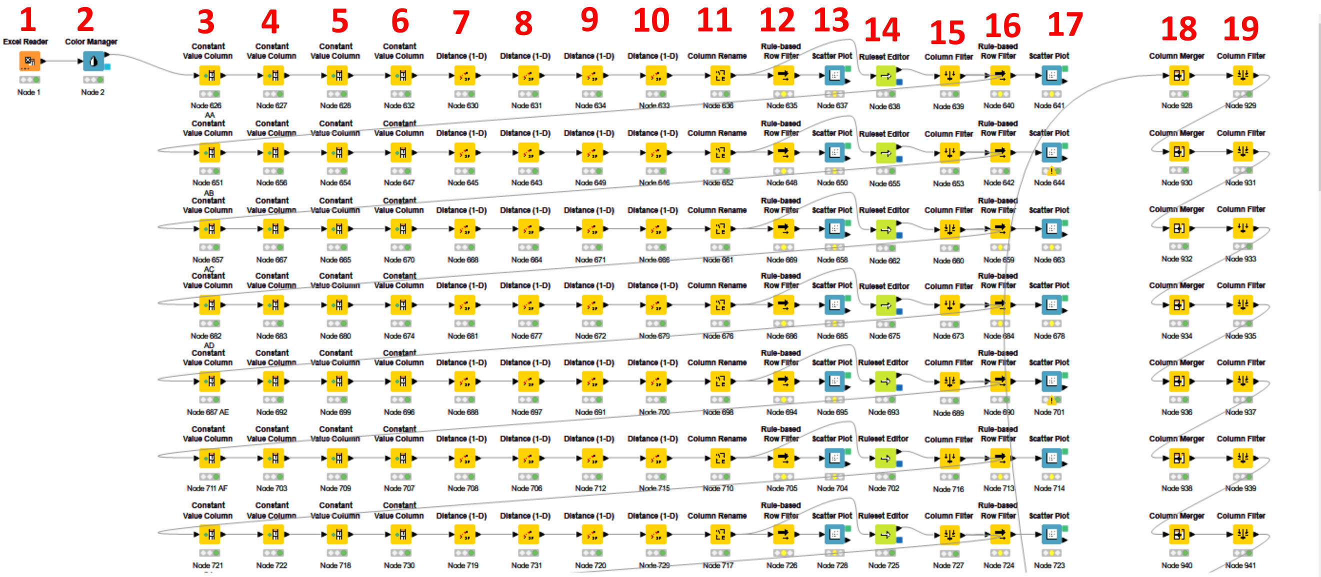


Figure 12: Nodes flow of the discretization of the basic grip, 1st part.

Continuation of the nodes flow...

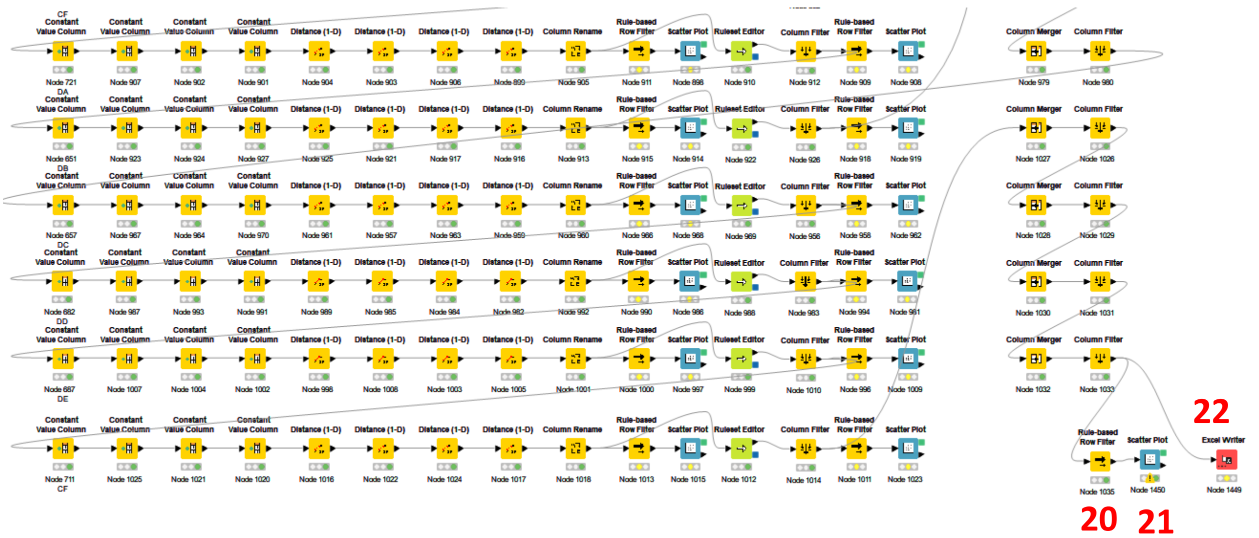


Figure 13: Nodes flow of the discretization of the basic grip, 2nd part.

1) Read the excel file with the dataset positions, animals from FG, and already reduced from size.

Row ID	I Column0	S timestampms	I tagid	I MACad...	D x-value	D y-value	S ID	S timedate	S hour	S combined ID date
Row0	1064	2017-05-25 01:04:00	44	147197	-19.51	28.03	DE.2011.14	2017-05-25	01:04:00	DE.2011.14,2017-05-25 01:00
Row1	1129	2017-05-25 01:10:00	44	147197	-19.48	28.27	DE.2011.14	2017-05-25	01:10:00	DE.2011.14,2017-05-25 01:10
Row2	1239	2017-05-25 01:20:00	44	147197	-19.26	28.65	DE.2011.14	2017-05-25	01:20:00	DE.2011.14,2017-05-25 01:20
Row3	1344	2017-05-25 01:30:00	44	147197	-20.38	29.01	DE.2011.14	2017-05-25	01:30:00	DE.2011.14,2017-05-25 01:30
Row4	1458	2017-05-25 01:40:00	44	147197	-21.17	25.24	DE.2011.14	2017-05-25	01:40:00	DE.2011.14,2017-05-25 01:40
Row5	4408	2017-05-28 16:26:00	44	147197	-23.91	-32.44	DE.2011.14	2017-05-28	16:26:00	DE.2011.14,2017-05-28 16:20

Figure 14: Table reading the node 1.

2) In order to prove step by step that the discretization is being done correctly, we assign color to the ID columns, so that every point (position) in a map, would look of a different color for every animal.

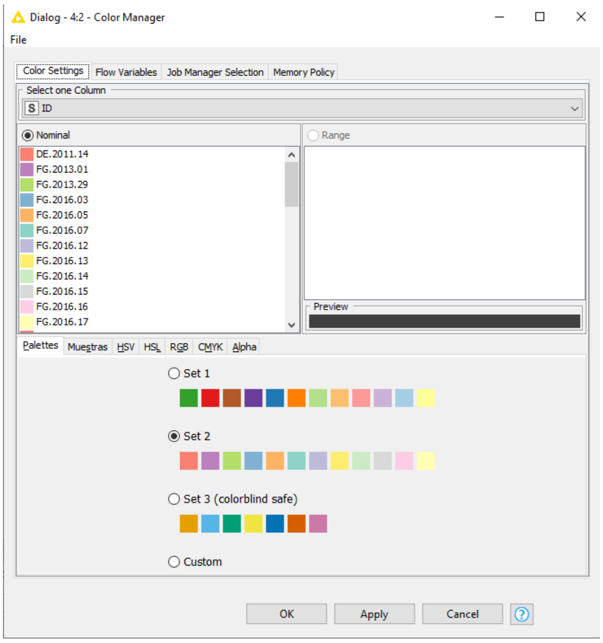


Figure 15: Node 2, adding color to the ID's column.

3) In this point, we start to build the zone (rectangle) that we want to discretize. We use the coordinates "x" and "y" given in the dataset, to measure the distance of a point (position) with the vortexes or lines of this rectangle. The coordinates of the axis are the result of basic analytics geometry calculations (step not shown in this work).

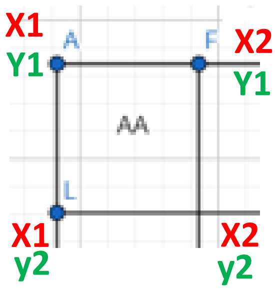


Figure 16: Section "AA" of the basic grid, with the names of its vortexes used for the distance's calculations in Knime.

The coordinates of the axis x1 are add to each row, in a new column:

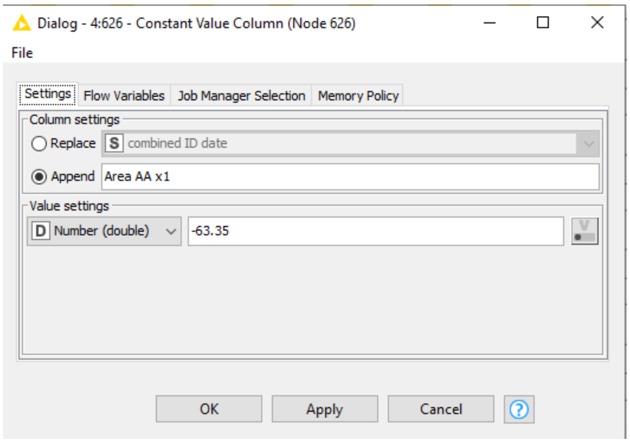
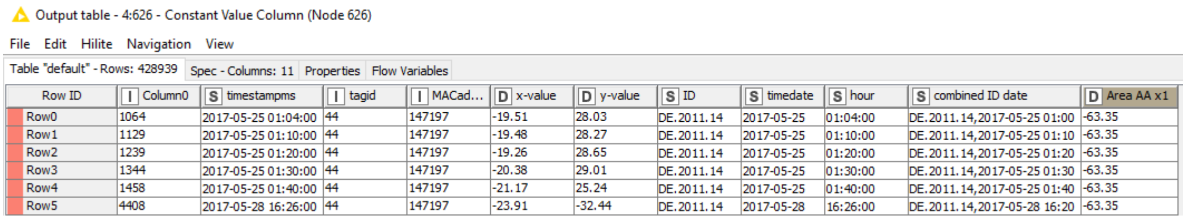


Figure 17: Shows the node adding of a column with a constant value in each row.



Output table - 4:626 - Constant Value Column (Node 626)

File Edit Hilite Navigation View

Table "default" - Rows: 428939 | Spec - Columns: 11 | Properties | Flow Variables

Row ID	I Column0	S timestampms	I tagid	I MACad...	D x-value	D y-value	S ID	S timedate	S hour	S combined ID date	D Area AA x1
Row0	1064	2017-05-25 01:04:00	44	147197	-19.51	28.03	DE.2011.14	2017-05-25	01:04:00	DE.2011.14,2017-05-25 01:00	-63.35
Row1	1129	2017-05-25 01:10:00	44	147197	-19.48	28.27	DE.2011.14	2017-05-25	01:10:00	DE.2011.14,2017-05-25 01:10	-63.35
Row2	1239	2017-05-25 01:20:00	44	147197	-19.26	28.65	DE.2011.14	2017-05-25	01:20:00	DE.2011.14,2017-05-25 01:20	-63.35
Row3	1344	2017-05-25 01:30:00	44	147197	-20.38	29.01	DE.2011.14	2017-05-25	01:30:00	DE.2011.14,2017-05-25 01:30	-63.35
Row4	1458	2017-05-25 01:40:00	44	147197	-21.17	25.24	DE.2011.14	2017-05-25	01:40:00	DE.2011.14,2017-05-25 01:40	-63.35
Row5	4408	2017-05-28 16:26:00	44	147197	-23.91	-32.44	DE.2011.14	2017-05-28	16:26:00	DE.2011.14,2017-05-28 16:20	-63.35

Figure 18: The table shows the result of the past step.

4) The coordinate of the axis y1 is add as a new column to all the rows.

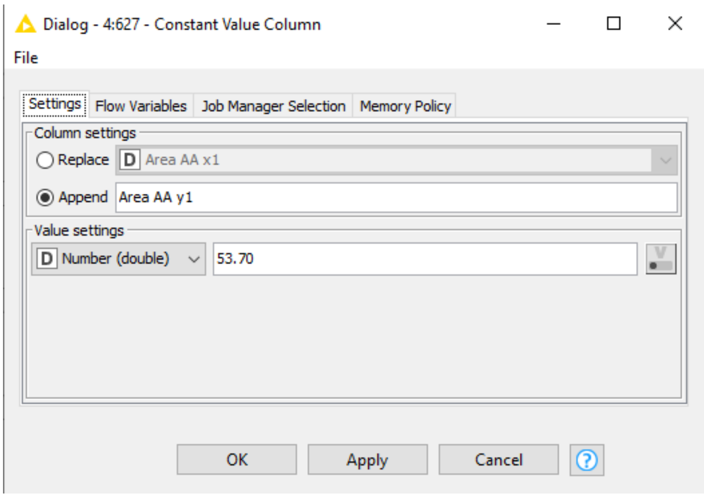


Figure 19: Shows the node adding of a column with a constant value in each row.

5) The coordinate of the axis x2 is add as a new column to all the rows.
6) The coordinate of the axis y2 is add as a new column to all the rows.
7) The distance between the coordinate "x" of the animal in a row and the vortex or side of the rectangle x1 is calculated.

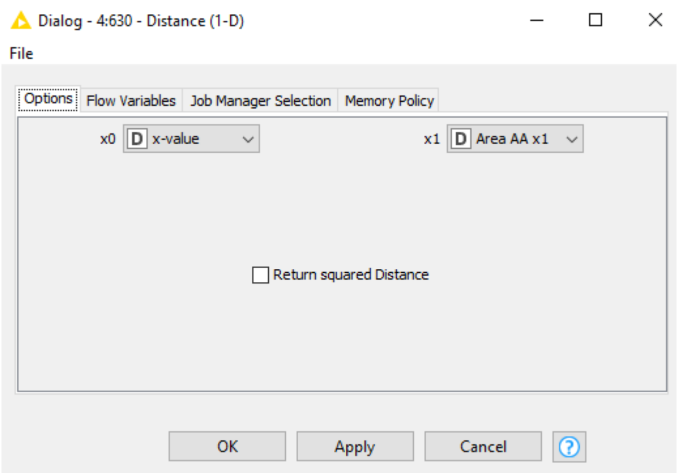


Figure 20: Shows the node selection of the 2 columns that will be used to calculate the distance between them.

8) The distance between the coordinate "x" of the animal in a row and the vortex or side of the rectangle x2 is calculated.
9) The distance between the coordinate "y" of the animal in a row and the vortex or side of the rectangle y1 is calculated.
10) The distance between the coordinate "y" of the animal in a row and the vortex or side of the rectangle y2 is calculated.
11) The results of the distances calculations nodes get a name in automatic, this node is to rename the columns, for an easier handling later on.

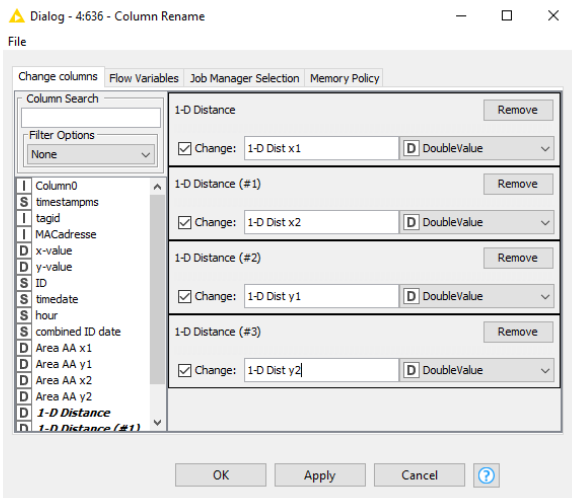


Figure 21: Renaming the columns.

12) This branch of the nodes is only to test that the past steps are working well and getting values. By using conditionals, this node filters in only the points inside the new rectangle (in this case "AA").

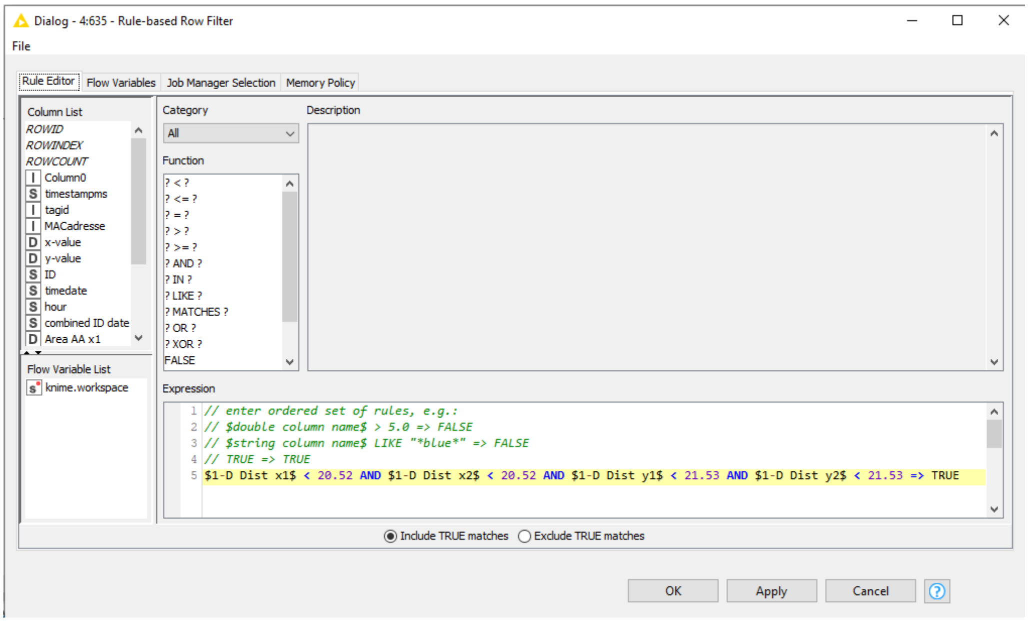


Figure 22: Conditional filter, to include or exclude rows. Node used only to test the results.

13) The values inside the new rectangle are displayed in a scatter plot. Again, this branch of nodes is only to test the results so far.
14) This node is filtering with the same criteria than the node 12, but in this case, the filtered in values will be assigned the name of the new zone "AA" in a new column.

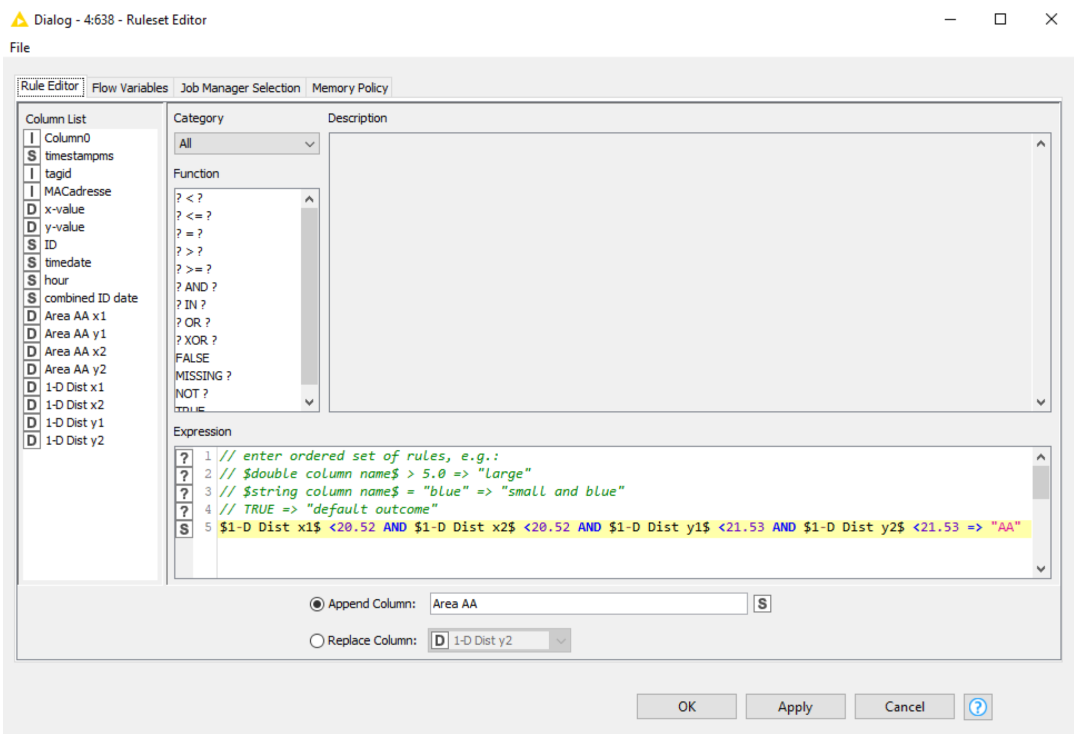


Figure 24: Node used to assign a name to rows that fulfill a conditional rule.

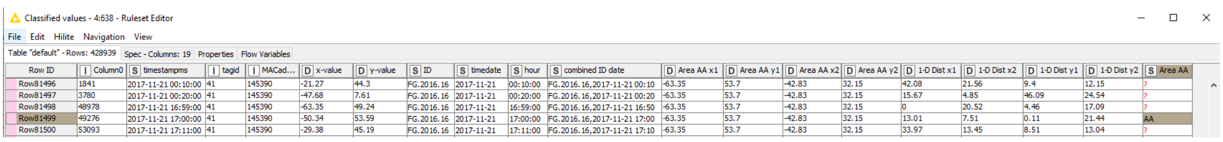

Classified values - 4:638 - Ruleset Editor

Table "default" - Rows: 428939 | Spec - Columns: 19 | Properties | Flow Variables

Row ID	Column0	timestampms	tagid	MACad...	x-value	y-value	ID	timedate	hour	combined ID date	Area AA x1	Area AA y1	Area AA x2	Area AA y2	1-D Dist x1	1-D Dist x2	1-D Dist y1	1-D Dist y2	Area AA
Row81496	1841	2017-11-21 00:10:00	41	145390	-21.27	44.3	FG.2016.16	2017-11-21	00:10:00	FG.2016.16,2017-11-21 00:10	-63.35	53.7	-42.83	32.15	42.08	21.56	9.4	12.15	?
Row81497	3780	2017-11-21 00:20:00	41	145390	-47.68	7.61	FG.2016.16	2017-11-21	00:20:00	FG.2016.16,2017-11-21 00:20	-63.35	53.7	-42.83	32.15	15.67	4.85	46.09	24.54	?
Row81498	48978	2017-11-21 16:59:00	41	145390	-63.35	49.24	FG.2016.16	2017-11-21	16:59:00	FG.2016.16,2017-11-21 16:50	-63.35	53.7	-42.83	32.15	0	20.52	4.46	17.09	?
Row81499	49276	2017-11-21 17:00:00	41	145390	-50.34	53.59	FG.2016.16	2017-11-21	17:00:00	FG.2016.16,2017-11-21 17:00	-63.35	53.7	-42.83	32.15	13.01	7.51	0.11	21.44	AA
Row81500	53093	2017-11-21 17:11:00	41	145390	-29.38	45.19	FG.2016.16	2017-11-21	17:11:00	FG.2016.16,2017-11-21 17:10	-63.35	53.7	-42.83	32.15	33.97	13.45	8.51	13.04	?

Figure 23: Table showing the result from last step.

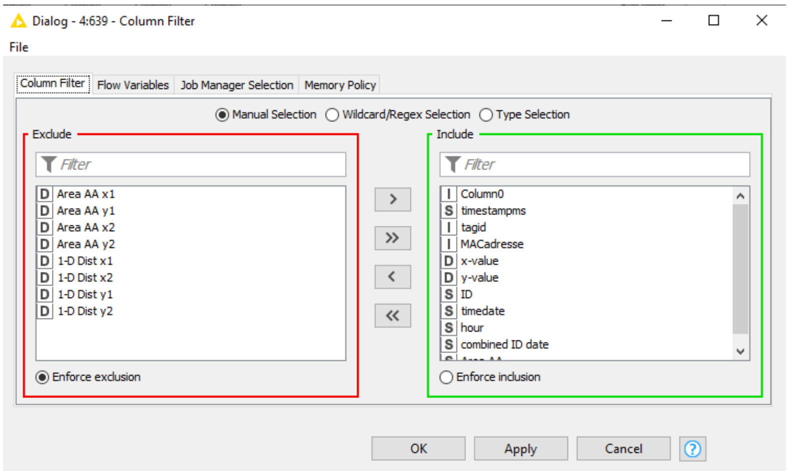
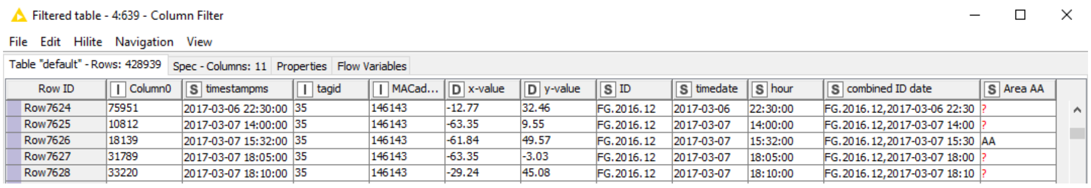


Figure 25: Filtering out columns that were made in the process, but are no longer necessary.



Row ID	I Column0	S timestampms	I tagid	I MACad...	D x-value	D y-value	S ID	S timedate	S hour	S combined ID date	S Area AA
Row7624	75951	2017-03-06 22:30:00	35	146143	-12.77	32.46	FG.2016.12	2017-03-06	22:30:00	FG.2016.12,2017-03-06 22:30	?
Row7625	10812	2017-03-07 14:00:00	35	146143	-63.35	9.55	FG.2016.12	2017-03-07	14:00:00	FG.2016.12,2017-03-07 14:00	?
Row7626	18139	2017-03-07 15:32:00	35	146143	-61.84	49.57	FG.2016.12	2017-03-07	15:32:00	FG.2016.12,2017-03-07 15:30	AA
Row7627	31789	2017-03-07 18:05:00	35	146143	-63.35	-3.03	FG.2016.12	2017-03-07	18:05:00	FG.2016.12,2017-03-07 18:00	?
Row7628	33220	2017-03-07 18:10:00	35	146143	-29.24	45.08	FG.2016.12	2017-03-07	18:10:00	FG.2016.12,2017-03-07 18:10	?

Figure 26: Table showing the result of the past step, filtering columns.

16) This branch of nodes is to test the result of the line of nodes. This node is to filter in the values of some selected new zones/areas, that are already discretized.

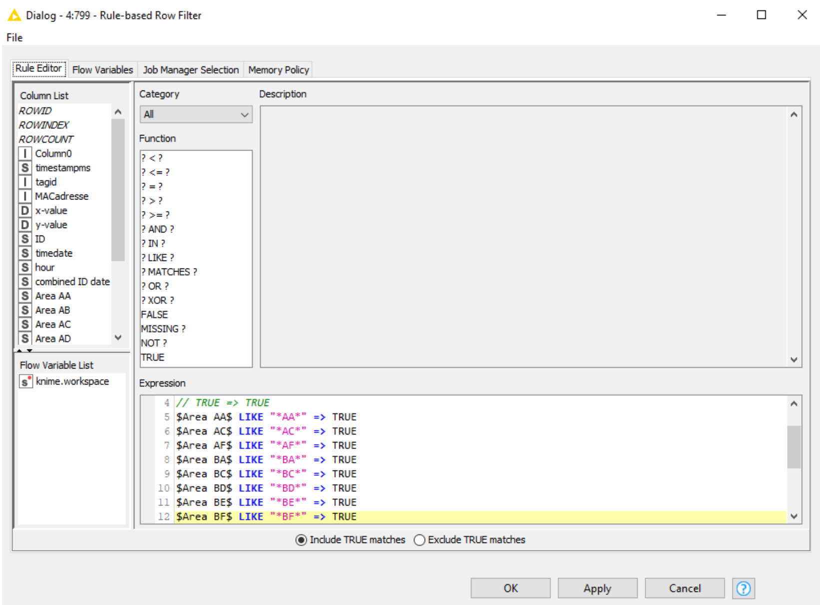


Figure 27: Node for testing several conditionals at the same time. This step is done after all these areas were already developed. This example is NOT from the 1st line of nodes shown in the flow.

17) Result on a scatter plot of the filtering in the node 16. Testing if the grid is being built correctly.

Figure 28: Scatter plot to show the results of last step. This step is done after all these areas were already developed. This example is NOT from the 1st line of nodes shown in the flow.

18) The new discretized zones are being shown each one in a different column. This node combines 1 column with another column, resulting in a new column that includes both.
19) This node deletes the columns used in the node 18, and only leave the new one.
20) Testing filter.
21) Testing scatter plot.
22) The final archive is ready, with all the new zones assigned. This node exports the file.

Filtered table - 4:1033 - Column Filter

File Edit Hilite Navigation View

Table "default" - Rows: 428939 | Spec - Columns: 11 | Properties | Flow Variables

Row ID	Column0	timestampms	tagid	MACad...	x-value	y-value	ID	timedate	hour	combined ID date	Zones (FG)
Row6	4732	2017-05-28 16:30:00	44	147197	-23.06	-32.44	DE.2011.14	2017-05-28	16:30:00	DE.2011.14,2017-05-28 16:30	DB
Row7	5475	2017-05-28 16:40:00	44	147197	-9.6	37.55	DE.2011.14	2017-05-28	16:40:00	DE.2011.14,2017-05-28 16:40	AC
Row8	5849	2017-05-28 16:50:00	44	147197	-32.77	24.69	DE.2011.14	2017-05-28	16:50:00	DE.2011.14,2017-05-28 16:50	BB
Row9	6202	2017-05-28 17:00:00	44	147197	-15.08	50.16	DE.2011.14	2017-05-28	17:00:00	DE.2011.14,2017-05-28 17:00	AC
Row10	6498	2017-05-28 17:10:00	44	147197	-17.54	53.7	DE.2011.14	2017-05-28	17:10:00	DE.2011.14,2017-05-28 17:10	?

Figure 29: Table showing the final result of the discretization.

- 3.4.3 Discretization of the map approach 2 (polygons from coordinates):

For this approach, the Ap1 zones were used and some new areas were added that are based on information about where the feeding areas were, which were delimited onsite by fences.

Polygons for the approach 2: A segmentation of areas was carried out that includes 2 irregular polygons (marked in blue) and 1 circle as part of the areas where the animals are located, this in addition to the area outside these 3 figures. The 2 irregular polygons are areas delimited by fences that were planned to be the areas where the animals would be feed. The circle indicates the location of the pond.

In the following image the polygons are placed on the aerial image of the "research" enclosure, however this is only done as a reference, the vertices of the polygon are not defined using the aerial image, but rather coordinates provided with the starting material for this project.

In the dataset these 3 zones can be found as P1, P2 and P3. It is worth mentioning that the FG animals only had the opportunity to move in P1 and P3 (pond), since P2 is only for animals belonging to VG.

The coordinates for the construction of these polygons were obtained from the initial materials given for the project and were not obtained in the field by the author of this work. Therefore, the analysis of these polygons and results is limited to what can be observed with the given coordinates.

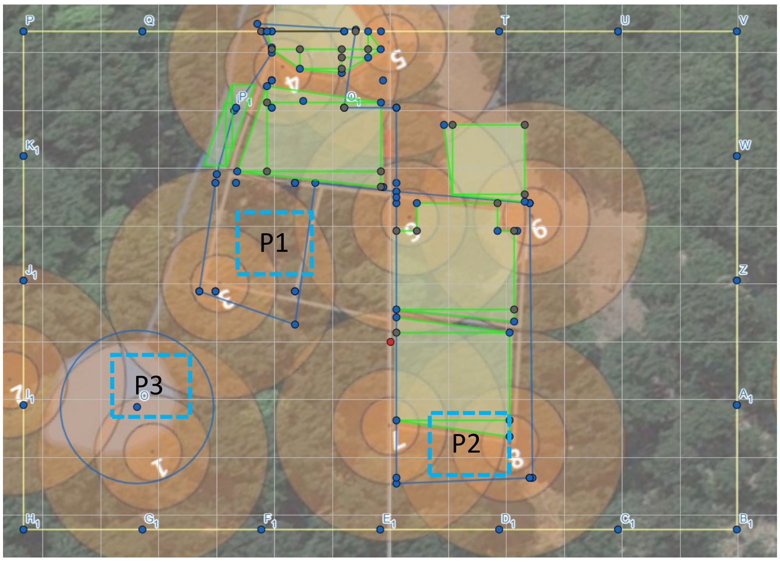


Figure 30: Polygons on the map. Blue is for polygons of approach #2 and green is for polygons of approach #3.

Filtering with approach 2: The following figure shows how the zone delimitations look like with the approach #2. The image shows the first 10 thousand values of the raw position dataset, and represents them as colored points in the image. Each animal is assigned a different color and only points are shown within the P1, P2 and P3 zone.

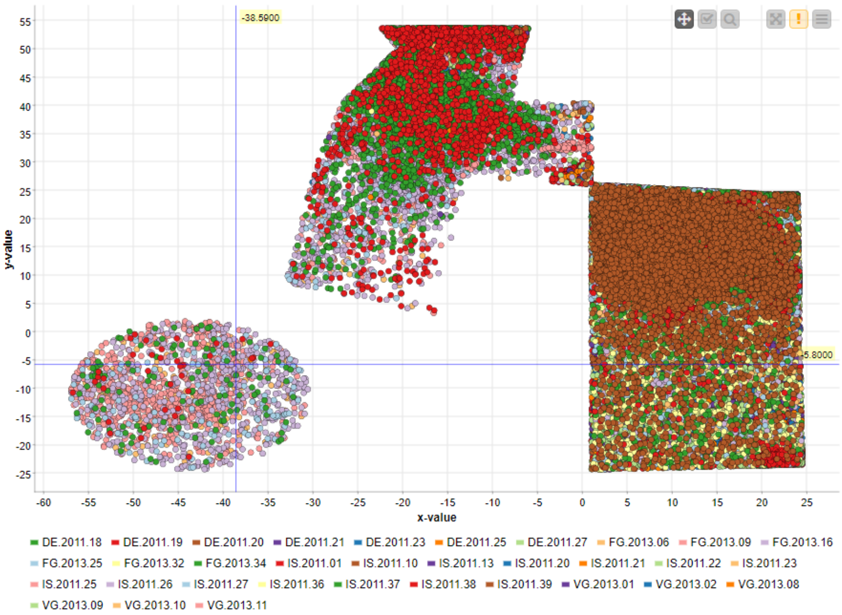


Figure 31: Animals positions filtered by polygons from the approach #2.

- ### 3.4.4 Discretization of the map approach 3 (polygons from map):

Approach 3 focuses on adding areas to the Ap1 grid that are called eating areas, that is, exactly the areas where the animals ate. Unlike the first 2 approaches, in this one the map is used as the origin to locate coordinates of the delimitation of the zones.

Polygons for the approach 3: The polygons created for the development of this approach are the green ones in the following figure. In total 3 irregular polygons were defined, although in the image polygon 2 and 3 have partitions within their bodies, in the final design these spaces are incorporated as part of the polygon, so there are 3 complete polygons. The numbers in the yellow boxes indicate the polygon number to which that area belongs.

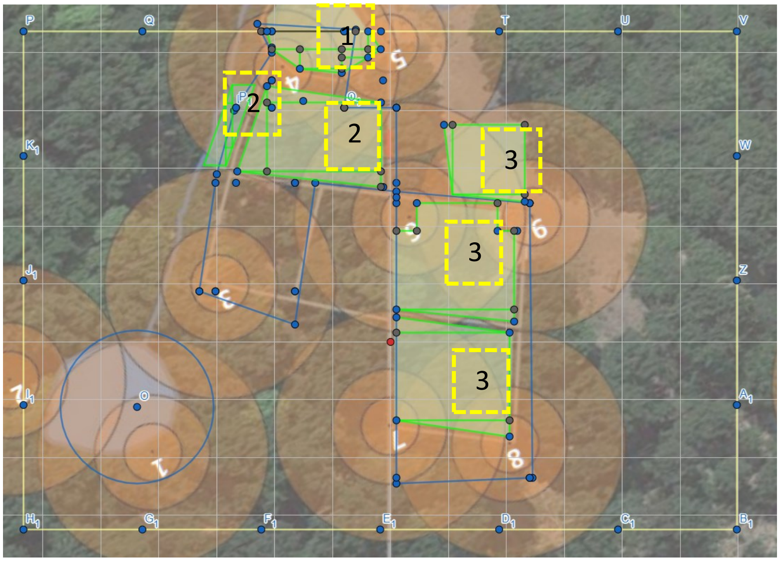


Figure 32: Eating areas polygons numbering for approach #3.

Filtering with approach 3: Below are 2 examples of how the result is seen in the map of animals located within the FA zones, the filter used is random, only to achieve a visualization of the result obtained after filtering with FA (1,2,3).

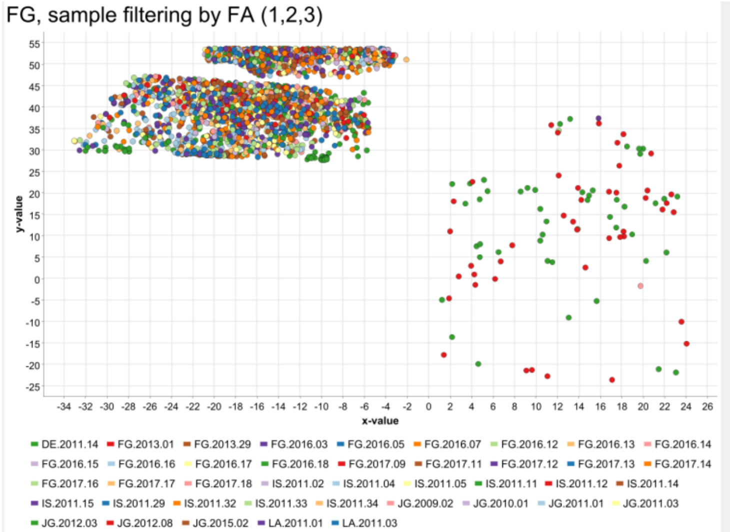


Figure 33: Sample of how the map looks filtering by FA (1,2,3) for FG set, approach #3.

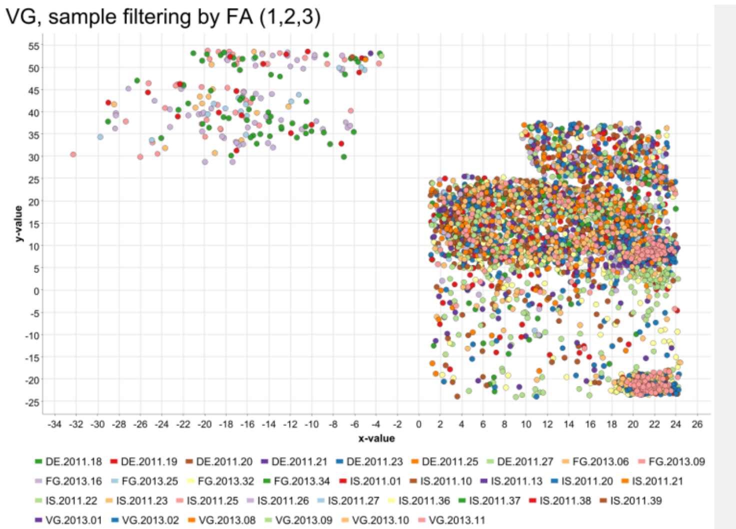


Figure 34: Sample of how the map looks filtering by FA (1,2,3) for VG set, approach #3.

3.5 Building the position's Heatmaps

Using the results of the discretization of the 3 approaches, this section shows the steps for the construction of heatmaps. Of the 3 approaches, 1 has been chosen to do the rest of the analysis based on it. This depends on how practical and functional the heatmaps made with the different approaches are for analysis.

The results, final visualization and end form of these heatmaps is shown in the section of "analysis and results (positions perspective).

NOTE: Some animals were excluded from these position heatmaps due to the low data quality they showed during the analysis (in the "Km" distance heatmaps they are indeed taken into account). It was decided to keep only the animals that were most decisive in the groups found later in the "group classification" section. The exclusion is justified, since the very low amount of data on these animals would not make any difference in the results, but it is of our interest to observe the group trend in the long term, for which is necessary to consider animals with good data quality during a relatively long period of time. ***The full list of animals used for the study in FG and VG can be found in the section "Animal's group classification". The 2 time matrixes there show the 34 (FG) and 33 (VG) animals' content in the datasets and analyzed.***

The animals excluded from FG are:

FG.2013.29, DE.2011.14 and FG.2013.01.

The animals excluded from VG are:

IS.2011.38, FG.2013.06, FG.2013.09, FG.2013.25, FG.2013.16 and FG.2013.34.

- ### 3.5.1- 1st approach Heatmaps

NOTE: this approach was SELECTED to be used in the following steps of the analysis.

FG zones heatmap (VG´s procedure is not shown, but follows same logic as FG): One of the main tools of this thesis is the heatmap. For this section of the analysis (positional heatmaps), heatmaps are made in 2 steps. First with the creation of a table that includes a color scale, and this is already a heatmap in itself, but with the values shown in the form of cells and columns. In the 2nd stage, the visual representation already shows a more compact and understandable result, since it is already a simulation of a map with Cartesian properties.

The 2nd step depends completely on the 1st step of the heatmap, so it is important to review how the 1st step is created and how the data is displayed in this part.

In the tables (figures) of the 1st step, the columns are aligned in such a way that the FG zones are on the left side of the table and the VG zones are on the right side of the table. This is a simple format to allow a better visualization of the FG and VG zones separately, otherwise it could be more difficult to see the trends.

1st step: The table shows in the columns the created zones of the grid, while in the rows it shows the animal IDs of the animals that were officially registered in the FG/VG zone. The values are relatives to each animal, it indicates the percentage % of time that each animal spent in each zone, taking into account only the total amount of time that each animal was in the enclosure. So, the summatory of the values of each animal (the summatory of each row) is = 100%. Therefore, the scale color white – yellow – red compares all the values of the table together. This way it's being considered the different total amount of time that each animal spent in the enclosure.

The AC zone shows a very high influence on the values, since most of the highest values are found in this column. It is to remember that these animals are in a semi-natural environment, so this is surely a result of the animals' visits to feeding areas. However, this high influence makes it difficult to see other trends on the map.

There are some values of a few animals out from the FG zone, that is, within the VG zone. This is normal, since some were changed of area when they were very young. It must also be taken into account that the areas of the grid are divided geometrically, and not dependent on real elements on the map. This means that although the central fence that divides FG and VG on the "y" axis makes a good approximation of being "central", it is not exactly dividing according to the fences onsite, and when animals are close to the center, they may be invading areas that in theory belong to the other side. These details are omitted because they are part of big data and are presumably negligible values.

	Grid areas, FG set																						
ID Sow	AA	AB	AC	BA	BB	BC	CA	CB	CC	DA	DB	DC	AD	AE	AF	BD	BE	BF	CD	CE	CF	DD	DE	DF
FG.2016.03	3.73	15.65	52.19	2.58	4.41	2.57	7.58	1.96	0.40	2.59	2.34	2.73	0.92	0.00	0.00	0.09	0.07	0.01	0.00	0.00	0.00	0.17	0.00	0.00
FG.2016.05	4.91	16.67	53.44	3.53	3.91	3.60	6.07	1.63	0.51	1.89	1.81	1.28	0.51	0.00	0.00	0.02	0.16	0.00	0.00	0.00	0.00	0.08	0.00	0.00
FG.2016.07	7.15	15.81	51.69	6.20	4.14	6.57	3.62	1.62	0.43	0.60	0.84	0.46	0.43	0.02	0.00	0.22	0.18	0.00	0.00	0.00	0.00	0.02	0.00	0.00
FG.2016.12	2.76	15.64	35.85	8.95	7.10	1.95	10.89	3.07	0.04	5.69	4.59	1.52	0.57	0.00	0.37	0.10	0.00	0.00	0.00	0.00	0.00	0.91	0.00	0.00
FG.2016.13	3.54	14.60	27.95	7.42	6.51	3.02	14.28	2.88	0.37	10.04	5.60	2.27	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	1.50	0.00	0.00
FG.2016.14	6.87	16.02	30.96	7.86	4.88	2.08	11.58	3.81	0.31	7.21	4.71	2.08	1.20	0.00	0.00	0.11	0.13	0.00	0.02	0.00	0.00	0.16	0.01	0.00
FG.2016.15	3.08	14.02	31.38	10.85	7.65	2.88	12.49	1.58	0.24	7.81	4.85	2.52	0.00	0.00	0.00	0.13	0.00	0.00	0.01	0.00	0.00	0.49	0.00	0.00
FG.2016.16	6.71	23.71	27.60	7.12	7.95	2.78	9.59	3.99	0.06	5.45	3.59	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
FG.2016.17	4.24	14.65	28.96	12.62	6.18	3.98	11.04	3.51	0.06	6.36	4.79	2.25	0.01	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	1.33	0.00	0.00
FG.2016.18	3.70	14.88	32.59	8.64	7.69	1.66	13.84	2.46	0.10	7.71	4.01	2.00	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.08	0.00	0.61	0.00	0.00
FG.2017.09	4.86	15.10	36.80	7.60	7.32	2.45	9.47	3.36	0.12	6.30	4.07	2.13	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00
FG.2017.11	8.17	14.32	24.51	6.45	7.06	2.52	9.08	4.54	1.98	6.54	9.33	4.44	0.11	0.00	0.00	0.10	0.00	0.00	0.26	0.00	0.00	0.58	0.00	0.00
FG.2017.12	8.10	14.57	23.61	7.61	5.22	2.54	7.92	4.30	2.52	7.94	10.80	4.31	0.16	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00
FG.2017.13	5.13	16.34	25.12	6.34	7.18	2.76	7.29	4.17	3.30	7.15	11.17	3.44	0.11	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.50	0.00	0.00
FG.2017.14	1.21	8.40	28.11	2.03	5.43	7.41	3.52	4.93	0.81	9.03	16.28	10.50	0.86	0.00	0.00	0.21	0.04	0.00	0.01	0.00	0.00	1.20	0.00	0.00
FG.2017.16	1.50	7.17	24.08	1.58	5.12	8.32	4.37	5.37	1.01	10.09	16.41	13.28	0.70	0.00	0.00	0.17	0.03	0.00	0.07	0.00	0.00	0.73	0.00	0.00
FG.2017.17	1.09	7.76	29.20	2.23	5.54	8.97	2.82	4.72	1.07	8.91	14.51	11.28	0.47	0.00	0.00	0.28	0.04	0.00	0.02	0.00	0.00	1.10	0.00	0.00
FG.2017.18	5.00	16.62	40.22	6.45	5.35	3.10	9.85	3.16	0.43	3.10	4.62	1.82	0.25	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
IS.2011.02	4.31	14.90	55.11	3.57	4.70	3.27	4.75	1.52	0.52	1.94	1.26	1.96	1.53	0.00	0.00	0.05	0.05	0.12	0.12	0.00	0.00	0.32	0.00	0.00
IS.2011.04	9.73	19.36	40.24	8.38	5.17	2.69	5.17	2.00	0.65	2.68	1.87	1.02	0.55	0.00	0.00	0.30	0.06	0.00	0.02	0.00	0.00	0.11	0.00	0.00
IS.2011.05	3.01	14.15	54.33	3.17	4.81	4.86	5.84	2.27	0.52	2.59	1.39	1.83	0.36	0.13	0.00	0.16	0.03	0.00	0.01	0.00	0.00	0.54	0.00	0.00
IS.2011.11	6.35	12.52	26.46	6.06	22.25	3.98	3.94	2.05	2.82	1.62	2.33	1.65	1.06	0.06	0.02	1.93	0.88	0.48	1.32	0.52	0.60	0.50	0.47	0.14
IS.2011.12	2.08	8.96	32.12	3.46	3.50	1.14	4.34	1.03	0.52	1.54	1.75	2.84	8.50	2.43	1.88	4.02	2.61	2.42	2.45	2.09	2.53	4.86	1.67	1.29
IS.2011.14	2.94	13.48	60.13	3.33	3.87	2.72	4.94	1.74	0.47	1.40	1.80	1.77	0.61	0.00	0.00	0.18	0.00	0.00	0.27	0.00	0.00	0.34	0.00	0.00
IS.2011.15	7.30	14.60	52.33	6.26	4.96	5.25	4.89	1.17	0.51	0.75	0.81	0.62	0.49	0.00	0.00	0.02	0.02	0.00	0.01	0.00	0.00	0.01	0.00	0.00
IS.2011.29	6.64	15.65	22.97	10.21	5.16	0.95	18.19	2.56	0.01	10.15	4.96	2.15	0.02	0.00	0.00	0.22	0.00	0.00	0.05	0.00	0.00	0.13	0.00	0.00
IS.2011.32	5.10	14.39	37.05	7.74	5.14	2.57	10.15	2.80	0.22	6.52	5.30	2.28	0.20	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.36	0.01	0.00
IS.2011.33	7.52	12.78	26.44	10.83	5.17	1.62	13.05	4.07	0.20	6.84	8.31	2.16	0.62	0.00	0.00	0.10	0.17	0.00	0.00	0.00	0.00	0.07	0.04	0.00
IS.2011.34	3.65	30.78	30.12	4.55	1.83	0.08	9.86	0.77	0.26	6.79	8.68	2.57	0.02	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
LA.2011.01	3.15	21.84	37.39	8.32	5.37	1.48	12.00	1.72	2.06	2.95	2.91	0.57	0.02	0.00	0.00	0.04	0.00	0.02	0.04	0.00	0.00	0.13	0.00	0.00
LA.2011.03	9.98	15.63	17.96	8.41	4.92	5.20	9.02	3.94	1.69	6.48	10.22	5.36	0.10	0.03	0.00	0.06	0.03	0.00	0.28	0.00	0.00	0.68	0.00	0.00

Figure 35: Positions heatmap (FG) step 1

2nd step (visualization improved): This overview is after eliminating values in the zones or columns of “AB” and “AC” in FG and “BD” in VG, which were zones of very high influence and their presence does not allow trends in other zones to be displayed correctly, in addition to the fact that it can be assumed that they are feeding zones.

Removing data from zones of high influence (due to feeding) allows for a better appreciation of all other non-eating zones. There are some trends that can be observed, but it is not very clear or easy to see trends with the naked eye, which is why the 2nd step is carried out to improve visibility and be able to obtain better conclusions.

Grid areas without AB and AC, FG set.																							
ID Sow	AA	AB	AC	BA	BB	BC	CA	CB	CC	DA	DB	DC	AD	AE	AF	BD	BE	BF	CD	CE	CF	DD	DE	DF
FG.2016.03	3.73			2.58	4.41	2.57	7.58	1.96	0.40	2.59	2.34	2.73	0.92	0.00	0.00	0.09	0.07	0.01	0.00	0.00	0.00	0.17	0.00	0.00
FG.2016.05	4.91			3.53	3.91	3.60	6.07	1.63	0.51	1.89	1.81	1.28	0.51	0.00	0.00	0.02	0.16	0.00	0.00	0.00	0.00	0.08	0.00	0.00
FG.2016.07	7.15			6.20	4.14	6.57	3.62	1.62	0.43	0.60	0.84	0.46	0.43	0.02	0.00	0.22	0.18	0.00	0.00	0.00	0.00	0.02	0.00	0.00
FG.2016.12	2.76			8.95	7.10	1.95	10.89	3.07	0.04	5.69	4.59	1.52	0.57	0.00	0.37	0.10	0.00	0.00	0.00	0.00	0.00	0.91	0.00	0.00
FG.2016.13	3.54			7.42	6.51	3.02	14.28	2.88	0.37	10.04	5.60	2.27	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	1.50	0.00	0.00
FG.2016.14	6.87			7.86	4.88	2.08	11.58	3.81	0.31	7.21	4.71	2.08	1.20	0.00	0.00	0.11	0.13	0.00	0.02	0.00	0.00	0.16	0.01	0.00
FG.2016.15	3.08			10.85	7.65	2.88	12.49	1.58	0.24	7.81	4.85	2.52	0.00	0.00	0.00	0.13	0.00	0.00	0.01	0.00	0.00	0.49	0.00	0.00
FG.2016.16	6.71			7.12	7.95	2.78	9.59	3.99	0.06	5.45	3.59	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
FG.2016.17	4.24			12.62	6.18	3.98	11.04	3.51	0.06	6.36	4.79	2.25	0.01	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	1.33	0.00	0.00
FG.2016.18	3.70			8.64	7.69	1.66	13.84	2.46	0.10	7.71	4.01	2.00	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.08	0.00	0.61	0.00	0.00
FG.2017.09	4.86			7.60	7.32	2.45	9.47	3.36	0.12	6.30	4.07	2.13	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00
FG.2017.11	8.17			6.45	7.06	2.52	9.08	4.54	1.98	6.54	9.33	4.44	0.11	0.00	0.00	0.10	0.00	0.00	0.26	0.00	0.00	0.58	0.00	0.00
FG.2017.12	8.10			7.61	5.22	2.54	7.92	4.30	2.52	7.94	10.80	4.31	0.16	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00
FG.2017.13	5.13			6.34	7.18	2.76	7.29	4.17	3.30	7.15	11.17	3.44	0.11	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.50	0.00	0.00
FG.2017.14	1.21			2.03	5.43	7.41	3.52	4.93	0.81	9.03	16.28	10.50	0.86	0.00	0.00	0.21	0.04	0.00	0.01	0.00	0.00	1.20	0.00	0.00
FG.2017.16	1.50			1.58	5.12	8.32	4.37	5.37	1.01	10.09	16.41	13.28	0.70	0.00	0.00	0.17	0.03	0.00	0.07	0.00	0.00	0.73	0.00	0.00
FG.2017.17	1.09			2.23	5.54	8.97	2.82	4.72	1.07	8.91	14.51	11.28	0.47	0.00	0.00	0.28	0.04	0.00	0.02	0.00	0.00	1.10	0.00	0.00
FG.2017.18	5.00			6.45	5.35	3.10	9.85	3.16	0.43	3.10	4.62	1.82	0.25	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
IS.2011.02	4.31			3.57	4.70	3.27	4.75	1.52	0.52	1.94	1.26	1.96	1.53	0.00	0.00	0.05	0.05	0.12	0.12	0.00	0.00	0.32	0.00	0.00
IS.2011.04	9.73			8.38	5.17	2.69	5.17	2.00	0.65	2.68	1.87	1.02	0.55	0.00	0.00	0.30	0.06	0.00	0.02	0.00	0.00	0.11	0.00	0.00
IS.2011.05	3.01			3.17	4.81	4.86	5.84	2.27	0.52	2.59	1.39	1.83	0.36	0.13	0.00	0.16	0.03	0.00	0.01	0.00	0.00	0.54	0.00	0.00
IS.2011.11	6.35			6.06	22.25	3.98	3.94	2.05	2.82	1.62	2.33	1.65	1.06	0.06	0.02	1.93	0.88	0.48	1.32	0.52	0.60	0.50	0.47	0.14
IS.2011.12	2.08			3.46	3.50	1.14	4.34	1.03	0.52	1.54	1.75	2.84	8.50	2.43	1.88	4.02	2.61	2.42	2.45	2.09	2.53	4.86	1.67	1.29
IS.2011.14	2.94			3.33	3.87	2.72	4.94	1.74	0.47	1.40	1.80	1.77	0.61	0.00	0.00	0.18	0.00	0.00	0.27	0.00	0.00	0.34	0.00	0.00
IS.2011.15	7.30			6.26	4.96	5.25	4.89	1.17	0.51	0.75	0.81	0.62	0.49	0.00	0.00	0.02	0.02	0.00	0.01	0.00	0.00	0.01	0.00	0.00
IS.2011.29	6.64			10.21	5.16	0.95	18.19	2.56	0.01	10.15	4.96	2.15	0.02	0.00	0.00	0.22	0.00	0.00	0.05	0.00	0.00	0.13	0.00	0.00
IS.2011.32	5.10			7.74	5.14	2.57	10.15	2.80	0.22	6.52	5.30	2.28	0.20	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.36	0.01	0.00
IS.2011.33	7.52			10.83	5.17	1.62	13.05	4.07	0.20	6.84	8.31	2.16	0.62	0.00	0.00	0.10	0.17	0.00	0.00	0.00	0.00	0.07	0.04	0.00
IS.2011.34	3.65			4.55	1.83	0.08	9.86	0.77	0.26	6.79	8.68	2.57	0.02	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
LA.2011.01	3.15			8.32	5.37	1.48	12.00	1.72	2.06	2.95	2.91	0.57	0.02	0.00	0.00	0.04	0.00	0.02	0.04	0.00	0.00	0.13	0.00	0.00
LA.2011.03	9.98			8.41	4.92	5.20	9.02	3.94	1.69	6.48	10.22	5.36	0.10	0.03	0.00	0.06	0.03	0.00	0.28	0.00	0.00	0.68	0.00	0.00

Figure 36: Positions heatmap (FG) step 2, after taking away AB and AC.

3rd step (Heatmap by positions in the map): These heatmaps are completely based on the heatmaps of the 1st and 2nd stage explained above, only in these the information is more concentrated and oriented to a "positional" visualization on the map.

These heatmaps (positional) are a simulation of the map view from an aerial view. A map divided into zones (product of discretization). Thus, the position of animals or groups of animals can be observed under different climatic and temporal conditions, being a good tool to learn about the positional distribution of groups of boars.

Description of heatmaps: The positioning heatmaps in this section show on a 3-color color scale (white, yellow, red) that indicates in which areas the animals spent the most time, with white for the lowest values and red for the highest values. The zones are accompanied by a small pie chart inside that shows, in quarters, an approximate of what this zone represents with respect to the maximum value. It should be remembered that the 2 areas (FG and VG) are practically divided in half (on the Y axis) by a fence. It can be imagined that there is a fence between columns "C" and "D", the left side for the FG animals (columns A, B, C) and the right side for the VG animals (columns D, C, F). Due to the nature of the enclosure, naturally these delimitations are not perfect geometrically speaking, so there are values of FG animals in areas that in theory are VG, but as mentioned before, these values are too low and are not representative.

The positional heatmaps represent the entire map where the animals of the FG and VG datasets were, called research area. The heatmap is divided into almost square zones, a product of the discretization of the map and its coordinates.

Numerical values in the zones: the numerical values in each of the zones of the heatmap represent a magnitude, it is a magnitude of the time that a group of animals spent in the zone. These values come from the calculation of the sum of each of the time periods recorded for each of the animals in each of the areas, independently. These values are calculated in units of days, after that these magnitudes in days are converted into percentages, giving by each animal, the percentage % of the time this animal spent in each zone, relative to its own total amount of time.

Thus, the values are independent for each individual and the overview results are not affected by different total amounts of time spent in the enclosure by each animal.

Finally, the values seen in the heatmaps come from calculating the average of the percentages of time for each of the animals, considering only the animals selected as a study group (they can be all the animals together or by groups). This was carried out independently for each of the areas of the map. The values obtained can be defined as a magnitude that represents the average of the percentage of time that the study group of selected animals spent in each of the areas of the map, considering the different total values of time that each animal was in the area. research enclosure.

There was also the option of choosing this representative value as the sum of the percentages of time that the selected animals spent in each area, but for practical reasons (size of the ciphers), the type of representation explained above was chosen.

	A	B	C	D	E	F
A	5.45	15.64	30.11	0.58	0.07	0.06
B	7.64	6.61	2.78	0.25	0.15	0.12
C	9.82	3.04	0.68	0.08	0.08	0.49
D	6.41	6.09	3.58	0.49	0.07	0.05

Figure 37: Grid´s general overview (FG). Example of a finished heatmap by positions in map: Positions of all FG animals from 2017-2019

- ### 3.5.2- 2nd approach Heatmap building FG

NOTE: this approach was not used in the following steps of the analysis. This section explains the reasons. VG'S table not shown, as it follows same logic than FG

The logic for constructing the heatmap is the same as in approach 1, the table is built with the values per zone. In this case, because there are already the labels assigned by approach #1, the table could be built by adding the labels of approach 1, as long as they were outside the polygons of approach 2 (P1, P2, P3), This is with the aim of having more precision when the points (x, y) were outside the polygons created in approach #2. If the Ap1 labels were not used, the table of this heatmap would only have 3 columns, P1, P2 and P3, and positions outside these polygons would not be known.

Grid areas + Feeding areas (PO), FG set																											
ID Sow	PO1	PO2	PO3	AA	AB	AC	BA	BB	BC	CA	CB	CC	DA	DB	DC	AD	AE	AF	BD	BE	BF	CD	CE	CF	DD	DE	DF
FG.2016.03	35.86	0.05	2.00	3.73	13.09	22.03	2.58	3.34	0.62	6.91	1.39	0.39	2.15	1.93	2.73	0.92	0.00	0.00	0.07	0.04	0.01	0.00	0.00	0.00	0.17	0.00	0.00
FG.2016.05	37.03	0.00	1.52	4.90	14.72	22.29	3.53	3.03	0.62	5.62	1.30	0.51	1.22	1.66	1.28	0.51	0.00	0.00	0.01	0.16	0.00	0.00	0.00	0.00	0.08	0.00	0.00
FG.2016.07	37.94	0.04	0.55	7.15	13.63	22.59	6.20	3.17	1.16	3.51	1.31	0.30	0.40	0.74	0.46	0.43	0.02	0.00	0.21	0.15	0.00	0.00	0.00	0.00	0.02	0.00	0.00
FG.2016.12	32.33	0.33	2.51	2.76	13.35	8.62	8.95	5.90	0.40	10.28	2.20	0.01	4.84	4.39	1.52	0.57	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.68	0.00	0.00
FG.2016.13	28.81	0.00	5.52	3.54	11.61	6.06	7.42	5.51	0.67	12.51	2.26	0.07	7.42	4.83	2.27	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	1.50	0.00	0.00
FG.2016.14	24.97	0.04	5.34	6.87	15.06	10.06	7.86	3.50	0.43	10.45	2.68	0.29	5.06	3.75	2.08	1.20	0.00	0.00	0.06	0.13	0.00	0.02	0.00	0.00	0.16	0.01	0.00
FG.2016.15	30.24	0.26	2.91	3.08	11.71	7.08	10.84	6.01	0.96	11.91	1.37	0.24	6.08	4.39	2.52	0.00	0.00	0.00	0.07	0.00	0.00	0.01	0.00	0.00	0.29	0.00	0.00
FG.2016.16	30.41	0.00	4.18	6.70	18.74	8.80	7.12	3.92	0.30	8.63	2.97	0.06	3.95	2.77	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
FG.2016.17	25.81	0.15	2.10	4.24	13.25	8.46	12.62	5.47	1.25	10.72	2.39	0.02	5.51	4.54	2.25	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	1.18	0.00	0.00
FG.2016.18	30.38	0.12	4.07	3.70	12.92	6.87	8.64	6.04	0.63	13.27	1.18	0.10	6.00	3.48	2.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.08	0.00	0.49	0.00	0.00
FG.2017.09	32.99	0.00	4.88	4.86	13.31	10.36	7.60	5.42	0.14	8.01	1.91	0.11	4.96	2.92	2.13	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00
FG.2017.11	21.13	0.08	3.87	8.17	13.41	8.25	6.45	5.40	0.38	8.35	3.10	1.97	5.21	8.93	4.44	0.11	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.50	0.00	0.00
FG.2017.12	21.01	0.03	2.77	8.09	13.28	8.03	7.58	3.64	0.42	7.26	3.66	2.21	6.95	10.23	4.31	0.16	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00
FG.2017.13	21.67	0.08	3.16	5.13	14.54	9.71	6.34	5.42	0.30	6.56	3.06	3.25	6.22	10.59	3.44	0.11	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.43	0.00	0.00
FG.2017.14	30.37	0.07	4.30	1.21	7.08	8.64	2.03	3.19	0.61	2.68	3.41	0.79	8.10	14.95	10.50	0.68	0.00	0.00	0.20	0.02	0.00	0.01	0.00	0.00	1.16	0.00	0.00
FG.2017.16	28.40	0.12	4.33	1.50	6.40	7.25	1.58	2.06	1.12	3.85	3.65	0.86	9.09	15.04	13.28	0.61	0.00	0.00	0.14	0.02	0.00	0.02	0.00	0.00	0.66	0.00	0.00
FG.2017.17	31.50	0.03	3.23	1.09	7.09	10.29	2.23	2.42	0.63	1.97	3.55	1.00	8.17	13.73	11.28	0.41	0.00	0.00	0.23	0.02	0.00	0.02	0.00	0.00	1.09	0.00	0.00
FG.2017.18	27.30	0.00	3.60	5.00	14.97	17.53	6.45	4.61	0.93	8.65	1.65	0.43	2.56	4.24	1.82	0.24	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
IS.2011.02	35.64	0.01	1.27	4.31	13.51	25.04	3.57	3.53	0.50	4.29	1.32	0.52	1.42	1.11	1.96	1.37	0.00	0.00	0.04	0.04	0.12	0.12	0.00	0.00	0.32	0.00	0.00
IS.2011.04	27.77	0.14	1.47	9.73	17.28	18.26	8.38	4.03	0.56	4.62	1.65	0.51	2.27	1.59	1.02	0.43	0.00	0.00	0.14	0.04	0.00	0.00	0.00	0.00	0.11	0.00	0.00
IS.2011.05	39.88	0.03	1.70	3.01	12.83	21.16	3.17	3.59	0.92	5.58	1.42	0.51	1.93	1.35	1.83	0.32	0.13	0.00	0.10	0.01	0.00	0.01	0.00	0.00	0.54	0.00	0.00
IS.2011.11	28.34	2.79	1.46	6.33	11.17	11.97	6.06	14.45	0.94	3.58	1.36	1.49	1.26	1.99	1.65	1.05	0.06	0.02	0.64	0.64	0.48	0.63	0.20	0.60	0.45	0.25	0.14
IS.2011.12	22.01	6.14	1.27	2.08	8.40	12.63	3.46	2.73	0.34	4.15	0.61	0.46	1.16	1.35	2.84	8.41	2.43	1.88	1.81	1.92	2.42	0.61	1.57	2.53	4.00	1.51	1.29
IS.2011.14	39.34	0.01	0.85	2.94	11.80	25.13	3.33	3.30	0.78	4.51	1.42	0.46	1.22	1.75	1.77	0.59	0.00	0.00	0.18	0.00	0.00	0.27	0.00	0.00	0.34	0.00	0.00
IS.2011.15	39.39	0.02	0.57	7.30	13.34	20.43	6.26	3.66	0.65	4.67	0.96	0.27	0.56	0.77	0.62	0.49	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00
IS.2011.29	19.26	0.04	4.92	6.64	14.26	7.26	10.21	3.80	0.19	17.14	1.96	0.01	7.99	3.80	2.15	0.02	0.00	0.00	0.22	0.00	0.00	0.01	0.00	0.00	0.13	0.00	0.00
IS.2011.32	27.11	0.02	2.09	5.10	13.65	13.29	7.74	4.54	0.61	9.60	2.17	0.22	5.87	5.01	2.28	0.20	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00
IS.2011.33	23.80	0.13	5.26	7.52	11.43	6.88	10.83	3.94	0.21	11.61	2.42	0.19	5.78	6.98	2.16	0.61	0.00	0.00	0.07	0.05	0.00	0.00	0.00	0.00	0.06	0.04	0.00
IS.2011.34	20.41	0.00	2.73	3.65	27.19	13.88	4.55	1.79	0.00	9.76	0.32	0.26	6.78	6.05	2.57	0.02	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
LA.2011.01	33.47	0.00	0.81	3.15	18.84	11.50	8.32	3.51	0.01	11.60	0.43	2.06	2.71	2.81	0.57	0.02	0.00	0.00	0.01	0.00	0.02	0.04	0.00	0.00	0.13	0.00	0.00
LA.2011.03	17.76	0.18	4.05	9.98	14.64	7.50	8.41	3.78	0.39	7.91	2.40	1.65	5.43	9.55	5.36	0.10	0.03	0.00	0.06	0.00	0.00	0.15	0.00	0.00	0.66	0.00	0.00

Figure 38: FG grid heatmap building + polygons of approach #2.

Without the main zone PO(1)																											
ID Sow	PO1	PO2	PO3	AA	AB	AC	BA	BB	BC	CA	CB	CC	DA	DB	DC	AD	AE	AF	BD	BE	BF	CD	CE	CF	DD	DE	DF
FG.2016.03		0.05	2.00	3.73	13.09	22.03	2.58	3.34	0.62	6.91	1.39	0.39	2.15	1.93	2.73	0.92	0.00	0.00	0.07	0.04	0.01	0.00	0.00	0.00	0.17	0.00	0.00
FG.2016.05		0.00	1.52	4.90	14.72	22.29	3.53	3.03	0.62	5.62	1.30	0.51	1.22	1.66	1.28	0.51	0.00	0.00	0.01	0.16	0.00	0.00	0.00	0.00	0.08	0.00	0.00
FG.2016.07		0.04	0.55	7.15	13.63	22.59	6.20	3.17	1.16	3.51	1.31	0.30	0.40	0.74	0.46	0.43	0.02	0.00	0.21	0.15	0.00	0.00	0.00	0.00	0.02	0.00	0.00
FG.2016.12		0.33	2.51	2.76	13.35	8.62	8.95	5.90	0.40	10.28	2.20	0.01	4.84	4.39	1.52	0.57	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.68	0.00	0.00
FG.2016.13		0.00	5.52	3.54	11.61	6.06	7.42	5.51	0.67	12.51	2.26	0.07	7.42	4.83	2.27	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	1.50	0.00	0.00
FG.2016.14		0.04	5.34	6.87	15.06	10.06	7.86	3.50	0.43	10.45	2.68	0.29	5.06	3.75	2.08	1.20	0.00	0.00	0.06	0.13	0.00	0.02	0.00	0.00	0.16	0.01	0.00
FG.2016.15		0.26	2.91	3.08	11.71	7.08	10.84	6.01	0.96	11.91	1.37	0.24	6.08	4.39	2.52	0.00	0.00	0.00	0.07	0.00	0.00	0.01	0.00	0.00	0.29	0.00	0.00
FG.2016.16		0.00	4.18	6.70	18.74	8.80	7.12	3.92	0.30	8.63	2.97	0.06	3.95	2.77	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
FG.2016.17		0.15	2.10	4.24	13.25	8.46	12.62	5.47	1.25	10.72	2.39	0.02	5.51	4.54	2.25	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	1.18	0.00	0.00
FG.2016.18		0.12	4.07	3.70	12.92	6.87	8.64	6.04	0.63	13.27	1.18	0.10	6.00	3.48	2.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.08	0.00	0.49	0.00	0.00
FG.2017.09		0.00	4.88	4.86	13.31	10.36	7.60	5.42	0.14	8.01	1.91	0.11	4.96	2.92	2.13	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00
FG.2017.11		0.08	3.87	8.17	13.41	8.25	6.45	5.40	0.38	8.35	3.10	1.97	5.21	8.93	4.44	0.11	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.50	0.00	0.00
FG.2017.12		0.03	2.77	8.09	13.28	8.03	7.58	3.64	0.42	7.26	3.66	2.21	6.95	10.23	4.31	0.16	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00
FG.2017.13		0.08	3.16	5.13	14.54	9.71	6.34	5.42	0.30	6.56	3.06	3.25	6.22	10.59	3.44	0.11	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.43	0.00	0.00
FG.2017.14		0.07	4.30	1.21	7.08	8.64	2.03	3.19	0.61	2.68	3.41	0.79	8.10	14.95	10.50	0.68	0.00	0.00	0.20	0.02	0.00	0.01	0.00	0.00	1.16	0.00	0.00
FG.2017.16		0.12	4.33	1.50	6.40	7.25	1.58	2.06	1.12	3.85	3.65	0.86	9.09	15.04	13.28	0.61	0.00	0.00	0.14	0.02	0.00	0.02	0.00	0.00	0.66	0.00	0.00
FG.2017.17		0.03	3.23	1.09	7.09	10.29	2.23	2.42	0.63	1.97	3.55	1.00	8.17	13.73	11.28	0.41	0.00	0.00	0.23	0.02	0.00	0.02	0.00	0.00	1.09	0.00	0.00
FG.2017.18		0.00	3.60	5.00	14.97	17.53	6.45	4.61	0.93	8.65	1.65	0.43	2.56	4.24	1.82	0.24	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
IS.2011.02		0.01	1.27	4.31	13.51	25.04	3.57	3.53	0.50	4.29	1.32	0.52	1.42	1.11	1.96	1.37	0.00	0.00	0.04	0.04	0.12	0.12	0.00	0.00	0.32	0.00	0.00
IS.2011.04		0.14	1.47	9.73	17.28	18.26	8.38	4.03	0.56	4.62	1.65	0.51	2.27	1.59	1.02	0.43	0.00	0.00	0.14	0.04	0.00	0.00	0.00	0.00	0.11	0.00	0.00
IS.2011.05		0.03	1.70	3.01	12.83	21.16	3.17	3.59	0.92	5.58	1.42	0.51	1.93	1.35	1.83	0.32	0.13	0.00	0.10	0.01	0.00	0.01	0.00	0.00	0.54	0.00	0.00
IS.2011.11		2.79	1.46	6.33	11.17	11.97	6.06	14.45	0.94	3.58	1.36	1.49	1.26	1.99	1.65	1.05	0.06	0.02	0.64	0.64	0.48	0.63	0.20	0.60	0.45	0.25	0.14
IS.2011.12		6.14	1.27	2.08	8.40	12.63	3.46	2.73	0.34	4.15	0.61	0.46	1.16	1.35	2.84	8.41	2.43	1.88	1.81	1.92	2.42	0.61	1.57	2.53	4.00	1.51	1.29
IS.2011.14		0.01	0.85	2.94	11.80	25.13	3.33	3.30	0.78	4.51	1.42	0.46	1.22	1.75	1.77	0.59	0.00	0.00	0.18	0.00	0.00	0.27	0.00	0.00	0.34	0.00	0.00
IS.2011.15		0.02	0.57	7.30	13.34	20.43	6.26	3.66	0.65	4.67	0.96	0.27	0.56	0.77	0.62	0.49	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00
IS.2011.29		0.04	4.92	6.64	14.26	7.26	10.21	3.80	0.19	17.14	1.96	0.01	7.99	3.80	2.15	0.02	0.00	0.00	0.22	0.00	0.00	0.01	0.00	0.00	0.13	0.00	0.00
IS.2011.32		0.02	2.09	5.10	13.65	13.29	7.74	4.54	0.61	9.60	2.17	0.22	5.87	5.01	2.28	0.20	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00
IS.2011.33		0.13	5.26	7.52	11.43	6.88	10.83	3.94	0.21	11.61	2.42	0.19	5.78	6.98	2.16	0.61	0.00	0.00	0.07	0.05	0.00	0.00	0.00	0.00	0.06	0.04	0.00
IS.2011.34		0.00	2.73	3.65	27.19	13.88	4.55	1.79	0.00	9.76	0.32	0.26	6.78	6.05	2.57	0.02	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
LA.2011.01		0.00	0.81	3.15	18.84	11.50	8.32	3.51	0.01	11.60	0.43	2.06	2.71	2.81	0.57	0.02	0.00	0.00	0.01	0.00	0.02	0.04	0.00	0.00	0.13	0.00	0.00
LA.2011.03		0.18	4.05	9.98	14.64	7.50	8.41	3.78	0.39	7.91	2.40	1.65	5.43	9.55	5.36	0.10	0.03	0.00	0.06	0.00	0.00	0.15	0.00	0.00	0.66	0.00	0.00

Figure 39: FG grid heatmap building + polygons of approach #2, without the feeding area PO (1).

The Zone PO1 in FG has a very high influence, so it can be deduced that it is the feeding zone. The problem is that the influence of AB AND AC (observed in approach #1) has not completely disappeared, which necessarily indicates that the delimitation of the P1 polygon is not entirely correct, since in theory it should cover the entire area of influence of AB and AC (which, as seen in AP1, are also feeding areas).

The values of PO2 in FG seem to correspond correctly with its location. It is an area where it would be expected to see high values but only from animals belonging to VG and not animals from FG.

PO2 in VG has the same problem than the polygons in FG, the delimitation seem to not be entirely correct. The original zones of high influence found in approach 1, remain being the areas with most influence. This may imply that the polygons are not exact, and even if this is not the case, the approach #2 is kind of ending up being an extension of approach 1, but not bringing some valuable information for a general overview.

- ### 3.5.3- 3rd approach Heatmap building FG

NOTE: this approach was not used in the following step of the analysis. This section explains the reasons. (VG's tables not shown, as it follows same logic as FG):

The technique of constructing the heatmap for approach 3 is the same as for the previous ones. The Ap1 grid zones were taken as a basis and the Ap3 zones were added, these being the eating areas: FA (1), FA (2), FA (3). In this way they can also be found in the position's dataset.

Grid areas + FA, FG set																														
ID Sow	FA (1)	FA (2)	FA (3)	AA	AB	AC	BA	BB	BC	CA	CB	CC	DA	DB	DC	AD	AE	AF	BD	BE	BF	CD	CE	CF	DD	DE	DF
FG.2016.03	13.45	19.02	0.05	3.73	11.62	24.78	2.58	4.17	1.79	7.58	1.96	0.40	2.59	2.34	2.73	0.92	0.00	0.00	0.07	0.04	0.01	0.00	0.00	0.00	0.17	0.00	0.00
FG.2016.05	14.83	21.30	0.00	4.90	12.79	23.22	3.53	3.74	1.74	6.07	1.63	0.51	1.89	1.81	1.28	0.51	0.00	0.00	0.02	0.15	0.00	0.00	0.00	0.00	0.08	0.00	0.00
FG.2016.07	11.80	21.81	0.04	7.15	12.18	24.06	6.20	3.91	4.46	3.62	1.62	0.43	0.60	0.84	0.46	0.43	0.02	0.00	0.21	0.15	0.00	0.00	0.00	0.00	0.02	0.00	0.00
FG.2016.12	6.14	24.61	0.33	2.76	11.78	10.36	8.95	6.73	0.92	10.89	3.06	0.04	5.69	4.59	1.52	0.57	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.68	0.00	0.00
FG.2016.13	4.98	21.33	0.00	3.54	10.39	7.40	7.42	6.00	1.97	14.28	2.88	0.37	10.04	5.60	2.27	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	1.50	0.00	0.00
FG.2016.14	6.27	16.49	0.04	6.87	13.42	11.78	7.86	4.82	1.15	11.58	3.81	0.31	7.21	4.71	2.08	1.20	0.00	0.00	0.09	0.13	0.00	0.02	0.00	0.00	0.16	0.01	0.00
FG.2016.15	5.05	23.00	0.26	3.08	10.22	8.32	10.84	7.22	2.11	12.49	1.58	0.24	7.81	4.85	2.52	0.00	0.00	0.00	0.07	0.00	0.00	0.01	0.00	0.00	0.29	0.00	0.00
FG.2016.16	7.11	21.37	0.00	6.70	16.77	10.53	7.12	5.19	1.09	9.58	3.99	0.06	5.45	3.59	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
FG.2016.17	4.70	19.57	0.17	4.24	11.55	9.94	12.62	5.90	2.12	11.04	3.51	0.06	6.36	4.79	2.25	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.18	0.00	0.00
FG.2016.18	5.43	21.74	0.12	3.70	11.38	10.01	8.64	7.30	0.94	13.84	2.46	0.10	7.71	4.01	2.00	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.08	0.00	0.49	0.00	0.00
FG.2017.09	9.74	19.16	0.00	4.86	11.75	13.47	7.60	6.78	0.79	9.47	3.36	0.12	6.30	4.07	2.13	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00
FG.2017.11	6.10	12.46	0.08	8.17	11.81	9.92	6.45	6.60	1.52	9.08	4.54	1.98	6.54	9.33	4.44	0.11	0.00	0.00	0.10	0.00	0.00	0.26	0.00	0.00	0.50	0.00	0.00
FG.2017.12	6.07	11.57	0.03	8.09	11.41	10.33	7.61	4.77	1.81	7.92	4.30	2.52	7.94	10.80	4.31	0.16	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00
FG.2017.13	6.82	12.41	0.08	5.13	12.44	11.35	6.34	6.87	1.50	7.29	4.17	3.30	7.15	11.17	3.44	0.11	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.43	0.00	0.00
FG.2017.14	6.16	16.37	0.09	1.21	5.97	10.65	2.03	4.72	5.50	3.52	4.93	0.81	9.03	16.28	10.50	0.86	0.00	0.00	0.20	0.02	0.00	0.01	0.00	0.00	1.16	0.00	0.00
FG.2017.16	6.87	14.51	0.13	1.50	5.12	8.00	1.58	4.89	5.31	4.37	5.37	1.01	10.09	16.41	13.28	0.69	0.00	0.00	0.17	0.02	0.00	0.02	0.00	0.00	0.66	0.00	0.00
FG.2017.17	6.93	16.74	0.04	1.09	5.66	11.61	2.23	5.14	5.40	2.82	4.72	1.07	8.91	14.51	11.28	0.47	0.00	0.00	0.27	0.02	0.00	0.02	0.00	0.00	1.09	0.00	0.00
FG.2017.18	13.60	13.60	0.00	5.00	13.16	18.57	6.45	5.05	1.31	9.85	3.16	0.43	3.10	4.62	1.82	0.25	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
IS.2011.02	15.50	16.99	0.01	4.31	11.87	27.71	3.57	4.50	1.42	4.75	1.52	0.52	1.94	1.26	1.96	1.53	0.00	0.00	0.04	0.04	0.12	0.12	0.00	0.00	0.32	0.00	0.00
IS.2011.04	11.47	13.77	0.15	9.73	15.96	20.25	8.38	4.73	1.28	5.17	2.00	0.65	2.68	1.87	1.02	0.55	0.00	0.00	0.20	0.03	0.00	0.00	0.00	0.00	0.11	0.00	0.00
IS.2011.05	13.67	22.04	0.04	3.01	11.07	24.34	3.17	4.75	2.29	5.84	2.26	0.52	2.59	1.39	1.83	0.36	0.13	0.00	0.16	0.01	0.00	0.01	0.00	0.00	0.54	0.00	0.00
IS.2011.11	5.77	12.86	3.17	6.33	9.96	13.66	6.06	20.49	2.49	3.94	2.05	2.82	1.62	2.33	1.65	1.00	0.05	0.02	0.41	0.57	0.48	0.63	0.20	0.60	0.45	0.25	0.14
IS.2011.12	9.02	11.73	7.42	2.08	7.18	13.91	3.46	3.37	0.53	4.34	1.03	0.52	1.54	1.75	2.84	8.23	2.40	1.88	1.26	1.62	2.42	0.61	1.57	2.53	4.00	1.51	1.29
IS.2011.14	16.72	19.37	0.01	2.94	10.33	28.12	3.33	3.80	1.85	4.94	1.74	0.47	1.40	1.80	1.77	0.61	0.00	0.00	0.18	0.00	0.00	0.27	0.00	0.00	0.34	0.00	0.00
IS.2011.15	12.25	22.56	0.02	7.30	11.77	23.35	6.26	4.59	2.71	4.89	1.17	0.41	0.75	0.81	0.62	0.49	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00
IS.2011.29	3.92	14.23	0.04	6.64	12.74	8.25	10.21	5.12	0.46	18.19	2.56	0.01	10.15	4.96	2.15	0.02	0.00	0.00	0.22	0.00	0.00	0.01	0.00	0.00	0.13	0.00	0.00
IS.2011.32	10.47	16.16	0.02	5.10	12.22	14.16	7.74	4.77	1.39	10.15	2.80	0.22	6.52	5.30	2.28	0.20	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00
IS.2011.33	7.28	14.96	0.13	7.52	10.02	8.06	10.83	5.01	0.68	13.05	4.07	0.20	6.84	8.31	2.16	0.62	0.00	0.00	0.09	0.05	0.00	0.00	0.00	0.00	0.06	0.04	0.00
IS.2011.34	4.25	18.00	0.00	3.65	22.19	16.53	4.55	1.83	0.00	9.86	0.77	0.26	6.79	8.68	2.57	0.02	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
LA.2011.01	3.29	24.79	0.00	3.15	16.57	17.31	8.32	3.67	0.46	12.00	1.72	2.06	2.95	2.91	0.57	0.02	0.00	0.00	0.04	0.00	0.02	0.04	0.00	0.00	0.13	0.00	0.00
LA.2011.03	3.93	9.61	0.18	9.98	13.75	8.37	8.41	4.52	3.52	9.02	3.94	1.69	6.48	10.22	5.36	0.10	0.03	0.00	0.06	0.00	0.00	0.15	0.00	0.00	0.66	0.00	0.00

Figure 40: FG grid heatmap building + FA (eating areas from approach #3)

Grid areas + FA, VG set, without FA (2)																											
ID Sow	FA (1)	FA (2)	FA (3)	AA	AB	AC	BA	BB	BC	CA	CB	CC	DA	DB	DC	AD	AE	AF	BD	BE	BF	CD	CE	CF	DD	DE	DF
FG.2016.03	13.45		0.05	3.73	11.62	24.78	2.58	4.17	1.79	7.58	1.96	0.40	2.59	2.34	2.73	0.92	0.00	0.00	0.07	0.04	0.01	0.00	0.00	0.00	0.17	0.00	0.00
FG.2016.05	14.83		0.00	4.90	12.79	23.22	3.53	3.74	1.74	6.07	1.63	0.51	1.89	1.81	1.28	0.51	0.00	0.00	0.02	0.15	0.00	0.00	0.00	0.00	0.08	0.00	0.00
FG.2016.07	11.80		0.04	7.15	12.18	24.06	6.20	3.91	4.46	3.62	1.62	0.43	0.60	0.84	0.46	0.43	0.02	0.00	0.21	0.15	0.00	0.00	0.00	0.00	0.02	0.00	0.00
FG.2016.12	6.14		0.33	2.76	11.78	10.36	8.95	6.73	0.92	10.89	3.06	0.04	5.69	4.59	1.52	0.57	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.68	0.00	0.00
FG.2016.13	4.98		0.00	3.54	10.39	7.40	7.42	6.00	1.97	14.28	2.88	0.37	10.04	5.60	2.27	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	1.50	0.00	0.00
FG.2016.14	6.27		0.04	6.87	13.42	11.78	7.86	4.82	1.15	11.58	3.81	0.31	7.21	4.71	2.08	1.20	0.00	0.00	0.09	0.13	0.00	0.02	0.00	0.00	0.16	0.01	0.00
FG.2016.15	5.05		0.26	3.08	10.22	8.32	10.84	7.22	2.11	12.49	1.58	0.24	7.81	4.85	2.52	0.00	0.00	0.00	0.07	0.00	0.00	0.01	0.00	0.00	0.29	0.00	0.00
FG.2016.16	7.11		0.00	6.70	16.77	10.53	7.12	5.19	1.09	9.58	3.99	0.06	5.45	3.59	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
FG.2016.17	4.70		0.17	4.24	11.55	9.94	12.62	5.90	2.12	11.04	3.51	0.06	6.36	4.79	2.25	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.18	0.00	0.00
FG.2016.18	5.43		0.12	3.70	11.38	10.01	8.64	7.30	0.94	13.84	2.46	0.10	7.71	4.01	2.00	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.08	0.00	0.49	0.00	0.00
FG.2017.09	9.74		0.00	4.86	11.75	13.47	7.60	6.78	0.79	9.47	3.36	0.12	6.30	4.07	2.13	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00
FG.2017.11	6.10		0.08	8.17	11.81	9.92	6.45	6.60	1.52	9.08	4.54	1.98	6.54	9.33	4.44	0.11	0.00	0.00	0.10	0.00	0.00	0.26	0.00	0.00	0.50	0.00	0.00
FG.2017.12	6.07		0.03	8.09	11.41	10.33	7.61	4.77	1.81	7.92	4.30	2.52	7.94	10.80	4.31	0.16	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00
FG.2017.13	6.82		0.08	5.13	12.44	11.35	6.34	6.87	1.50	7.29	4.17	3.30	7.15	11.17	3.44	0.11	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.43	0.00	0.00
FG.2017.14	6.16		0.09	1.21	5.97	10.65	2.03	4.72	5.50	3.52	4.93	0.81	9.03	16.28	10.50	0.86	0.00	0.00	0.20	0.02	0.00	0.01	0.00	0.00	1.16	0.00	0.00
FG.2017.16	6.87		0.13	1.50	5.12	8.00	1.58	4.89	5.31	4.37	5.37	1.01	10.09	16.41	13.28	0.69	0.00	0.00	0.17	0.02	0.00	0.02	0.00	0.00	0.66	0.00	0.00
FG.2017.17	6.93		0.04	1.09	5.66	11.61	2.23	5.14	5.40	2.82	4.72	1.07	8.91	14.51	11.28	0.47	0.00	0.00	0.27	0.02	0.00	0.02	0.00	0.00	1.09	0.00	0.00
FG.2017.18	13.60		0.00	5.00	13.16	18.57	6.45	5.05	1.31	9.85	3.16	0.43	3.10	4.62	1.82	0.25	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00
IS.2011.02	15.50		0.01	4.31	11.87	27.71	3.57	4.50	1.42	4.75	1.52	0.52	1.94	1.26	1.96	1.53	0.00	0.00	0.04	0.04	0.12	0.12	0.00	0.00	0.32	0.00	0.00
IS.2011.04	11.47		0.15	9.73	15.96	20.25	8.38	4.73	1.28	5.17	2.00	0.65	2.68	1.87	1.02	0.55	0.00	0.00	0.20	0.03	0.00	0.00	0.00	0.00	0.11	0.00	0.00
IS.2011.05	13.67		0.04	3.01	11.07	24.34	3.17	4.75	2.29	5.84	2.26	0.52	2.59	1.39	1.83	0.36	0.13	0.00	0.16	0.01	0.00	0.01	0.00	0.00	0.54	0.00	0.00
IS.2011.11	5.77		3.17	6.33	9.96	13.66	6.06	20.49	2.49	3.94	2.05	2.82	1.62	2.33	1.65	1.00	0.05	0.02	0.41	0.57	0.48	0.63	0.20	0.60	0.45	0.25	0.14
IS.2011.12	9.02		7.42	2.08	7.18	13.91	3.46	3.37	0.53	4.34	1.03	0.52	1.54	1.75	2.84	8.23	2.40	1.88	1.26	1.62	2.42	0.61	1.57	2.53	4.00	1.51	1.29
IS.2011.14	16.72		0.01	2.94	10.33	28.12	3.33	3.80	1.85	4.94	1.74	0.47	1.40	1.80	1.77	0.61	0.00	0.00	0.18	0.00	0.00	0.27	0.00	0.00	0.34	0.00	0.00
IS.2011.15	12.25		0.02	7.30	11.77	23.35	6.26	4.59	2.71	4.89	1.17	0.41	0.75	0.81	0.62	0.49	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00
IS.2011.29	3.92		0.04	6.64	12.74	8.25	10.21	5.12	0.46	18.19	2.56	0.01	10.15	4.96	2.15	0.02	0.00	0.00	0.22	0.00	0.00	0.01	0.00	0.00	0.13	0.00	0.00
IS.2011.32	10.47		0.02	5.10	12.22	14.16	7.74	4.77	1.39	10.15	2.80	0.22	6.52	5.30	2.28	0.20	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00
IS.2011.33	7.28		0.13	7.52	10.02	8.06	10.83	5.01	0.68	13.05	4.07	0.20	6.84	8.31	2.16	0.62	0.00	0.00	0.09	0.05	0.00	0.00	0.00	0.00	0.06	0.04	0.00
IS.2011.34	4.25		0.00	3.65	22.19	16.53	4.55	1.83	0.00	9.86	0.77	0.26	6.79	8.68	2.57	0.02	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
LA.2011.01	3.29		0.00	3.15	16.57	17.31	8.32	3.67	0.46	12.00	1.72	2.06	2.95	2.91	0.57	0.02	0.00	0.00	0.04	0.00	0.02	0.04	0.00	0.00	0.13	0.00	0.00
LA.2011.03	3.93		0.18	9.98	13.75	8.37	8.41	4.52	3.52	9.02	3.94	1.69	6.48	10.22	5.36	0.10	0.03	0.00	0.06	0.00	0.00	0.15	0.00	0.00	0.66	0.00	0.00

Figure 41: FG grid heatmap building + FA (eating areas from approach #3), without FA (2)

4 Analysis and Results (Positions perspective)

To develop the analysis and show results in this research work, it was decided to do it in 3 parts, or perspectives, since the analysis is approached from different perspectives from which valuable results can be seen, but very different from each other.

The 3 perspectives are named as: positions, distance and acceleration. As the name of each of them says, the perspective is based on an analysis carried out regarding the positions of the animals at some specific moments of time or under certain conditions and so respectively with the others. Each of the perspectives naturally uses different data from the datasets and different analysis approaches.

4.1 Animal's groups classification

For the application, use and understanding of the 3 different perspectives, it was necessary to have a direction of understanding. When dealing with highly social animals, finding and defining groups of animals is the beginning. These groups will be the basis for the next steps of the analysis and the visualizations will show the relationship that each perspective generates between the different groups of animals.

From this section on, the results are normally shown using the identification of animal groups carried out in this part, which is very practical for the visualization of social behavior patterns in the different heatmaps shown later on. It will also serve as a sample and evidence that the group identification technique used in this work is correct, works efficiently, and is recommended to be applied in similar analyses.

The clustering technique: The technique and calculations for the identification of clusters or groups of animals is a technique developed by the author of this work, and no library cluster technique has been used, and this, naturally, has a reason for being so. Normally the techniques of clustering are applied to begin understanding a group of data, to start observing patterns and learn what is in the data. But in the case of this work, there is a lot of knowledge about the datasets and their nature, so the direction in which an identification by groups needed to be made was already known from the beginning. Being animals of a social nature, and as has been demonstrated on several occasions (researches), sharing a space-time zone in a species of this type, normally means that the animals have an affinity with each other and are part of a group. Therefore, the group identification technique was designed to aim at identifying groups of animals spending time in the same areas (the zones resulting from the discretization approach #1) and at the same time. This being the approach, the derived calculations are a product of this logic that in the following sections (results) will demonstrate its effectiveness and good quality of operation. For the application of the tool, a matrix is developed that is explained in this same section below.

Main value attributes of the technique: The technique allows us to consider the complete chronology of all the animals in the enclosure, without losing valuable information in time lapses. This technique starts from points (x, y) in space (a 2-dimensional Cartesian plane), but it does not evaluate distances between points in a direct way, rather, what it does is that through the discretization of zones, It allows us to reduce the possible positions on the map (going from continuous values of "x" and "y" to a reduced number of discrete values). Then additional time information is added by zones.

An important difference with other techniques is that it does not use or analyze a group of points in space from a purely geometric perspective, but instead adds a dimension (time), and analyzes the groups by comparing the total time sum that each of the animals spend on each of the areas into which the map was divided, at a certain moment (when they were together with other animals). Being the time per zone (magnitude of time), the value that makes the final categorization into clusters, instead of some magnitude of distance.

- ### 4.1.1 Animals time together Matrix FG group

This matrix is the result of working with the FG and VG position datasets, to calculate the amount of time that each of the animals spend with each of the animals, that is, who is with whom and for how long. In this way, it was intended to identify groups or clusters of animals spending time together and also some special cases, such as isolated animals or some phenomenon that could be notable.

The number in the cells indicates the percentage of time that the animal indicated in each row (columns on left side of the table) spends with the animal indicated at the top of the table.

The percentage manages to obtain a result relative to each of the animals, so it is not important if some animals lasted longer than others in the enclosure, because the matrix manages to communicate how much time, of the total time that the animal was in the enclosure, spent with each of the other animals. Reading the data on each row, from left to right, the total of the sum of each of the values in the row is = 100%, which is 100% of the time of the animal indicated in the selected row.

Matrix construction example: The following figure shows a fragment of a dataset derived from the FG position's dataset, which contains, in chronological order (from 2017 to 2019), all the instances of time (when there was a data record) in all zones of the map. The areas are already shown discretely, according to the result of the discretization of approach #1. Basically, this dataset shows for each of the FG animals (the procedure is the same for VG), all the time records that are in the dataset, and since the timestamp includes the information of its location zone, we can then see at each instant of time in each zone, what animals were there and how long did they stay in that position. Most of the values are 10, because remember, the position dataset is reduced and contains instances in periods of 10 minutes.

- "Time + grid area" column: Contains a time stamp in chronological order, which also includes the zone at the end.

- Columns with animal IDs: contain values in minutes, if the animal was in that area at that time. The minutes indicate the duration of the animal's stay in that position.

- The blue column is the animal ID with respect to which is the analysis being done in the example.

		Animal ID (Units in minutes)																																
Time + grid area	IS.2011.11	LA.2011.03	FG.2016.12	FG.2013.01	FG.2016.13	FG.2016.14	FG.2016.15	FG.2016.16	FG.2016.17	FG.2016.18	IS.2011.29	IS.2011.32	IS.2011.33	IS.2011.34	LA.2011.01	FG.2013.29	DE.2011.14	FG.2016.03	FG.2016.05	FG.2016.07	IS.2011.02	IS.2011.04	IS.2011.05	IS.2011.12	IS.2011.14	IS.2011.15	FG.2017.09	FG.2017.11	FG.2017.12	FG.2017.13	FG.2017.14	FG.2017.16	FG.2017.17	FG.2017.18
2017-02-13 17:40AC											10.00					11.00	10.00		10.00	10.00	10.00	10.00	10.00		10.00	10.00								
2017-02-13 17:40BC	10																	10.00						10.00										
2017-02-13 17:50AB		10.00									11.00		13.00		10.00																			
2017-02-13 17:50AC																9.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00									
2017-02-13 17:50BC	10																									10.00								
2017-02-13 18:00AB		12.00						8.00			9.00		5.00																					
2017-02-13 18:00AC															10.00	10.00	10.00		10.00	10.00	10.00	10.00		10.00	10.00	10.00								
2017-02-13 18:00BB			8.00		8.00	9.00	8.00		8.00	8.00				10.00									10.00											
2017-02-13 18:00BC	10																	10.00																
2017-02-13 18:00CA				9.00																														
2017-02-13 18:00DA												7.00																						
2017-02-13 18:10AB		11.00					10.00			10.00	63.00	10.00	28.00	22.00	11.00																			
2017-02-13 18:10AC	10															10.00	10.00		10.00		10.00	10.00	10.00	10.00	10.00									
2017-02-13 18:10BB			28.00	10.00	10.00	10.00		21.00	10.00																									
2017-02-13 18:10BC																		10.00		10.00						10.00								

Figure 42: stays by zone and its duration

With the previous table, a new one is built. We are interested in knowing how much time the animals spent at the same time in the same zone. The table above only tells us how much time the animals spent in each area at a time, but not how much time they spent there with other animals.

To obtain this information, a sum is made, but it is necessary to do it in reference to 1 animal at a time (the blue column in this example).

To be able to sum values by columns, the following table is first constructed, in this way: The example table is made in reference to the animal ID of FG IS.2011.11, that is why we keep the original blue column (as a reference). Then we define the values of each cell as follows (example):

- Cell values; 2017-02-13 17:40BC (row), FG.2016.03 (column): using the values from the table "stays by zone and its duration", if the value of the animal ID used as reference (IS.2011.11), is > 0, and the value of the cell that is calculated 2017-02-13 17:40BC (row), FG.2016.03 (column) is also > 0, then in this cell the minimum value between these 2 cells that are being compared is written. If the condition described above is not met, then the number "0" is written. Then the value of this cell is = 10.

When the condition is met, it means that the 2 animals were in this area at the same time, and the minimum value is written because we are only interested in knowing how long the 2 animals were together in that area, if one has a shorter duration, then the rest of time the other animal stayed there is no longer of our interest.

Afterwards, the entire column is added, which gives a total in minutes, and is converted to days to reduce the ciphers and analyze more easily later. The result of this sum is the total time in days that each animal was with the animal used as a reference, in the same area, at the same time.

		Animal ID (Units in minutes)														
Time + grid area	IS.2011.11	LA.2011.03	FG.2016.12	FG.2013.01	FG.2016.13	FG.2016.14	FG.2016.15	FG.2016.16	FG.2016.17	FG.2016.18	IS.2011.29	IS.2011.32	IS.2011.33	IS.2011.34	LA.2011.01	FG.2013.29
2017-02-13 17:40AC		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 17:40BC	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 17:50AB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 17:50AC		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 17:50BC	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:00AB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:00AC		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:00BB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:00BC	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:00CA		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:00DA		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:10AB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:10AC	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
2017-02-13 18:10BB		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:10BC		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum until end of data		*Sum until end of data*														
Total hours		398.17	68.583	44.317	21.933	61.95	35.517	80.35	43.767	41.95	19.783	96.35	89.1	0.7167	35.917	258.28
Total days		16.59	2.8576	1.8465	0.9139	2.5813	1.4799	3.3479	1.8236	1.7479	0.8243	4.0146	3.7125	0.0299	1.4965	10.762

	Animal ID (Units in minutes)																	
Time + grid area	DE.2011.14	FG.2016.03	FG.2016.05	FG.2016.07	IS.2011.02	IS.2011.04	IS.2011.05	IS.2011.12	IS.2011.14	IS.2011.15	FG.2017.09	FG.2017.11	FG.2017.12	FG.2017.13	FG.2017.14	FG.2017.16	FG.2017.17	FG.2017.18
2017-02-13 17:40AC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 17:40BC	0	10	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0
2017-02-13 17:50AB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 17:50AC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 17:50BC	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0
2017-02-13 18:00AB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:00AC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:00BB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:00BC	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:00CA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:00DA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:10AB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:10AC	10	0	10	0	10	10	10	10	10	0	0	0	0	0	0	0	0	0
2017-02-13 18:10BB	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2017-02-13 18:10BC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum until end of data																		
Total hours	260.48	722.32	776.58	996.05	714.4	1960.7	706.45	734.85	675.8	958.18	100.17	186.25	176.7	198.53	273.37	245.7	247.48	69.767
Total days	10.853	30.097	32.358	41.502	29.767	81.697	29.435	30.619	28.158	39.924	4.1736	7.7604	7.3625	8.2722	11.39	10.238	10.312	2.9069

Figure 43: Building the; Animals time together matrix FG group_1

Then a sum is made of all the results obtained from the previous summation, that is, we add all the values of the row "total days", of the table "Building the; Animals time together matrix FG group", this has a value of 470.85 days.

This value of 470.85 days is the time that the animal we analyzed spent with other animals at the same time in the same areas of the map. This is 100% of the time that animal ID IS.2011.11 shared together with other animals. Now we need to put the results in perspective as a percentage of the total time, for a better visualization.

In this step, for each total day's cell, how much percentage % this value in this cell represents of 100% is calculated. So, in the final matrix you can see what percentage of its time this animal spent with other animals in the same place. 2 examples below:

1) IS.2011.11 vs (8) IS.2011.12:

(30.61/470.85) x 100 = 6.50%

2) IS.2011.11 vs (18) FG.2017.14:

(11.39/470.85) x 100 = 2.42

ID	#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	3
IS.2011.11	1		6.39	6.87	8.81	6.32	17.35	6.25	6.50	.98	8.48	3.52	0.32	1.65	1.56	1.76	2.29	2.3	2.42	.17	2.19	0.61	0.39	0.19	0.31	0.39	0.37	0.85	0.62	0.55	0.
FG.2016.03	2	2.62		11.03	5.28	20.89	3.42	16.25	[illegible]	17.26	4.63	0.60	0.06	0.60	0.49	0.77	0.84	0.89	[illegible]	1.01	1.24	0.17	0.13	0.18	0.20	0.14	0.19	0.43	0.25	0.24	0.
FG.2016.05	3	2.85	11.16		13.72	9.94	5.47	12.32	15.90	8.99	9.07	0.65	0.03	0.61	0.64	0.67	0.60	0.63	1.14	1.06	1.01	0.16	0.10	0.11	0.12	0.18	0.18	0.55	0.52	0.34	0.
FG.2016.07	4	4.48	6.55	16.83		5.78	7.52	7.62	6.88	5.58	25.02	0.58	0.03	0.67	0.68	0.76	1.18	1.13	1.57	1.18	1.32	0.22	0.15	0.11	0.27	0.28	0.33	0.64	0.53	0.47	0.
IS.2011.02	5	2.58	20.83	9.80	4.65		3.42	17.00	7.79	18.52	4.26	0.71	0.04	0.70	0.52	0.87	0.78	0.83	0.92	1.24	1.06	0.11	0.22	0.15	0.19	0.20	0.29	0.63	0.39	0.27	0.
IS.2011.04	6	12.78	6.14	9.71	10.90	6.17		8.15	9.43	5.87	12.07	1.31	0.05	1.04	1.08	1.25	1.55	1.66	1.69	1.54	1.71	0.29	0.20	0.31	0.18	0.23	0.28	0.68	0.57	0.87	0.

Figure 44: Building the; Animals time together matrix FG group_2

Then this is repeated for each one of the animals.

Animals time together Matrix FG Group (final result)

The following matrix is the result of the construction of the previous steps, presenting the final FG matrix, and with the clusters found ordered by color, for a better visualization.

The matrix contains a heatmap of white-yellow-green colors, which highlights the cells by their color from smallest to largest, white being the smallest and green being the largest. This heatmap is only as a visual aid to better appreciate clusters.

The cells are highlighted with a frame of the color of the group to which they are assigned, if the value is equal to or greater than 10. In a few cases, some animals have cells highlighted in a different color than the group to which they are assigned, This is because they share more cells with values greater than 10 with the group to which they were assigned, but they could have had affinity with animals from other groups to a lesser extent.

The minimum value of 10 was found empirically, testing different values in this matrix, and 10 obtained the most stable, visible and defined results, where groups could be easily seen.

ID	#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
IS.2011.11	1		6.39	6.87	8.81	6.32	17.35	6.25	6.50	5.98	8.48	3.52	0.32	1.65	1.56	1.76	2.29	2.31
FG.2016.03	2	2.62		11.03	5.28	20.89	3.42	16.25	8.28	17.26	4.63	0.60	0.06	0.60	0.49	0.77	0.84	0.89
FG.2016.05	3	2.85	11.16		13.72	9.94	5.47	12.32	15.90	8.99	9.07	0.65	0.03	0.61	0.64	0.67	0.60	0.63
FG.2016.07	4	4.48	6.55	16.83		5.78	7.52	7.62	6.88	5.58	25.02	0.58	0.03	0.67	0.68	0.76	1.18	1.13
IS.2011.02	5	2.58	20.83	9.80	4.65		3.42	17.00	7.79	18.52	4.26	0.71	0.04	0.70	0.52	0.87	0.78	0.83
IS.2011.04	6	12.78	6.14	9.71	10.90	6.17		8.15	9.43	5.87	12.07	1.31	0.05	1.04	1.08	1.25	1.55	1.66
IS.2011.05	7	2.54	16.13	12.09	6.09	16.91	4.50		10.13	15.90	5.07	0.68	0.03	0.63	0.61	0.89	0.73	0.73
IS.2011.12	8	3.60	11.17	21.21	7.49	10.54	7.08	13.77		8.59	6.88	0.55	0.03	0.56	0.61	0.74	0.72	0.98
IS.2011.14	9	2.71	19.06	9.81	4.97	20.50	3.61	17.69	7.03		5.06	0.59	0.05	0.46	0.67	0.75	0.88	0.71
IS.2011.15	10	4.84	6.45	12.49	28.08	5.95	9.35	7.11	7.10	6.38		0.79	0.05	0.60	0.88	0.75	0.84	1.01
LA.2011.03	11	2.72	1.12	1.22	0.88	1.34	1.38	1.29	0.77	1.00	1.06		1.05	21.64	21.75	18.34	8.81	2.63
LA.2011.01	12	10.06	4.53	2.29	2.02	3.31	1.95	2.43	1.63	3.56	2.62	42.96		0.00	0.00	0.00	1.72	2.40
FG.2017.11	13	1.15	1.02	1.03	0.91	1.19	0.99	1.07	0.71	0.71	0.73	19.58	0.00		29.43	24.36	3.99	1.38
FG.2017.12	14	1.06	0.81	1.04	0.90	0.87	0.99	1.01	0.75	1.00	1.04	19.03	0.00	28.45		29.20	2.84	1.04
FG.2017.13	15	1.23	1.31	1.14	1.04	1.50	1.19	1.53	0.94	1.16	0.93	16.68	0.00	24.47	30.34		3.03	1.16
FG.2013.29	16	1.67	1.50	1.05	1.70	1.40	1.54	1.32	0.96	1.41	1.07	8.33	0.04	4.17	3.07	3.15		20.55
DE.2011.14	17	1.71	1.61	1.13	1.64	1.50	1.67	1.33	1.32	1.16	1.31	2.53	0.06	1.47	1.14	1.22	20.88	
FG.2017.14	18	1.44	1.45	1.64	1.84	1.34	1.36	1.19	0.86	1.10	1.18	1.01	0.00	1.27	1.18	1.56	11.48	13.89
FG.2017.16	19	1.40	1.59	1.65	1.50	1.95	1.34	1.76	0.77	1.39	1.15	1.05	0.00	1.07	1.02	1.24	12.27	16.77
FG.2017.17	20	1.35	1.88	1.51	1.61	1.61	1.44	1.60	0.68	1.21	1.35	1.25	0.00	1.52	1.31	1.51	11.59	14.25
FG.2016.12	21	0.68	0.47	0.43	0.48	0.31	0.44	0.58	0.54	0.29	0.55	0.68	0.04	0.51	0.52	0.49	0.41	0.36
FG.2013.01	22	0.60	0.48	0.37	0.46	0.82	0.41	0.57	0.62	0.27	0.40	0.84	0.07	0.81	0.69	0.63	0.67	0.78
FG.2016.13	23	0.23	0.52	0.31	0.26	0.45	0.50	0.44	0.18	0.26	0.38	0.76	0.08	0.54	0.25	0.45	0.40	0.37
FG.2016.15	24	0.35	0.54	0.32	0.59	0.52	0.27	0.61	0.31	0.58	0.48	0.90	0.08	0.62	0.38	0.57	0.28	0.30
FG.2016.17	25	0.38	0.33	0.42	0.54	0.47	0.30	0.49	0.24	0.40	0.48	0.57	0.05	0.45	0.42	0.29	0.37	0.57
FG.2016.18	26	0.34	0.43	0.41	0.59	0.67	0.36	0.31	0.35	0.37	0.49	0.77	0.06	0.69	0.52	0.84	0.48	0.49
IS.2011.32	27	0.67	0.82	1.05	1.00	1.20	0.72	1.27	0.57	1.04	0.74	1.17	0.04	0.96	1.00	1.28	0.73	0.48
FG.2017.18	28	1.31	1.27	2.67	2.22	2.01	1.64	1.64	0.87	1.26	0.84	1.89	0.00	2.15	2.40	3.41	1.41	0.53
FG.2016.14	29	0.52	0.56	0.77	0.87	0.63	1.12	0.85	0.85	0.36	0.82	1.29	0.04	1.42	1.07	1.25	0.71	0.59
FG.2016.16	30	0.82	0.88	1.33	1.01	1.19	0.96	1.12	0.86	0.82	0.89	1.53	0.05	1.79	1.62	1.88	1.25	0.68
IS.2011.29	31	0.30	0.42	0.44	0.32	0.49	0.50	0.28	0.27	0.61	0.34	1.02	0.07	0.57	0.45	0.43	0.33	0.36
IS.2011.33	32	1.20	0.94	0.87	1.56	0.80	1.25	0.93	1.28	0.35	0.67	1.30	0.08	0.62	0.67	0.56	1.16	1.07
IS.2011.34	33	0.07	0.36	0.33	0.43	0.42	0.19	0.22	0.21	0.25	0.19	0.36	0.19	0.00	0.00	0.00	0.09	0.20
FG.2017.09	34	1.31	0.90	1.53	1.65	0.89	1.75	0.86	0.71	0.77	1.12	1.39	0.00	1.95	1.51	1.30	1.00	0.83

ID	#	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
IS.2011.11	1	2.42	2.17	2.19	0.61	0.39	0.19	0.31	0.39	0.37	0.85	0.62	0.55	0.71	0.18	0.79	0.01	0.89
FG.2016.03	2	1.00	1.01	1.24	0.17	0.13	0.18	0.20	0.14	0.19	0.43	0.25	0.24	0.31	0.10	0.25	0.01	0.25
FG.2016.05	3	1.14	1.06	1.01	0.16	0.10	0.11	0.12	0.18	0.18	0.55	0.52	0.34	0.48	0.11	0.24	0.01	0.43
FG.2016.07	4	1.57	1.18	1.32	0.22	0.15	0.11	0.27	0.28	0.33	0.64	0.53	0.47	0.44	0.09	0.52	0.02	0.57
IS.2011.02	5	0.92	1.24	1.06	0.11	0.22	0.15	0.19	0.20	0.29	0.63	0.39	0.27	0.42	0.11	0.22	0.02	0.25
IS.2011.04	6	1.69	1.54	1.71	0.29	0.20	0.31	0.18	0.23	0.28	0.68	0.57	0.87	0.61	0.21	0.60	0.01	0.87
IS.2011.05	7	0.82	1.11	1.05	0.21	0.15	0.15	0.23	0.20	0.14	0.66	0.31	0.36	0.40	0.07	0.25	0.01	0.24
IS.2011.12	8	0.80	0.66	0.61	0.26	0.22	0.08	0.16	0.13	0.21	0.40	0.23	0.49	0.41	0.09	0.47	0.01	0.27
IS.2011.14	9	0.84	0.98	0.89	0.12	0.08	0.10	0.24	0.18	0.18	0.60	0.27	0.17	0.32	0.16	0.10	0.01	0.24
IS.2011.15	10	1.13	1.02	1.25	0.28	0.15	0.18	0.25	0.28	0.30	0.54	0.23	0.49	0.44	0.11	0.25	0.01	0.43
LA.2011.03	11	1.31	1.26	1.56	0.47	0.42	0.49	0.63	0.45	0.64	1.15	0.69	1.05	1.02	0.46	0.66	0.03	0.73
LA.2011.01	12	0.00	0.00	0.00	1.17	1.52	1.98	2.32	1.47	2.17	1.80	0.00	1.30	1.41	1.27	1.57	0.55	0.00
FG.2017.11	13	1.49	1.17	1.71	0.32	0.37	0.32	0.39	0.32	0.52	0.85	0.71	1.05	1.08	0.23	0.28	0.00	0.92
FG.2017.12	14	1.34	1.07	1.43	0.31	0.30	0.14	0.23	0.29	0.38	0.85	0.76	0.76	0.95	0.18	0.30	0.00	0.69
FG.2017.13	15	1.84	1.35	1.72	0.30	0.28	0.26	0.36	0.21	0.63	1.15	1.13	0.93	1.14	0.17	0.26	0.00	0.62
FG.2013.29	16	14.11	13.93	13.68	0.27	0.32	0.24	0.19	0.28	0.38	0.68	0.48	0.55	0.79	0.14	0.56	0.01	0.49
DE.2011.14	17	17.35	19.35	17.11	0.24	0.38	0.23	0.20	0.43	0.39	0.45	0.18	0.46	0.43	0.16	0.52	0.01	0.42
FG.2017.14	18		23.71	27.57	0.11	0.17	0.08	0.24	0.33	0.28	0.85	0.78	0.33	0.79	0.08	0.41	0.00	0.48
FG.2017.16	19	25.66		22.68	0.16	0.20	0.11	0.10	0.20	0.30	0.55	0.53	0.35	0.47	0.13	0.26	0.00	0.37
FG.2017.17	20	28.69	21.81		0.11	0.25	0.10	0.11	0.16	0.28	0.55	0.64	0.35	0.62	0.10	0.22	0.00	0.36
FG.2016.12	21	0.22	0.29	0.20		6.70	20.14	11.93	12.84	13.96	10.21	0.00	4.32	2.34	3.55	3.22	0.62	1.67
FG.2013.01	22	0.44	0.48	0.62	9.19		9.42	10.28	9.11	9.59	10.45	0.00	8.77	4.90	5.50	5.06	1.41	5.29
FG.2016.13	23	0.16	0.21	0.19	21.58	7.35		13.31	12.85	12.93	11.61	0.00	3.40	1.67	3.39	2.44	0.84	1.71
FG.2016.15	24	0.45	0.17	0.20	11.75	7.38	12.24		15.18	16.21	10.94	0.00	4.87	2.80	4.17	2.95	1.08	1.91
FG.2016.17	25	0.55	0.30	0.25	11.23	5.80	10.48	13.46		19.47	14.66	0.00	4.44	1.43	3.09	5.41	0.74	1.91
FG.2016.18	26	0.44	0.44	0.41	11.54	5.77	9.97	13.60	18.41		12.90	0.00	4.40	1.96	2.90	6.40	0.85	1.81
IS.2011.32	27	1.13	0.67	0.70	7.15	5.33	7.59	7.77	11.75	10.93		15.55	4.04	4.10	2.16	2.17	0.67	3.54
FG.2017.18	28	2.78	1.73	2.20	0.00	0.00	0.00	0.00	0.00	0.00	41.91		5.15	10.21	0.00	0.00	0.00	8.50
FG.2016.14	29	0.52	0.52	0.54	3.64	5.40	2.68	4.17	4.29	4.50	4.87	2.30		19.30	10.98	9.85	0.94	11.76
FG.2016.16	30	1.55	0.85	1.16	2.41	3.67	1.60	2.92	1.68	2.44	6.02	5.57	23.51		7.29	4.57	0.26	15.82
IS.2011.29	31	0.24	0.35	0.27	5.49	6.18	4.88	6.53	5.46	5.42	4.76	0.00	20.08	10.95		15.96	1.91	4.32
IS.2011.33	32	1.05	0.62	0.55	4.36	5.00	3.08	4.05	8.39	10.49	4.19	0.00	15.80	6.02	14.00		1.55	5.54
IS.2011.34	33	0.00	0.00	0.00	5.92	9.80	7.49	10.46	8.09	9.86	9.11	0.00	10.63	2.38	11.82	10.94		0.00
FG.2017.09	34	1.19	0.85	0.86	2.20	5.05	2.09	2.54	2.87	2.88	6.63	5.91	18.27	20.18	3.67	5.36	0.00	

Figure 45: Animals time together Matrix FG Group. Cells encircled if > 10

Animals time together Matrix FG Group final result, with a less strict criterion.

The following matrix is the same version as the previous one, but shows highlighted values greater than 5. This means, percentages of time shared between the animals, greater than 5%, compared to the previous matrix (where the minimum value is 10) It is a more flexible value and covers more cells. This is to have an extra perspective and verify that the groups are maintained under these criteria. As a note, the cells indicated in the previous matrix are maintained, to better compare the results between matrices.

ID	#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	Total %
IS.2011.11	1		6.39	6.87	8.81	6.32	17.35	6.25	6.50	5.98	8.48	3.52	0.32	1.65	1.56	1.76	2.29	2.31	2.42	2.17	2.19	0.61	0.39	0.19	0.31	0.39	0.37	0.85	0.62	0.55	0.71	0.18	0.79	0.01	0.89	100
FG.2016.03	2	2.62		11.03	5.28	20.89	3.42	16.25	8.28	17.26	4.63	0.60	0.06	0.60	0.49	0.77	0.84	0.89	1.00	1.01	1.24	0.17	0.13	0.18	0.20	0.14	0.19	0.43	0.25	0.24	0.31	0.10	0.25	0.01	0.25	100
FG.2016.05	3	2.85	11.16		13.72	9.94	5.47	12.32	15.90	8.99	9.07	0.65	0.03	0.61	0.64	0.67	0.60	0.63	1.14	1.06	1.01	0.16	0.10	0.11	0.12	0.18	0.18	0.55	0.52	0.34	0.48	0.11	0.24	0.01	0.43	100
FG.2016.07	4	4.48	6.55	16.83		5.78	7.52	7.62	6.88	5.58	25.02	0.58	0.03	0.67	0.68	0.76	1.18	1.13	1.57	1.18	1.32	0.22	0.15	0.11	0.27	0.28	0.33	0.64	0.53	0.47	0.44	0.09	0.52	0.02	0.57	100
IS.2011.02	5	2.58	20.83	9.80	4.65		3.42	17.00	7.79	18.52	4.26	0.71	0.04	0.70	0.52	0.87	0.78	0.83	0.92	1.24	1.06	0.11	0.22	0.15	0.19	0.20	0.29	0.63	0.39	0.27	0.42	0.11	0.22	0.02	0.25	100
IS.2011.04	6	12.78	6.14	9.71	10.90	6.17		8.15	9.43	5.87	12.07	1.31	0.05	1.04	1.08	1.25	1.55	1.66	1.69	1.54	1.71	0.29	0.20	0.31	0.18	0.23	0.28	0.68	0.57	0.87	0.61	0.21	0.60	0.01	0.87	100
IS.2011.05	7	2.54	16.13	12.09	6.09	16.91	4.50		10.13	15.90	5.07	0.68	0.03	0.63	0.61	0.89	0.73	0.73	0.82	1.11	1.05	0.21	0.15	0.15	0.23	0.20	0.14	0.66	0.31	0.36	0.40	0.07	0.25	0.01	0.24	100
IS.2011.12	8	3.60	11.17	21.21	7.49	10.54	7.08	13.77		8.59	6.88	0.55	0.03	0.56	0.61	0.74	0.72	0.98	0.80	0.66	0.61	0.26	0.22	0.08	0.16	0.13	0.21	0.40	0.23	0.49	0.41	0.09	0.47	0.01	0.27	100
IS.2011.14	9	2.71	19.06	9.81	4.97	20.50	3.61	17.69	7.03		5.06	0.59	0.05	0.46	0.67	0.75	0.88	0.71	0.84	0.98	0.89	0.12	0.08	0.10	0.24	0.18	0.18	0.60	0.27	0.17	0.32	0.16	0.10	0.01	0.24	100
IS.2011.15	10	4.84	6.45	12.49	28.08	5.95	9.35	7.11	7.10	6.38		0.79	0.05	0.60	0.88	0.75	0.84	1.01	1.13	1.02	1.25	0.28	0.15	0.18	0.25	0.28	0.30	0.54	0.23	0.49	0.44	0.11	0.25	0.01	0.43	100
LA.2011.03	11	2.72	1.12	1.22	0.88	1.34	1.38	1.29	0.77	1.00	1.06		1.05	21.64	21.75	18.34	8.81	2.63	1.31	1.26	1.56	0.47	0.42	0.49	0.63	0.45	0.64	1.15	0.69	1.05	1.02	0.46	0.66	0.03	0.73	100
LA.2011.01	12	10.06	4.53	2.29	2.02	3.31	1.95	2.43	1.63	3.56	2.62	42.96		0.00	0.00	0.00	1.72	2.40	0.00	0.00	0.00	1.17	1.52	1.98	2.32	1.47	2.17	1.80	0.00	1.30	1.41	1.27	1.57	0.55	0.00	100
FG.2017.11	13	1.15	1.02	1.03	0.91	1.19	0.99	1.07	0.71	0.71	0.73	19.58	0.00		29.43	24.36	3.99	1.38	1.49	1.17	1.71	0.32	0.37	0.32	0.39	0.32	0.52	0.85	0.71	1.05	1.08	0.23	0.28	0.00	0.92	100
FG.2017.12	14	1.06	0.81	1.04	0.90	0.87	0.99	1.01	0.75	1.00	1.04	19.03	0.00	28.45		29.20	2.84	1.04	1.34	1.07	1.43	0.31	0.30	0.14	0.23	0.29	0.38	0.85	0.76	0.76	0.95	0.18	0.30	0.00	0.69	100
FG.2017.13	15	1.23	1.31	1.14	1.04	1.50	1.19	1.53	0.94	1.16	0.93	16.68	0.00	24.47	30.34		3.03	1.16	1.84	1.35	1.72	0.30	0.28	0.26	0.36	0.21	0.63	1.15	1.13	0.93	1.14	0.17	0.26	0.00	0.62	100
FG.2013.29	16	1.67	1.50	1.05	1.70	1.40	1.54	1.32	0.96	1.41	1.07	8.33	0.04	4.17	3.07	3.15		20.55	14.11	13.93	13.68	0.27	0.32	0.24	0.19	0.28	0.38	0.68	0.48	0.55	0.79	0.14	0.56	0.01	0.49	100
DE.2011.14	17	1.71	1.61	1.13	1.64	1.50	1.67	1.33	1.32	1.16	1.31	2.53	0.06	1.47	1.14	1.22	20.88		17.35	19.35	17.11	0.24	0.38	0.23	0.20	0.43	0.39	0.45	0.18	0.46	0.43	0.16	0.52	0.01	0.42	100
FG.2017.14	18	1.44	1.45	1.64	1.84	1.34	1.36	1.19	0.86	1.10	1.18	1.01	0.00	1.27	1.18	1.56	11.48	13.89		23.71	27.57	0.11	0.17	0.08	0.24	0.33	0.28	0.85	0.78	0.33	0.79	0.08	0.41	0.00	0.48	100
FG.2017.16	19	1.40	1.59	1.65	1.50	1.95	1.34	1.76	0.77	1.39	1.15	1.05	0.00	1.07	1.02	1.24	12.27	16.77	25.66		22.68	0.16	0.20	0.11	0.10	0.20	0.30	0.55	0.53	0.35	0.47	0.13	0.26	0.00	0.37	100
FG.2017.17	20	1.35	1.88	1.51	1.61	1.61	1.44	1.60	0.68	1.21	1.35	1.25	0.00	1.52	1.31	1.51	11.59	14.25	28.69	21.81		0.11	0.25	0.10	0.11	0.16	0.28	0.55	0.64	0.35	0.62	0.10	0.22	0.00	0.36	100
FG.2016.12	21	0.68	0.47	0.43	0.48	0.31	0.44	0.58	0.54	0.29	0.55	0.68	0.04	0.51	0.52	0.49	0.41	0.36	0.22	0.29	0.20		6.70	20.14	11.93	12.84	13.96	10.21	0.00	4.32	2.34	3.55	3.22	0.62	1.67	100
FG.2013.01	22	0.60	0.48	0.37	0.46	0.82	0.41	0.57	0.62	0.27	0.40	0.84	0.07	0.81	0.69	0.63	0.67	0.78	0.44	0.48	0.62	9.19		9.42	10.28	9.11	9.59	10.45	0.00	8.77	4.90	5.50	5.06	1.41	5.29	100
FG.2016.13	23	0.23	0.52	0.31	0.26	0.45	0.50	0.44	0.18	0.26	0.38	0.76	0.08	0.54	0.25	0.45	0.40	0.37	0.16	0.21	0.19	21.58	7.35		13.31	12.85	12.93	11.61	0.00	3.40	1.67	3.39	2.44	0.84	1.71	100
FG.2016.15	24	0.35	0.54	0.32	0.59	0.52	0.27	0.61	0.31	0.58	0.48	0.90	0.08	0.62	0.38	0.57	0.28	0.30	0.45	0.17	0.20	11.75	7.38	12.24		15.18	16.21	10.94	0.00	4.87	2.80	4.17	2.95	1.08	1.91	100
FG.2016.17	25	0.38	0.33	0.42	0.54	0.47	0.30	0.49	0.24	0.40	0.48	0.57	0.05	0.45	0.42	0.29	0.37	0.57	0.55	0.30	0.25	11.23	5.80	10.48	13.46		19.47	14.66	0.00	4.44	1.43	3.09	5.41	0.74	1.91	100
FG.2016.18	26	0.34	0.43	0.41	0.59	0.67	0.36	0.31	0.35	0.37	0.49	0.77	0.06	0.69	0.52	0.84	0.48	0.49	0.44	0.44	0.41	11.54	5.77	9.97	13.60	18.41		12.90	0.00	4.40	1.96	2.90	6.40	0.85	1.81	100
IS.2011.32	27	0.67	0.82	1.05	1.00	1.20	0.72	1.27	0.57	1.04	0.74	1.17	0.04	0.96	1.00	1.28	0.73	0.48	1.13	0.67	0.70	7.15	5.33	7.59	7.77	11.75	10.93		15.55	4.04	4.10	2.16	2.17	0.67	3.54	100
FG.2017.18	28	1.31	1.27	2.67	2.22	2.01	1.64	1.64	0.87	1.26	0.84	1.89	0.00	2.15	2.40	3.41	1.41	0.53	2.78	1.73	2.20	0.00	0.00	0.00	0.00	0.00	0.00	41.91		5.15	10.21	0.00	0.00	0.00	8.50	100
FG.2016.14	29	0.52	0.56	0.77	0.87	0.63	1.12	0.85	0.85	0.36	0.82	1.29	0.04	1.42	1.07	1.25	0.71	0.59	0.52	0.52	0.54	3.64	5.40	2.68	4.17	4.29	4.50	4.87	2.30		19.30	10.98	9.85	0.94	11.76	100
FG.2016.16	30	0.82	0.88	1.33	1.01	1.19	0.96	1.12	0.86	0.82	0.89	1.53	0.05	1.79	1.62	1.88	1.25	0.68	1.55	0.85	1.16	2.41	3.67	1.60	2.92	1.68	2.44	6.02	5.57	23.51		7.29	4.57	0.26	15.82	100
IS.2011.29	31	0.30	0.42	0.44	0.32	0.49	0.50	0.28	0.27	0.61	0.34	1.02	0.07	0.57	0.45	0.43	0.33	0.36	0.24	0.35	0.27	5.49	6.18	4.88	6.53	5.46	5.42	4.76	0.00	20.08	10.95		15.96	1.91	4.32	100
IS.2011.33	32	1.20	0.94	0.87	1.56	0.80	1.25	0.93	1.28	0.35	0.67	1.30	0.08	0.62	0.67	0.56	1.16	1.07	1.05	0.62	0.55	4.36	5.00	3.08	4.05	8.39	10.49	4.19	0.00	15.80	6.02	14.00		1.55	5.54	100
IS.2011.34	33	0.07	0.36	0.33	0.43	0.42	0.19	0.22	0.21	0.25	0.19	0.36	0.19	0.00	0.00	0.00	0.09	0.20	0.00	0.00	0.00	5.92	9.80	7.49	10.46	8.09	9.86	9.11	0.00	10.63	2.38	11.82	10.94		0.00	100
FG.2017.09	34	1.31	0.90	1.53	1.65	0.89	1.75	0.86	0.71	0.77	1.12	1.39	0.00	1.95	1.51	1.30	1.00	0.83	1.19	0.85	0.86	2.20	5.05	2.09	2.54	2.87	2.88	6.63	5.91	18.27	20.18	3.67	5.36	0.00		100

Figure 46: Animals time together Matrix FG Group. Cells in red background if > 5

This matrix considers the positions of the animals for 3 years. This means that for this matrix all the data available and suitable for analysis were used. This with the aim of achieving a very general visualization of the animals' behavior.

For better visualization, the observed groups are indicated in colors in the matrix. In the case of the FG region, 5 groups of animals were found spending time in the same areas (it can be assumed they were together).

- ### 4.1.2 Animals time together Matrix VG group

The form of construction of this matrix is the same as for the FG zone explained previously in this same section, with the only difference that the group of animals that are analyzed belong to the VG group.

First matrix obtained of VG and analysis of it

In the following figure a matrix created with 33 animals can be seen, however the area marked in red, which are the animals listed in columns 16 to 20, present something strange. Almost all of their values are too low, something that is only observed in block (same group) with these 5 animals, and in the cells where they have high values, these are too high when compared to the high values of other animals.

To understand what this means let's review the following; There are 2 ways to read the values, in reference to the # column, or in reference to the # row ID. ***Being "m" and "n" assignable variables for all rows and columns.***

- In reference to the # row ID: Here the values are read by row (horizontal rows of data) individually for each different ID. The sum of the entire row is =100%. So, the definitional meaning of each value in each cell would be: Percentage % of time that the animal in this row "n" spent in the same area, at the same time, with the animal in column "m".

This definition answers the question: how much of its life (total time in the enclosure) did the animal in row ID "n" spent in the same area and at the same time, with the animal in column "m"?

- In reference to the # column: Here the values are read by column (vertical rows of data) individually for each different #. The sum of the entire column is not = 100%.

However, this reference answers a different question: In what percentage of the life (time in the enclosure) of the animal in column "m", was the animal in row "n" present in the same area and at the same time?

As can be seen, in the first reference (by row), the reference is with respect to the total time of the animal analyzed. While in the 2nd reference (by column), the reference is regarding the total time of the other animals.

Once this is understood, it can be said that what the columns with very low values (16-20) mean is that these animals spent a very short time (of the total possible) in the enclosure with the other animals. That is why they were not a "company" of considerable time for the rest of the animals. And their high values (which by the way they only have among themselves), show that of the very short time they were in the enclosure, the vast majority was spent being among themselves. For this reason, and also because these 5 animals have the same origin and, birth date and were introduced at the same time to the enclosure, this group of animals is not taken into account in the following parts of the analysis, since their interaction with the other animals did not last long enough.

ID	#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
DE.2011.25	1		13.07	16.12	12.87	0.06	10.20	12.06	7.31	2.86	1.82	2.70	1.01	0.29	1.53	0.98	0.00	0.00	0.00	0.00	0.00	1.03	0.87	0.00	1.96	1.94	1.62	1.32	1.10	1.46	1.88	0.95	2.61	0.37
IS.2011.21	2	2.64		10.62	4.91	0.02	27.86	4.48	18.94	0.53	1.44	1.14	0.85	0.13	1.87	0.72	0.00	0.00	0.00	0.01	0.21	0.63	1.24	0.69	2.22	1.78	2.50	2.10	2.34	2.09	1.71	1.56	3.07	1.68
IS.2011.26	3	3.51	11.44		15.02	0.31	10.81	17.42	6.29	0.00	1.82	1.37	2.12	0.09	2.81	0.87	0.00	0.01	0.00	0.01	0.07	1.00	2.31	1.11	4.10	3.09	1.68	1.64	2.23	2.30	1.80	1.56	1.74	1.47
VG.2013.01	4	3.25	6.14	17.44		0.73	7.25	25.47	10.49	0.01	1.57	0.97	1.23	0.00	1.30	0.51	0.00	0.00	0.00	0.01	0.08	0.72	1.10	0.67	2.46	2.58	1.87	1.67	2.67	2.67	1.43	1.58	2.44	1.68
IS.2011.25	5	0.79	1.49	17.39	35.21		8.23	23.88	6.94	0.00	0.71	0.70	0.57	0.00	0.67	0.52	0.00	0.05	0.11	0.00	0.00	0.40	0.41	0.00	0.26	0.46	0.20	0.15	0.16	0.11	0.10	0.10	0.34	0.05
IS.2011.23	6	2.18	29.41	10.60	6.12	0.14		5.40	21.10	0.00	1.29	0.88	1.11	0.00	1.22	0.51	0.00	0.00	0.00	0.01	0.07	0.56	1.21	0.65	1.68	1.60	2.53	1.56	2.09	1.78	1.33	1.31	2.52	1.15
IS.2011.27	7	3.03	5.58	20.12	25.34	0.49	6.36		7.71	0.00	1.60	1.56	1.89	0.00	1.47	0.44	0.00	0.00	0.01	0.01	0.21	0.80	1.59	0.78	3.10	2.93	2.01	1.86	2.27	2.11	1.34	1.69	2.28	1.40
IS.2011.20	8	1.67	21.37	6.60	9.47	0.13	22.56	7.00		0.00	1.44	0.95	1.15	0.00	1.84	0.39	0.00	0.00	0.00	0.02	0.09	0.85	1.10	0.74	2.18	2.14	2.23	2.04	3.01	2.68	1.45	1.80	3.14	1.95
DE.2011.20	9	17.81	16.28	0.04	0.13	0.00	0.00	0.00	0.00		7.25	10.89	0.00	3.54	4.22	4.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	1.63	10.61	5.87	0.00	0.00	0.00	6.48	7.95	2.09
IS.2011.10	10	0.56	2.20	2.57	1.91	0.02	1.85	1.96	1.94	0.36		27.21	23.08	0.33	3.36	1.30	0.01	0.01	0.00	0.05	0.14	1.67	2.24	1.22	2.46	2.29	2.65	2.14	2.06	2.14	1.72	5.24	3.44	1.87
IS.2011.13	11	0.95	2.00	2.24	1.36	0.02	1.46	2.20	1.47	0.62	31.33		25.16	0.38	3.17	1.93	0.01	0.30	0.00	0.03	0.01	1.34	2.10	1.05	1.86	2.05	2.06	1.81	1.71	1.68	1.16	4.44	3.03	1.06
IS.2011.01	12	0.37	1.54	3.56	1.78	0.02	1.91	2.74	1.84	0.00	27.43	25.97		0.00	4.54	0.93	0.00	0.01	0.00	0.05	0.14	2.17	2.92	1.06	3.88	2.56	1.93	1.27	1.78	1.66	1.51	2.96	1.97	1.48
IS.2011.38	13	0.57	1.27	0.80	0.03	0.00	0.02	0.00	0.00	1.13	2.12	2.11	0.01		22.54	31.17	1.49	2.04	0.00	2.00	26.17	0.00	0.08	0.02	0.08	0.66	1.64	1.11	0.01	0.01	0.01	1.60	0.91	0.40
IS.2011.39	14	0.31	1.89	2.63	1.05	0.01	1.17	1.20	1.65	0.14	2.23	1.82	2.54	2.31		14.74	0.00	0.01	0.01	0.08	0.15	13.58	25.82	12.25	2.28	2.11	1.60	1.04	1.32	1.54	0.87	1.46	1.13	1.09
VG.2013.08	15	0.33	1.20	1.35	0.68	0.01	0.81	0.59	0.58	0.27	1.42	1.84	0.86	5.30	24.41		0.00	0.00	0.00	0.02	0.01	1.35	22.13	25.63	1.06	1.09	1.73	0.90	0.95	1.10	0.48	1.35	1.39	1.14
FG.2013.06	16	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.03	0.02	0.01	1.09	0.01	0.00		56.73	37.99	1.51	2.45	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.02	0.02
FG.2013.09	17	0.00	0.00	0.04	0.01	0.01	0.00	0.02	0.00	0.00	0.06	1.17	0.03	1.42	0.04	0.02	53.64		33.90	4.21	2.93	0.00	0.01	0.02	0.05	0.01	0.45	0.19	0.01	0.01	0.03	0.03	1.68	0.01
FG.2013.25	18	0.00	0.00	0.01	0.02	0.02	0.00	0.06	0.00	0.00	0.01	0.01	0.02	0.00	0.08	0.01	50.30	47.46		0.97	0.85	0.00	0.07	0.00	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.03	0.05	0.02
FG.2013.16	19	0.03	0.43	0.30	0.19	0.00	0.39	0.19	0.69	0.00	1.41	0.71	1.13	8.27	3.06	0.47	8.50	24.96	4.09		30.91	5.43	1.15	0.17	0.71	0.60	0.94	0.71	1.37	0.67	0.88	0.87	0.39	0.37
FG.2013.34	20	0.00	3.20	0.99	1.04	0.00	1.02	2.58	1.25	0.00	1.46	0.12	1.24	41.04	2.31	0.06	5.22	6.60	1.37	11.75		0.75	2.92	0.05	1.02	1.62	1.59	2.84	1.09	1.10	3.02	1.42	1.24	0.06
IS.2011.36	21	0.50	1.51	2.24	1.39	0.02	1.28	1.56	1.83	0.00	2.65	1.85	2.90	0.00	32.50	1.96	0.00	0.00	0.00	0.32	0.12		32.75	0.00	2.02	1.86	1.21	1.06	1.55	1.26	1.16	1.45	1.52	1.52
VG.2013.09	22	0.19	1.37	2.37	0.97	0.01	1.26	1.41	1.08	0.00	1.62	1.32	1.78	0.01	28.24	14.61	0.00	0.00	0.01	0.03	0.21	14.96		12.74	3.21	1.56	2.84	0.99	1.22	1.18	1.01	1.23	1.15	1.42
IS.2011.37	23	0.00	1.34	1.99	1.04	0.00	1.18	1.21	1.26	0.00	1.55	1.15	1.13	0.00	23.41	29.58	0.00	0.01	0.00	0.01	0.01	0.00	22.26		1.73	1.26	1.71	0.88	1.20	1.59	0.58	1.59	1.19	1.15
DE.2011.27	24	0.30	1.68	2.89	1.49	0.00	1.20	1.89	1.46	0.01	1.22	0.80	1.63	0.01	1.71	0.48	0.00	0.01	0.00	0.01	0.05	0.63	2.20	0.68		17.87	19.15	8.91	7.41	8.10	14.70	1.34	1.22	0.93
VG.2013.02	25	0.29	1.34	2.16	1.55	0.01	1.14	1.77	1.42	0.04	1.13	0.88	1.06	0.05	1.57	0.49	0.00	0.00	0.00	0.01	0.08	0.58	1.06	0.49	17.72		13.61	11.93	10.77	11.57	13.52	1.17	1.61	0.98
DE.2011.23	26	0.24	1.85	1.16	1.11	0.00	1.77	1.20	1.47	0.25	1.29	0.87	0.79	0.12	1.17	0.77	0.00	0.05	0.00	0.02	0.08	0.37	1.90	0.66	18.71	13.41		12.92	9.34	9.60	14.73	1.51	1.66	0.97
FG.2013.32	27	0.25	1.99	1.44	1.27	0.00	1.40	1.42	1.72	0.18	1.33	0.98	0.67	0.11	0.97	0.51	0.00	0.03	0.00	0.02	0.17	0.42	0.85	0.43	11.15	15.05	16.53		11.91	12.11	12.14	1.40	2.14	1.42
IS.2011.22	28	0.19	2.04	1.80	1.86	0.00	1.72	1.59	2.33	0.00	1.18	0.85	0.86	0.00	1.14	0.49	0.00	0.00	0.00	0.03	0.06	0.56	0.96	0.54	8.54	12.52	11.01	10.96		20.72	12.03	1.74	2.56	1.69
VG.2013.10	29	0.25	1.79	1.83	1.83	0.00	1.44	1.45	2.03	0.00	1.20	0.82	0.79	0.00	1.30	0.57	0.00	0.00	0.00	0.01	0.06	0.44	0.92	0.70	9.15	13.18	11.09	10.93	20.31		12.86	1.55	1.98	1.48
VG.2013.11	30	0.33	1.47	1.44	0.98	0.00	1.08	0.93	1.11	0.00	0.97	0.57	0.72	0.00	0.74	0.25	0.00	0.00	0.00	0.02	0.17	0.41	0.79	0.26	16.68	15.47	17.10	11.01	11.85	12.93		0.88	1.04	0.80
DE.2011.18	31	0.31	2.49	2.30	2.01	0.00	1.97	2.17	2.54	0.33	5.48	4.03	2.60	0.26	2.30	1.28	0.00	0.01	0.01	0.03	0.15	0.95	1.78	1.31	2.82	2.48	3.24	2.36	3.16	2.88	1.63		25.72	21.38
DE.2011.19	32	0.73	4.29	2.25	2.72	0.01	3.32	2.56	3.88	0.36	3.15	2.41	1.52	0.13	1.56	1.16	0.00	0.34	0.01	0.01	0.11	0.88	1.45	0.86	2.24	2.99	3.13	3.15	4.09	3.23	1.69	22.54		23.21
DE.2011.21	33	0.13	3.03	2.46	2.42	0.00	1.97	2.02	3.11	0.12	2.22	1.10	1.48	0.07	1.94	1.22	0.00	0.00	0.00	0.02	0.01	1.13	2.32	1.07	2.21	2.36	2.37	2.71	3.50	3.12	1.68	24.22	29.99	

Figure 47: Animals time together Matrix VG Group, initial version.

Second matrix obtained of VG, after filtering out 5 animals:

After removing the 5 animals in the previous section, the final matrix for VG was left with a total of 28 animals. The highest values in the initial matrix were found in the 5 animals that were extracted for this matrix, so now the color contrast in the heatmap is easier to see, the green tones begin to be seen at values close to 10, which It is the minimum value for us to consider an animal as part of a group. The fact that green coincides with these values is something visually very convenient.

ID	#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	21	22	23	24	25	26	27	28	29	30	31	32	33
DE.2011.25	1		13.07	16.12	12.87	0.06	10.20	12.06	7.31	2.86	1.82	2.70	1.01	0.29	1.53	0.98	1.03	0.87	0.00	1.96	1.94	1.62	1.32	1.10	1.46	1.88	0.95	2.61	0.37
IS.2011.21	2	2.64		10.62	4.91	0.02	27.86	4.48	18.94	0.53	1.44	1.14	0.85	0.13	1.87	0.72	0.63	1.24	0.69	2.22	1.78	2.50	2.10	2.34	2.09	1.71	1.56	3.07	1.68
IS.2011.26	3	3.51	11.44		15.02	0.31	10.81	17.42	6.29	0.00	1.82	1.37	2.12	0.09	2.81	0.87	1.00	2.31	1.11	4.10	3.09	1.68	1.64	2.23	2.30	1.80	1.56	1.74	1.47
VG.2013.01	4	3.25	6.14	17.44		0.73	7.25	25.47	10.49	0.01	1.57	0.97	1.23	0.00	1.30	0.51	0.72	1.10	0.67	2.46	2.58	1.87	1.67	2.67	2.67	1.43	1.58	2.44	1.68
IS.2011.25	5	0.79	1.49	17.39	35.21		8.23	23.88	6.94	0.00	0.71	0.70	0.57	0.00	0.67	0.52	0.40	0.41	0.00	0.26	0.46	0.20	0.15	0.16	0.11	0.10	0.10	0.34	0.05
IS.2011.23	6	2.18	29.41	10.60	6.12	0.14		5.40	21.10	0.00	1.29	0.88	1.11	0.00	1.22	0.51	0.56	1.21	0.65	1.68	1.60	2.53	1.56	2.09	1.78	1.33	1.31	2.52	1.15
IS.2011.27	7	3.03	5.58	20.12	25.34	0.49	6.36		7.71	0.00	1.60	1.56	1.89	0.00	1.47	0.44	0.80	1.59	0.78	3.10	2.93	2.01	1.86	2.27	2.11	1.34	1.69	2.28	1.40
IS.2011.20	8	1.67	21.37	6.60	9.47	0.13	22.56	7.00		0.00	1.44	0.95	1.15	0.00	1.84	0.39	0.85	1.10	0.74	2.18	2.14	2.23	2.04	3.01	2.68	1.45	1.80	3.14	1.95
DE.2011.20	9	17.81	16.28	0.04	0.13	0.00	0.00	0.00	0.00		7.25	10.89	0.00	3.54	4.22	4.92	0.00	0.00	0.00	0.29	1.63	10.61	5.87	0.00	0.00	0.00	6.48	7.95	2.09
IS.2011.10	10	0.56	2.20	2.57	1.91	0.02	1.85	1.96	1.94	0.36		27.21	23.08	0.33	3.36	1.30	1.67	2.24	1.22	2.46	2.29	2.65	2.14	2.06	2.14	1.72	5.24	3.44	1.87
IS.2011.13	11	0.95	2.00	2.24	1.36	0.02	1.46	2.20	1.47	0.62	31.33		25.16	0.38	3.17	1.93	1.34	2.10	1.05	1.86	2.05	2.06	1.81	1.71	1.68	1.16	4.44	3.03	1.06
IS.2011.01	12	0.37	1.54	3.56	1.78	0.02	1.91	2.74	1.84	0.00	27.43	25.97		0.00	4.54	0.93	2.17	2.92	1.06	3.88	2.56	1.93	1.27	1.78	1.66	1.51	2.96	1.97	1.48
IS.2011.38	13	0.57	1.27	0.80	0.03	0.00	0.02	0.00	0.00	1.13	2.12	2.11	0.01		22.54	31.17	0.00	0.08	0.02	0.08	0.66	1.64	1.11	0.01	0.01	0.01	1.60	0.91	0.40
IS.2011.39	14	0.31	1.89	2.63	1.05	0.01	1.17	1.20	1.65	0.14	2.23	1.82	2.54	2.31		14.74	13.58	25.82	12.25	2.28	2.11	1.60	1.04	1.32	1.54	0.87	1.46	1.13	1.09
VG.2013.08	15	0.33	1.20	1.35	0.68	0.01	0.81	0.59	0.58	0.27	1.42	1.84	0.86	5.30	24.41		1.35	22.13	25.63	1.06	1.09	1.73	0.90	0.95	1.10	0.48	1.35	1.39	1.14
IS.2011.36	21	0.50	1.51	2.24	1.39	0.02	1.28	1.56	1.83	0.00	2.65	1.85	2.90	0.00	32.50	1.96		32.75	0.00	2.02	1.86	1.21	1.06	1.55	1.26	1.16	1.45	1.52	1.52
VG.2013.09	22	0.19	1.37	2.37	0.97	0.01	1.26	1.41	1.08	0.00	1.62	1.32	1.78	0.01	28.24	14.61	14.96		12.74	3.21	1.56	2.84	0.99	1.22	1.18	1.01	1.23	1.15	1.42
IS.2011.37	23	0.00	1.34	1.99	1.04	0.00	1.18	1.21	1.26	0.00	1.55	1.15	1.13	0.00	23.41	29.58	0.00	22.26		1.73	1.26	1.71	0.88	1.20	1.59	0.58	1.59	1.19	1.15
DE.2011.27	24	0.30	1.68	2.89	1.49	0.00	1.20	1.89	1.46	0.01	1.22	0.80	1.63	0.01	1.71	0.48	0.63	2.20	0.68		17.87	19.15	8.91	7.41	8.10	14.70	1.34	1.22	0.93
VG.2013.02	25	0.29	1.34	2.16	1.55	0.01	1.14	1.77	1.42	0.04	1.13	0.88	1.06	0.05	1.57	0.49	0.58	1.06	0.49	17.72		13.61	11.93	10.77	11.57	13.52	1.17	1.61	0.98
DE.2011.23	26	0.24	1.85	1.16	1.11	0.00	1.77	1.20	1.47	0.25	1.29	0.87	0.79	0.12	1.17	0.77	0.37	1.90	0.66	18.71	13.41		12.92	9.34	9.60	14.73	1.51	1.66	0.97
FG.2013.32	27	0.25	1.99	1.44	1.27	0.00	1.40	1.42	1.72	0.18	1.33	0.98	0.67	0.11	0.97	0.51	0.42	0.85	0.43	11.15	15.05	16.53		11.91	12.11	12.14	1.40	2.14	1.42
IS.2011.22	28	0.19	2.04	1.80	1.86	0.00	1.72	1.59	2.33	0.00	1.18	0.85	0.86	0.00	1.14	0.49	0.56	0.96	0.54	8.54	12.52	11.01	10.96		20.72	12.03	1.74	2.56	1.69
VG.2013.10	29	0.25	1.79	1.83	1.83	0.00	1.44	1.45	2.03	0.00	1.20	0.82	0.79	0.00	1.30	0.57	0.44	0.92	0.70	9.15	13.18	11.09	10.93	20.31		12.86	1.55	1.98	1.48
VG.2013.11	30	0.33	1.47	1.44	0.98	0.00	1.08	0.93	1.11	0.00	0.97	0.57	0.72	0.00	0.74	0.25	0.41	0.79	0.26	16.68	15.47	17.10	11.01	11.85	12.93		0.88	1.04	0.80
DE.2011.18	31	0.31	2.49	2.30	2.01	0.00	1.97	2.17	2.54	0.33	5.48	4.03	2.60	0.26	2.30	1.28	0.95	1.78	1.31	2.82	2.48	3.24	2.36	3.16	2.88	1.63		25.72	21.38
DE.2011.19	32	0.73	4.29	2.25	2.72	0.01	3.32	2.56	3.88	0.36	3.15	2.41	1.52	0.13	1.56	1.16	0.88	1.45	0.86	2.24	2.99	3.13	3.15	4.09	3.23	1.69	22.54		23.21
DE.2011.21	33	0.13	3.03	2.46	2.42	0.00	1.97	2.02	3.11	0.12	2.22	1.10	1.48	0.07	1.94	1.22	1.13	2.32	1.07	2.21	2.36	2.37	2.71	3.50	3.12	1.68	24.22	29.99	

Figure 48: Animals time together Matrix VG Group, final version. Cells encircled if > 10

Amplified perspective of the VG Matrix

In the previous Matrix a grouping made with a minimum value of 10 is seen. While in this matrix a slightly different perspective is provided, the initial grouping is maintained, but the marking (in red background) of all cells with a value of 5 or higher is added. This is a less strict criterion, which seeks to see and demonstrate that even with a more permissible criterion, the initial clustering remains correct.

ID	#	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
DE.2011.25	1		13.07	16.12	12.87	0.06	10.20	12.06	7.31	2.86	1.82	2.70	1.01	0.29	1.53	0.98	1.03	0.87	0.00	1.96	1.94	1.62	1.32	1.10	1.46	1.88	0.95	2.61	0.37
IS.2011.21	2	2.64		10.62	4.91	0.02	27.86	4.48	18.94	0.53	1.44	1.14	0.85	0.13	1.87	0.72	0.63	1.24	0.69	2.22	1.78	2.50	2.10	2.34	2.09	1.71	1.56	3.07	1.68
IS.2011.26	3	3.51	11.44		15.02	0.31	10.81	17.42	6.29	0.00	1.82	1.37	2.12	0.09	2.81	0.87	1.00	2.31	1.11	4.10	3.09	1.68	1.64	2.23	2.30	1.80	1.56	1.74	1.47
VG.2013.01	4	3.25	6.14	17.44		0.73	7.25	25.47	10.49	0.01	1.57	0.97	1.23	0.00	1.30	0.51	0.72	1.10	0.67	2.46	2.58	1.87	1.67	2.67	2.67	1.43	1.58	2.44	1.68
IS.2011.25	5	0.79	1.49	17.39	35.21		8.23	23.88	6.94	0.00	0.71	0.70	0.57	0.00	0.67	0.52	0.40	0.41	0.00	0.26	0.46	0.20	0.15	0.16	0.11	0.10	0.10	0.34	0.05
IS.2011.23	6	2.18	29.41	10.60	6.12	0.14		5.40	21.10	0.00	1.29	0.88	1.11	0.00	1.22	0.51	0.56	1.21	0.65	1.68	1.60	2.53	1.56	2.09	1.78	1.33	1.31	2.52	1.15
IS.2011.27	7	3.03	5.58	20.12	25.34	0.49	6.36		7.71	0.00	1.60	1.56	1.89	0.00	1.47	0.44	0.80	1.59	0.78	3.10	2.93	2.01	1.86	2.27	2.11	1.34	1.69	2.28	1.40
IS.2011.20	8	1.67	21.37	6.60	9.47	0.13	22.56	7.00		0.00	1.44	0.95	1.15	0.00	1.84	0.39	0.85	1.10	0.74	2.18	2.14	2.23	2.04	3.01	2.68	1.45	1.80	3.14	1.95
DE.2011.20	9	17.81	16.28	0.04	0.13	0.00	0.00	0.00	0.00		7.25	10.89	0.00	3.54	4.22	4.92	0.00	0.00	0.00	0.29	1.63	10.61	5.87	0.00	0.00	0.00	6.48	7.95	2.09
IS.2011.10	10	0.56	2.20	2.57	1.91	0.02	1.85	1.96	1.94	0.36		27.21	23.08	0.33	3.36	1.30	1.67	2.24	1.22	2.46	2.29	2.65	2.14	2.06	2.14	1.72	5.24	3.44	1.87
IS.2011.13	11	0.95	2.00	2.24	1.36	0.02	1.46	2.20	1.47	0.62	31.33		25.16	0.38	3.17	1.93	1.34	2.10	1.05	1.86	2.05	2.06	1.81	1.71	1.68	1.16	4.44	3.03	1.06
IS.2011.01	12	0.37	1.54	3.56	1.78	0.02	1.91	2.74	1.84	0.00	27.43	25.97		0.00	4.54	0.93	2.17	2.92	1.06	3.88	2.56	1.93	1.27	1.78	1.66	1.51	2.96	1.97	1.48
IS.2011.38	13	0.57	1.27	0.80	0.03	0.00	0.02	0.00	0.00	1.13	2.12	2.11	0.01		22.54	31.17	0.00	0.08	0.02	0.08	0.66	1.64	1.11	0.01	0.01	0.01	1.60	0.91	0.40
IS.2011.39	14	0.31	1.89	2.63	1.05	0.01	1.17	1.20	1.65	0.14	2.23	1.82	2.54	2.31		14.74	13.58	25.82	12.25	2.28	2.11	1.60	1.04	1.32	1.54	0.87	1.46	1.13	1.09
VG.2013.08	15	0.33	1.20	1.35	0.68	0.01	0.81	0.59	0.58	0.27	1.42	1.84	0.86	5.30	24.41		1.35	22.13	25.63	1.06	1.09	1.73	0.90	0.95	1.10	0.48	1.35	1.39	1.14
IS.2011.36	16	0.50	1.51	2.24	1.39	0.02	1.28	1.56	1.83	0.00	2.65	1.85	2.90	0.00	32.50	1.96		32.75	0.00	2.02	1.86	1.21	1.06	1.55	1.26	1.16	1.45	1.52	1.52
VG.2013.09	17	0.19	1.37	2.37	0.97	0.01	1.26	1.41	1.08	0.00	1.62	1.32	1.78	0.01	28.24	14.61	14.96		12.74	3.21	1.56	2.84	0.99	1.22	1.18	1.01	1.23	1.15	1.42
IS.2011.37	18	0.00	1.34	1.99	1.04	0.00	1.18	1.21	1.26	0.00	1.55	1.15	1.13	0.00	23.41	29.58	0.00	22.26		1.73	1.26	1.71	0.88	1.20	1.59	0.58	1.59	1.19	1.15
DE.2011.27	19	0.30	1.68	2.89	1.49	0.00	1.20	1.89	1.46	0.01	1.22	0.80	1.63	0.01	1.71	0.48	0.63	2.20	0.68		17.87	19.15	8.91	7.41	8.10	14.70	1.34	1.22	0.93
VG.2013.02	20	0.29	1.34	2.16	1.55	0.01	1.14	1.77	1.42	0.04	1.13	0.88	1.06	0.05	1.57	0.49	0.58	1.06	0.49	17.72		13.61	11.93	10.77	11.57	13.52	1.17	1.61	0.98
DE.2011.23	21	0.24	1.85	1.16	1.11	0.00	1.77	1.20	1.47	0.25	1.29	0.87	0.79	0.12	1.17	0.77	0.37	1.90	0.66	18.71	13.41		12.92	9.34	9.60	14.73	1.51	1.66	0.97
FG.2013.32	22	0.25	1.99	1.44	1.27	0.00	1.40	1.42	1.72	0.18	1.33	0.98	0.67	0.11	0.97	0.51	0.42	0.85	0.43	11.15	15.05	16.53		11.91	12.11	12.14	1.40	2.14	1.42
IS.2011.22	23	0.19	2.04	1.80	1.86	0.00	1.72	1.59	2.33	0.00	1.18	0.85	0.86	0.00	1.14	0.49	0.56	0.96	0.54	8.54	12.52	11.01	10.96		20.72	12.03	1.74	2.56	1.69
VG.2013.10	24	0.25	1.79	1.83	1.83	0.00	1.44	1.45	2.03	0.00	1.20	0.82	0.79	0.00	1.30	0.57	0.44	0.92	0.70	9.15	13.18	11.09	10.93	20.31		12.86	1.55	1.98	1.48
VG.2013.11	25	0.33	1.47	1.44	0.98	0.00	1.08	0.93	1.11	0.00	0.97	0.57	0.72	0.00	0.74	0.25	0.41	0.79	0.26	16.68	15.47	17.10	11.01	11.85	12.93		0.88	1.04	0.80
DE.2011.18	26	0.31	2.49	2.30	2.01	0.00	1.97	2.17	2.54	0.33	5.48	4.03	2.60	0.26	2.30	1.28	0.95	1.78	1.31	2.82	2.48	3.24	2.36	3.16	2.88	1.63		25.72	21.38
DE.2011.19	27	0.73	4.29	2.25	2.72	0.01	3.32	2.56	3.88	0.36	3.15	2.41	1.52	0.13	1.56	1.16	0.88	1.45	0.86	2.24	2.99	3.13	3.15	4.09	3.23	1.69	22.54		23.21
DE.2011.21	28	0.13	3.03	2.46	2.42	0.00	1.97	2.02	3.11	0.12	2.22	1.10	1.48	0.07	1.94	1.22	1.13	2.32	1.07	2.21	2.36	2.37	2.71	3.50	3.12	1.68	24.22	29.99	

Figure 49: Animals time together Matrix VG Group, final version. Cells in red background if > 5

As in the FG group, in VG 5 groups of animals were identified. It is worth mentioning that the number of total animals in both groups is practically the same, 34 in FG and 33 in VG.

The identified groups have a similar pattern in number of members, regularly having less than 10 members and the red group VG being the largest, with 9 members.

The smallest group is green VG and like the smallest group in the FG group, it has 3 members.

As in the FG group, in the matrix it can be seen something that could be called "subgroups". These are groups to which the animals belong (mostly indicated in yellow in the matrix, due to their intermediate values) but have lower time-sharing values. This means that there are approaches and contact between these animals, but less than with the animals in their main group. This may be a product of the limited space available in semi-natural conditions and the social nature of these animals.

- ### 4.1.3 Heatmaps by positions FG (general overview)

This section shows the results of the positions heatmaps, whose construction is shown in detail in the previous section "Building the position's heatmaps".

Heatmap area FG of the positions of all animals during the 3 years (general overview)

This heatmap indicates the average of time that the sows spent in each of the zones in total. Allowing us to observe a very big influence of the feeding zone AC and also AB. Therefore, and as mentioned in the building process, for the following heatmaps these 2 areas are going to be omitted, so that the behavior in the other areas can be better observed without the influence of the feeding areas.

	A	B	C	D	E	F
A	5.45	15.64	30.11	0.58	0.07	0.06
B	7.64	6.61	2.78	0.25	0.15	0.12
C	9.82	3.04	0.68	0.08	0.08	0.49
D	6.41	6.09	3.58	0.49	0.07	0.05

Figure 50: Grid´s general overview (FG). All animals from FG during 2017-2019.

Heatmaps area FG by groups of animals 2017-2019

The following 5 heatmaps show, in color scale and numerically, a magnitude that represents the amount of time the groups of animals spend in each of the areas. It should be remembered that in this section only animals that were in the FG area are shown, so the areas of greatest presence will be almost exclusively on the left side of the map (FG).

For this group of heatmaps, the time period from 2017 to 2019 and all animals in the FG group were taken into consideration. In the first heatmap, all the animals are considered together, to have a general overview of the map and the presence of the animals in it, and in the following maps, only animals belonging to each of the groups of animals indicated colors are taken into consideration. It is here where it can be seen that the groups of animals have different preference areas from the others, and have a greater presence in different areas of the map. There is no group that repeats exactly the same areas of high presence on the map. One of the most notable observations is that the largest group is the one with the greatest presence in the areas immediately closest to the feeding areas.

Heatmap average of time % blue group by area	A	B	C	D	E	F
A	1.49			0.79	0.05	0.00
B	2.43	7.77	10.49	0.33	0.11	0.04
C	6.48	7.49	1.18	0.09	0.00	0.00
D	16.99	22.96	19.90	1.41	0.01	0.00

Figure 51: Blue group (FG)

Heatmap average of time % red group by area	A	B	C	D	E	F
A	8.86			0.19	0.00	0.06
B	17.56	12.01	5.18	0.02	0.02	0.00
C	22.78	4.83	0.76	0.00	0.00	0.00
D	12.73	9.62	4.73	0.67	0.00	0.00

Figure 52: Red group (FG)

Heatmap average of time % pink group by area	A	B	C	D	E	F
A	10.93			0.17	0.00	0.00
B	15.56	10.23	3.07	0.06	0.00	0.01
C	17.18	5.87	2.74	0.06	0.00	0.00
D	10.70	15.57	7.15	0.75	0.00	0.00

Figure 53: Purple group (FG)

Heatmap average of time % orange group by area	A	B	C	D	E	F
A	13.28			0.46	0.00	0.00
B	15.69	10.52	2.53	0.07	0.07	0.00
C	21.88	5.40	0.38	0.01	0.00	0.00
D	16.99	9.34	3.15	0.23	0.00	0.00

Figure 54: Orange group (FG)

Heatmap average of time % green group by area	A	B	C	D	E	F
A	14.22			2.75	0.37	0.25
B	15.11	15.59	7.50	1.21	0.68	0.58
C	16.74	5.16	1.53	0.63	0.41	0.46
D	6.45	4.60	4.04	1.14	0.35	0.23

Figure 55: Green group (FG)

The green group is the most numerous in FG, and shows clear dominance over the areas closest to the feeding areas.

The smallest group is the one that is generally furthest from the feeding areas.

The other groups, which are of an intermediate size, seem to somehow share the same areas in a more balanced way, however even so, the distribution between them is not exactly the same.

- ### 4.1.4 Heatmaps by positions VG (general overview)

The way this heatmap is constructed for VG is the same as for FG, which has already been explained previously. The only difference is that in this section the results of the group of animals belonging to VG are shown, therefore the significant values are shown reloaded on the right side (the VG part of the map).

Heatmap area VG of the average all animals all times (general overview)

This heatmap indicates the magnitude representative amount of time that the sows spent in each of the square areas in total from 2017-2019. Allowing us to observe a very big influence of the feeding zone BD. Therefore, for the following heatmaps this zone in VG is going to be omitted, so that the behavior in the other areas can be better observed without the influence of the feeding area.

	A	B	C	D	E	F
A	0.00	0.00	0.30	10.30	4.74	2.50
B	0.00	0.02	0.16	17.93	10.95	6.33
C	0.00	0.00	0.01	8.52	7.37	8.94
D	0.00	0.00	2.25	6.76	6.90	2.45

Figure 56: Grid´s general overview (VG). All animals from VG during 2017-2019.

Heatmaps area VG by groups of animals 2017-2019

As shown for FG, the following 5 heatmaps show, in color scale and numerically, a magnitude that represents the amount of time the groups of animals spend in each of the areas. In this section only animals that were mostly in the VG area are shown. The areas of greatest presence will be almost exclusively on the right side of the map (VG).

For this group of heatmaps, the time period from 2017 to 2019 and all animals in the VG group were taken into consideration. In the first heatmap, all the animals are considered together, to have a general overview of the map and the presence of the animals in it, and in these following maps, only animals belonging to each of the groups of animals indicated colors are taken into consideration. Showing the same trend as in FG, all the groups seem to have a considerable different positioning, there are no groups repeating exactly the same zones in the same magnitudes of time.

	A	B	C	D	E	F
A	0.00	0.00	0.53	16.80	6.10	4.57
B	0.00	0.00	0.03		12.95	8.61
C	0.00	0.00	0.00	9.37	7.25	11.40
D	0.00	0.00	3.54	9.07	7.17	2.61

Figure 57: Orange group (VG)

	A	B	C	D	E	F
A	0.00	0.01	0.10	6.20	2.46	1.03
B	0.00	0.00	0.00		12.72	5.21
C	0.00	0.00	0.00	10.93	13.22	10.71
D	0.00	0.00	2.32	10.90	19.39	4.79

Figure 58: Blue group (VG)

	A	B	C	D	E	F
A	0.00	0.00	0.31	12.73	3.93	1.69
B	0.00	0.01	0.01		10.79	7.80
C	0.00	0.00	0.01	9.95	6.91	14.05
D	0.00	0.02	8.24	12.22	6.66	4.66

Figure 59: Purple group (VG)

	A	B	C	D	E	F
A	0.00	0.00	0.49	15.48	7.53	3.95
B	0.00	0.07	0.68		16.50	10.34
C	0.00	0.00	0.06	12.50	10.41	11.82
D	0.00	0.00	0.00	5.39	3.20	1.26

Figure 60: Red group (VG)

	A	B	C	D	E	F
A	0.00	0.00	0.72	19.62	14.21	7.12
B	0.00	0.00	0.03		17.11	8.92
C	0.00	0.00	0.00	10.13	4.41	7.45
D	0.00	0.00	0.64	4.66	3.08	1.90

Figure 61: Green group (VG)

Unlike the overwhelming dominance that the green group in FG seems to have over the areas near the food, in VG this is not the case. There seems to be a dominance of the red group, but it is not as overwhelming as that of the green group in FG.

The smaller groups don't seem to be as far behind or isolated in one area of the map as they are in FG. However, the blue group (which is not one of the smallest) has as its main occupation zone, the zone on the lower edge of the map.

In general, the positions in VG seem to be much more balanced than in FG, but they are still different from each other.

- ### 4.1.5 FG Heatmap winter vs summer

In this section the results are observed in positional heatmaps but emphasizing changes in climatic and temporal conditions. Specifically, a comparison is made of the positions of the animals in summer vs. winter, using the most representative months and with temperatures that are more drastically different between them. In the case of winter, the months of January and February are used, and in the case of summer, the months of July and August are used.

The seasonal comparisons are shown below, pairs of heatmaps showing winter on the left side and summer on the right side (data from all 3 years together in total). There are 4 pairs of heatmaps that are compared, these are a general overview, including all the animals from the FG or VG area, and then the most numerous groups of each of them are shown. Being the most dominant groups, and after having observed in the previous section that their positioning seems to be dominant over that of the other groups, it can be inferred that the behavior of these 2 main groups is representative of what the animals really want to do, where they want to position themselves, because being the dominant groups, they decide first over the other groups, while the behavior or positioning of the other groups is a response to the climatic stimuli of the season, but also to the action position of the largest group in the area.

FG Heatmap winter-summer, 2017-2019

FG	A	B	C	D	E	F
A	10.61			1.06	0.04	0.00
B	14.78	14.28	10.33	0.24	0.33	0.03
C	17.68	4.98	1.75	0.09	0.08	0.05
D	8.70	8.51	5.94	0.50	0.01	0.00

Figure 62: Winter (FG). All animals of FG.

FG	A	B	C	D	E	F
A	12.99			11.41	0.10	0.02
B	11.47	10.95	2.84	0.34	0.16	0.10
C	19.52	4.55	0.82	0.27	0.22	0.04
D	11.41	10.62	5.51	0.85	0.12	0.11

Figure 63: Summer (FG). All animals of FG.

	A	B	C	D	E	F
A	14.37			2.74	0.10	0.01
B	17.24	16.32	14.52	0.66	0.85	0.09
C	17.63	3.53	2.27	0.21	0.22	0.15
D	4.16	1.88	2.03	1.01	0.02	0.01

Figure 64: Winter, green group (FG)

	A	B	C	D	E	F
A	16.88	0.00	0.00	1.58	0.31	0.06
B	12.54	17.34	5.27	1.07	0.50	0.32
C	17.61	4.08	1.48	0.81	0.69	0.12
D	6.67	4.62	5.65	1.73	0.36	0.34

Figure 65: Summer, green group (FG)

The areas that concentrate a greater concurrence of animals in the overview that includes all the animals in the group are not significantly different in summer than in winter. In the winter the animals are more dispersed while in the summer 1 single zone monopolizes the greatest activity, the "CA" zone. The CA zone includes a pond (the only one included within the spectrum of the "x" and "y" coordinates), it is assumed that this behavior responds to the search for a place to cool off in the summer.

The green group (the most numerous) does not show such great changes, it only shows less dispersion (fewer red areas with 4/4 quarters), they probably only retain the dominant position near the entrance to the feeding areas, and in the summer they disperse less.

- ### 4.1.6 VG Heatmap winter vs summer

These VG heatmaps work in the same way as for FG, which has already been explained previously in this section. The only difference is that the group of animals belonging to VG is analyzed.

VG Heatmap winter-summer, 2017-2019

VG	A	B	C	D	E	F
A	0.00	0.00	0.20	15.78	6.35	4.38
B	0.00	0.00	0.00		18.62	8.64
C	0.00	0.00	0.01	5.27	8.38	8.48
D	0.00	0.00	3.01	6.52	12.25	2.11

Figure 66: Winter (VG)

VG	A	B	C	D	E	F
A	0.00	0.03	0.28	15.05	8.25	3.04
B	0.00	0.00	0.00		16.88	7.64
C	0.00	0.00	0.00	6.07	8.31	12.39
D	0.00	0.00	1.29	6.96	10.18	3.62

Figure 67: Summer (VG)

	A	B	C	D	E	F
A	0.00	0.00	0.07	14.82	6.55	2.71
B	0.00	0.00	0.00		23.62	12.56
C	0.00	0.00	0.04	4.54	18.77	10.75
D	0.00	0.00	0.06	1.64	2.53	1.34

Figure 68: Red group, winter (VG)

	A	B	C	D	E	F
A	0.00	0.00	0.25	16.39	14.57	4.27
B	0.00	0.00	0.00		21.96	9.29
C	0.00	0.00	0.00	6.36	5.82	13.49
D	0.00	0.00	0.37	4.52	1.71	0.99

Figure 69: Red group, summer (VG)

For the VG red group winter-summer It is difficult in this VG area to observe obvious changes in animal dispersal between summer and winter. This may be due to the lack of a pond, and this could be one less stimulus for the movement in its positioning in summer.

- ### 4.1.7 Climate temperatures vs positioning correlations

Below are comparisons of animal positioning with changes in temperature of weather. Unlike the "winter vs summer" group of heatmaps, the parameter here that is used for control and segmentation of the data is not the months of the year, but the ambient temperature. The following is done using once again a form of discretization but applied to temperatures, taking the total range of recorded temperatures (with sufficient data, or occurrences) over 3 years and dividing it into sections. The range of temperatures with significant occurrence goes from 0c° to 45°, the sections are made every 15c°, in this way the temperature sections are from 0c° to 15c°, from 15c° to 30° and from 30c° at 45°. It is true that there are temperatures below 0° and greater than 45°, but the occurrences were not comparable with other temperatures, and given that general behaviors are initially being explored, it was decided not to include these temperatures outside this range.

Heatmap FG, temperature is 0-15 c° vs 30-45 c°

This first heatmap by temperatures shows a comparison between the positions of all FG animals in temperatures of 0c° and 15c° and their positions in temperatures between 30c° and 45c°, over 3 years (2017-2019). Feeding areas are omitted to prevent their high influence on the animals' behavior from affecting the visibility of other trends.

	A	B	C	D	E	F
A	9.92			1.63	0.05	0.07
B	12.79	13.75	8.95	0.43	0.43	0.03
C	14.12	6.53	1.99	0.11	0.08	0.09
D	11.10	10.34	6.77	0.79	0.02	0.02

Figure 70: Heatmap FG when temperature is 0-15 c°

	A	B	C	D	E	F
A	8.51			0.14	0.02	0.01
B	13.98	13.36	3.18	0.68	0.30	0.24
C	24.55	5.79	0.24	0.30	0.17	0.17
D	15.17	8.14	4.47	0.47	0.09	0.04

Figure 71: Heatmap FG when temperature is 30-45 c°

In the same way as observed in the "winter vs summer" heatmaps, in this comparison the same trend of greater distribution in winter than in summer can be observed in FG. This refers to the fact that the red zones (indicator of longer stay time) are more in winter than in summer, but it can also be confirmed by observing the pie chart of each of the zones. In the coldest temperatures there are 3 zones with 4/4 quarters, while in the hottest temperatures there is only 1 zone with 4/4 quarters, and it is again the area where the "CA" pond is.

Heatmap VG, temperature is 0-15 c° vs 30-45 c°

The logic of these heatmaps by temperature is the same as for FG, which has already been previously explained. The only difference is that these results are using animals from the VG area.

	A	B	C	D	E	F
A	0.00	0.00	0.28	15.79	5.40	2.84
B	0.00	0.00	0.04		17.55	8.65
C	0.00	0.00	0.02	12.12	10.36	7.09
D	0.00	0.00	3.41	6.96	7.79	1.68

Figure 72: Heatmap VG when temperature is 0-15 c°

	A	B	C	D	E	F
A	0.00	0.00	0.80	9.95	6.94	1.39
B	0.00	1.27	0.00		18.44	8.16
C	0.00	0.00	0.01	19.05	4.59	12.55
D	0.00	0.00	1.11	7.93	4.95	2.87

Figure 73: Heatmap VG when temperature is 30-45 c°

Just as seen in the "winter vs summer" heatmaps, in this temperature comparison, it is difficult to observe an obvious change in the positioning of the animals between cold and warm temperatures. And again, this may be influenced by the lack of a pond in this part of the map.

5 Analysis and results (Distances perspective)

At the beginning of the development of this research work, it was not considered to carry out a perspective of distances, however as the work evolved, it was possible to see that there was a possibility of exploring from this perspective. In order to carry it out, it was necessary to add an extra feature to the original position's dataset. The idea is as follows, if a plot can be done in chronological order with each location of each of the animals during the 3 years, then also the distance between each of those location points can be calculated. The displacement is an excellent reference for the magnitude of movement of the animals. The perspective of distance traveled has very productive results on this research work, and combined with the perspective of positions and group stability, it is very helpful to paint the reality of behavior that these animals have in a semi-natural environment.

5.1 Distances approach:

The distances perspective consists of different tools and graphs to create a general view of the number of meters or kilometers that the animals moved in a specific time. These tools show the movements of the animals in the 2 areas of the "research" enclosure FG and VG separately and by groups, using the groups of animals identified in the “animals group classification” section.

These tools also include (some of them) a perspective on weather conditions. The climate and the season or moment of the year are factors that are determining in the behavior of these animals.

In this results section, matrices with numerical values and heatmaps are shown, that seek to represent and show in a visual way what the general behavior of the boars is. The analysis is done from different approaches to generate a complete perspective from different points of view.

- ### 5.1.1 Distances calculation:

The distance data is included in each of the instants (rows) of the position's dataset. This data was used to generate the graphs in this section.

To calculate the distances, it was necessary to add in each of the rows of the position's dataset, the next position where the animal was. Some considerations were necessary for this data management, for example, when executing this operation, the data had to be sorted by animal ID (1) and in chronological order (2). This way we are sure that the chronological sequence is correct.

As has been observed in the datasets section regarding data reduction, the position dataset only has 1 instant recorded for every 10 minutes (over 3 years of data), which is the 1st instant recorded every 10 minutes, in chronological order. So, the calculation is conditioned to this situation, the distance is the result of calculating the distance between 2 points (x, y) approximately every 10 minutes, the points are the current position of the animal and the next position of the animal. The majority of records are every 10 minutes, but there are also several moments with variations of a few minutes, and also some holes in time with no instants recorded. There is not much that can be done about it since this depends on the original state of the data. However, this is why the following visualizations are needed, to be able to observe and take decisions over considerations needed when using the data for deeper analysis.

Although there are variations in time between some moments and others, it is considered that the distance data is valid and is the best possible approximation, since the animal did move from point A to point B, although in the case that information is not available for long periods of time, some movement points or positions of the "curve" (path) that the animal traveled are lost and the final approach may appear to be a straight line in a trajectory that could be more like a curve. However, it is still a very good approximation of the distance traveled by the animals and pretty much the best possible approximation when using this reduced dataset.

Description of main the graph's features

FG 2017, distances in KM, by months. Each row is a different KM heatmap													
ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	Total
FG.2016.03	0.00	1.02	7.40	0.76	9.40	11.93	8.90	3.84	4.67	6.29	8.70	8.29	71.18
FG.2016.05	0.00	0.67	6.85	0.60	4.13	8.62	9.83	3.58	4.48	5.34	7.85	6.58	58.53
FG.2016.07	0.00	0.73	8.53	0.81	5.24	8.83	9.82	3.59	1.13	4.63	8.10	5.90	57.31
IS.2011.02	0.00	0.96	8.63	1.01	9.43	9.97	9.17	4.03	4.71	5.77	8.30	6.99	68.96
IS.2011.04	0.00	0.70	6.81	0.00	3.32	8.55	9.84	3.48	4.24	5.37	9.83	5.87	57.99
IS.2011.05	0.00	0.79	9.16	0.00	3.88	9.78	12.53	4.74	6.16	6.01	8.52	7.67	69.25
IS.2011.11	0.00	2.12	16.92	1.74	32.68	46.04	19.98	6.37	4.93	9.43	3.14	6.23	149.57
IS.2011.12	0.00	0.78	7.35	0.00	3.36	8.88	9.94	3.77	4.03	5.59	8.05	6.34	58.10
IS.2011.14	0.00	0.93	8.12	0.83	8.73	9.62	9.39	3.65	4.99	5.68	7.65	6.44	66.04
IS.2011.15	0.00	0.73	8.74	0.35	4.64	9.28	10.25	4.14	4.59	6.46	8.49	6.15	63.81
FG.2016.12	0.00	0.49	6.42	0.89	7.69	11.38	13.58	5.20	4.84	4.66	5.35	9.40	69.87
FG.2016.13	0.00	0.53	6.59	0.94	7.58	10.51	13.14	5.08	4.77	4.90	5.23	9.82	69.09
FG.2016.15	0.00	0.46	6.43	0.84	6.09	10.07	14.25	5.03	4.75	4.75	4.47	9.67	66.80
FG.2016.17	0.00	0.53	6.45	0.81	4.55	10.84	14.78	5.29	4.82	4.83	4.85	10.00	67.75
FG.2016.18	0.00	0.44	6.28	0.79	4.62	10.58	14.64	5.28	4.86	4.71	4.91	9.88	66.99
FG.2017.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IS.2011.32	0.00	0.62	8.10	0.00	3.70	10.19	14.22	5.32	5.10	5.18	5.67	10.71	68.81
FG.2013.01	0.00	0.63	6.76	0.00	3.85	6.80	8.35	3.17	4.11	7.19	6.83	10.23	57.92
FG.2017.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.01	8.80	13.59	28.39
FG.2017.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.04	8.08	13.87	27.99
FG.2017.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.42	6.92	12.98	25.31
LA.2011.01	0.00	1.42	10.48	0.63	10.64	0.73	0.00	0.00	0.00	0.00	0.00	0.00	23.90
LA.2011.03	0.00	0.98	5.48	0.56	11.83	14.51	15.49	7.10	6.12	11.02	9.98	14.40	97.48
FG.2016.14	0.00	0.46	6.07	0.28	6.66	12.75	14.97	7.94	6.75	6.43	3.56	8.25	74.12
FG.2016.16	0.00	0.42	0.32	0.09	1.20	0.56	0.03	0.00	0.00	1.99	2.60	7.96	15.18
FG.2017.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.88	3.56	7.53	12.98
IS.2011.29	0.00	0.54	5.53	0.00	6.93	11.23	14.00	7.38	6.55	5.31	3.60	8.95	70.03
IS.2011.33	0.00	0.47	5.83	0.19	7.60	11.72	14.26	7.62	6.31	6.47	4.16	8.82	73.45
IS.2011.34	0.00	0.48	6.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.83
FG.2017.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.42	13.49	12.69	32.59
FG.2017.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.50	13.52	13.85	33.86
FG.2017.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.66	13.59	12.30	32.54
FG.2013.29	0.00	0.93	9.00	0.16	14.34	16.68	18.49	6.15	7.36	10.69	12.93	14.02	110.75
DE.2011.14	0.00	0.89	11.79	0.80	14.84	18.69	18.91	6.44	8.60	15.33	15.98	15.25	127.53
Outside Temperature TX5 (°C)	NA	18.61	16.95	9.61	21.86	30.42	30.06	29.23	15.64	12.38	5.42	2.95	
Inside Humidity (%)	NA	61.61	64.61	62.91	61.49	55.65	57.62	56.26	65.99	69.64	74.61	76.63	
Solar Radiation TX4	NA	NA	18.048	97.291	256.39	351.84	336.22	182.12	95.362	48.019	8.6206	22.496	
Rain Amount TX4 (mm)	NA	NA	0.0071	0.0141	0.0064	0.015	0.0281	0.018	0.0404	0.0075	0.0108	0.0096	
Wind Speed TX4 (k/hr)	NA	NA	1.8645	7.5924	5.5029	5.0041	4.7403	4.7705	4.1722	4.7054	4.6824	5.5965	

Figure 74: Example figure, as visual aid for the description of these kind of tables.

- Units of the white-blue-purple heatmaps and total columns are in KM units.

- ID Sow column: Shows the selected animals from the FG or VG region, grouped in colors according to the group in which they were identified for a better general visualization.

- Central columns: months, weeks or hours, from the years 2017-2019 (time parameter).

- Total: the sum of the row values. The column shows an independent heatmap of values (white – yellow – red), which are helpful to identify patterns between the groups.

- Climate rows: when they are present, they show how was the weather in a specific period of time, also including an independent heatmap.

- The numeration of months 1-12 follows the year order; January (1), February (2) and so on until December (12).

- The numeration of weeks starts with the year; #1 is for the first week of the year (in January) and it follows up chronologically.

- The colors of the groups previously identified are also shown and grouped always on the heatmaps, making the task of identifying trends easier.

- The heatmaps made on a white-yellow-red color white shows the lowest values, yellow shows the intermediate values and red the highest values, in addition to following the logic of a scale, the darker the color, the higher the value. There 2 ways in which the heatmap is applied, on the column of total values or in the rows of climate, both are independent from the other heatmaps in the table.

- In the heatmap made in a white-blue-purple color scale, white shows the lowest values, blue shows the intermediate values and purple the highest values, in addition to following the logic of a scale, the darker the color, the higher the value. There are 2 ways in which the heatmap is applied, by table or by row, and the result of the visualization has considerable changes:

1) Scale by table:

This heatmap shows the color scale considering all the values in the table (without the total values column and without the climate values), for each month, hour or week and for each of the animals, so **the maximum value (darkest color) is only 1 cell in the whole table**. This way the distance data can be observed in a very general way. But **it becomes harder to observe trends animal by animal**.

2) Scale by row:

This heatmap shows the color scale considering all the values (without the total values column and without the climate values) of 1 row at the time. **It goes row by row, so the maximum value (darkest color) is 1 box in every row,** resulting in more highest values than in the heatmaps with scale by table. This way the distance data can be observed in a more specific way, by animal. A very big advantage found with this technique is that **there are many trends observable, that would not be observable in a scale by table**.

What seems to be happening here is that the level of movement of the animals, which results in KM of displacement, is affected by the "character" of each animal. If the results of its cumulative displacement are measured and compared all together, consideration of the animal's “character” is omitted, and this can result in behavioral trends that cannot be observed because the magnitudes of some animal's displacement are overshadowed due to the magnitude of an animal that usually moves more. To give a clearer and more exaggerated example for easy understanding, if in summer there is a trend in which 4 animals in a group move a lot, but 1 of them has a “character” that makes it more active and move more than the others, on a scale of magnitudes by color (heatmap) with all animals together, the only animal that will have remarked data will be the one that moves considerably more. For the others, although with respect to themselves, they may move more in summer, on the scale that considers all the values of all animals, the summer data of the 3 that move less will be "invisible" for the color scale.

Hence the importance of using a scale by row, to make the observation of the data individual by animal without influence of the character of the other animals.

5.2 Distances by month along 3 years (2017-2019)

This approach shows the distances traveled by each FG and VG animal during the 3 years in total, by month. It is a very general overview, just to start looking at the data and visualizing it in a broad way. From here the approaches will be increasingly more specific.

- 5.2.1 FG Distances heatmap by month (1-12 months, 2017-2019, scale by table)

These heatmaps show the accumulated distances of each animal in KM, in each of the months of the year from 1-12, and taking into account 3 years together, from 2017 to 2019.

This perspective is very helpful to appreciate movement trends by month, however it is important to keep in mind that from this perspective it is not possible to appreciate the quality of the data, so the time periods without data for some animals cannot be appreciated. Due to this, if it is needed to analyze a specific case, perspectives that give more detail on the quality of the data are also required. These perspectives are also provided later in this same section.

FG Heatmap comparing all the values from all the shown animals, by months													
ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	Total
FG.2016.03	16.16	14.87	29.07	16.47	25.91	43.11	24.09	24.56	25.90	25.85	20.40	18.29	284.68
FG.2016.05	15.98	13.37	27.63	21.42	18.41	28.65	17.71	18.80	22.88	22.25	17.06	13.67	237.83
FG.2016.07	12.79	11.11	24.35	17.36	16.33	25.63	18.56	18.73	17.28	14.71	13.64	12.11	202.60
IS.2011.02	14.55	12.86	29.39	17.36	25.97	38.93	23.05	26.24	27.34	27.17	21.68	16.64	281.19
IS.2011.04	12.48	14.91	31.36	23.71	12.83	28.00	22.72	22.86	23.80	18.56	19.64	13.51	244.39
IS.2011.05	16.13	13.67	31.33	21.27	19.30	37.68	27.22	25.00	27.77	26.63	21.28	16.85	284.13
IS.2011.11	13.13	17.56	41.98	20.53	49.72	69.64	35.48	30.54	26.37	26.52	14.49	11.07	357.02
IS.2011.12	16.52	19.91	34.43	37.42	28.45	41.43	26.20	27.67	31.70	32.95	22.73	19.01	338.43
IS.2011.14	13.80	14.31	28.97	18.96	24.46	33.73	23.78	16.59	16.41	12.92	13.92	17.16	235.00
IS.2011.15	10.66	10.89	24.94	18.33	14.81	24.22	17.50	15.27	13.69	13.81	12.44	9.06	185.64
FG.2016.12	8.22	4.69	12.51	11.02	19.86	23.12	13.58	5.00	4.81	4.64	5.26	9.32	122.04
FG.2016.13	8.43	4.98	12.37	13.08	12.88	11.23	13.13	4.87	4.78	4.81	5.08	9.68	105.33
FG.2016.15	8.67	5.06	12.27	11.03	13.42	9.86	14.25	4.77	4.72	4.63	4.34	9.51	102.54
FG.2016.17	8.94	5.64	13.03	11.01	11.02	22.86	14.78	14.82	5.15	4.73	4.96	9.89	126.84
FG.2016.18	8.71	5.08	12.24	14.43	16.74	21.82	14.64	16.71	20.80	8.12	4.93	9.81	154.06
FG.2017.18	7.26	9.10	14.63	13.46	11.30	14.07	15.29	15.50	16.07	8.23	6.51	13.19	144.61
IS.2011.32	19.50	16.51	30.32	13.67	13.08	21.41	30.12	19.49	19.30	13.46	13.01	25.67	235.54
FG.2013.01	8.32	5.23	12.71	8.95	13.94	13.83	8.27	13.30	9.34	7.20	6.81	10.07	117.97
FG.2017.11	21.14	22.92	33.73	43.18	48.11	41.02	23.90	31.45	37.22	21.78	13.42	21.37	359.24
FG.2017.12	20.62	23.91	34.89	43.75	50.19	41.82	22.64	31.63	39.11	26.51	13.56	22.06	370.68
FG.2017.13	22.54	24.07	33.59	42.55	49.24	40.00	20.57	30.57	38.48	25.43	21.05	28.69	376.77
LA.2011.03	21.44	24.35	40.49	34.96	56.59	56.21	42.65	40.40	42.72	33.99	22.43	22.76	438.99
LA.2011.01	0.00	1.39	10.47	0.62	10.60	0.75	0.00	0.00	0.00	0.00	0.00	0.00	23.83
FG.2016.14	14.53	15.17	18.41	13.31	21.62	24.13	14.97	18.48	20.11	15.71	4.75	14.25	195.46
FG.2016.16	12.49	12.67	21.66	19.92	26.77	17.29	12.25	20.26	22.54	12.47	3.04	13.13	194.48
IS.2011.29	9.26	5.55	14.19	8.74	18.60	11.60	14.00	7.35	6.55	5.34	3.45	8.82	113.45
IS.2011.33	8.78	5.47	15.70	7.76	11.13	24.88	14.26	20.81	23.28	25.26	11.85	8.74	177.92
IS.2011.34	0.00	0.39	6.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.81
FG.2017.09	13.13	12.11	20.47	21.53	18.17	5.43	0.00	8.51	12.03	10.44	5.18	13.24	140.23
FG.2013.29	24.96	21.78	40.05	31.48	64.14	66.06	43.05	48.94	51.66	47.02	32.42	32.02	503.59
DE.2011.14	25.52	21.49	39.73	27.84	65.55	49.21	19.44	30.95	34.09	40.31	26.14	24.06	404.33
FG.2017.14	28.54	20.06	27.98	38.16	47.97	44.65	21.09	37.59	42.38	35.16	31.73	31.98	407.29
FG.2017.16	28.56	20.67	28.93	39.88	45.52	47.81	19.41	39.53	41.52	35.86	31.74	35.04	414.47
FG.2017.17	26.06	19.93	28.40	35.89	48.81	46.14	22.77	40.40	42.92	38.17	32.46	31.29	413.25

Figure 75: FG Distances heatmap by month (1-12 months, 2017-2019, scale by table)

The pink and blue groups show very marked trends in the heatmap of the "total" column, differentiating them from the other groups due to their "high" values.

The blue group, despite being the least numerous group, is the one that accumulates the most KM in the 3 years (individually speaking). The blue group shows very homogeneous behavior, since their values are generally very similar to each other.

The largest group (green) has 1 animal (IS.2011.11) that in the month of June shows a much greater distance traveled than the rest of the animals. This could be an identifier of the lead animal of a group.

The red group generally shows lower values compared to the other groups; however, this is most likely a result of the lack of data that this group has over some long periods of time. This lack of data is observed in more detail in figures below.

The months with the greatest displacement in general seem to be the 5th and 6th, however, the way the color scale is made (scale by table) does not allow a comparison between months to be visualized completely well.

Possible further research questions:

- Does a group of these animals have a greater tendency to move more KM than a larger group? Is there a correlation between group size and KM traveled?
- What is the influence, role and importance of an animal like IS.2011.11, which has considerably more KM accumulated than the rest of the group? What effect can a death/out event of this animal have on the group?

- 5.2.2 FG Distances heatmap by month (1-12 months, 2017-2019, scale by row)

As described before, this heatmap shows a color scale that considers only the values of each row. then the scale is relative to each animal, to the minimum and maximum value of each row. The values are exactly the same than in the last heatmap, but the white – blue - purple heatmap is different in the intensity of the colors, showing many more and clearer trends.

FG Heatmap by rows, indicating the scale on every row individually (by months)													
ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	Total
FG.2016.03	16.16	14.87	29.07	16.47	25.91	43.11	24.09	24.56	25.90	25.85	20.40	18.29	284.68
FG.2016.05	15.98	13.37	27.63	21.42	18.41	28.65	17.71	18.80	22.88	22.25	17.06	13.67	237.83
FG.2016.07	12.79	11.11	24.35	17.36	16.33	25.63	18.56	18.73	17.28	14.71	13.64	12.11	202.60
IS.2011.02	14.55	12.86	29.39	17.36	25.97	38.93	23.05	26.24	27.34	27.17	21.68	16.64	281.19
IS.2011.04	12.48	14.91	31.36	23.71	12.83	28.00	22.72	22.86	23.80	18.56	19.64	13.51	244.39
IS.2011.05	16.13	13.67	31.33	21.27	19.30	37.68	27.22	25.00	27.77	26.63	21.28	16.85	284.13
IS.2011.11	13.13	17.56	41.98	20.53	49.72	69.64	35.48	30.54	26.37	26.52	14.49	11.07	357.02
IS.2011.12	16.52	19.91	34.43	37.42	28.45	41.43	26.20	27.67	31.70	32.95	22.73	19.01	338.43
IS.2011.14	13.80	14.31	28.97	18.96	24.46	33.73	23.78	16.59	16.41	12.92	13.92	17.16	235.00
IS.2011.15	10.66	10.89	24.94	18.33	14.81	24.22	17.50	15.27	13.69	13.81	12.44	9.06	185.64
FG.2016.12	8.22	4.69	12.51	11.02	19.86	23.12	13.58	5.00	4.81	4.64	5.26	9.32	122.04
FG.2016.13	8.43	4.98	12.37	13.08	12.88	11.23	13.13	4.87	4.78	4.81	5.08	9.68	105.33
FG.2016.15	8.67	5.06	12.27	11.03	13.42	9.86	14.25	4.77	4.72	4.63	4.34	9.51	102.54
FG.2016.17	8.94	5.64	13.03	11.01	11.02	22.86	14.78	14.82	5.15	4.73	4.96	9.89	126.84
FG.2016.18	8.71	5.08	12.24	14.43	16.74	21.82	14.64	16.71	20.80	8.12	4.93	9.81	154.06
FG.2017.18	7.26	9.10	14.63	13.46	11.30	14.07	15.29	15.50	16.07	8.23	6.51	13.19	144.61
IS.2011.32	19.50	16.51	30.32	13.67	13.08	21.41	30.12	19.49	19.30	13.46	13.01	25.67	235.54
FG.2013.01	8.32	5.23	12.71	8.95	13.94	13.83	8.27	13.30	9.34	7.20	6.81	10.07	117.97
FG.2017.11	21.14	22.92	33.73	43.18	48.11	41.02	23.90	31.45	37.22	21.78	13.42	21.37	359.24
FG.2017.12	20.62	23.91	34.89	43.75	50.19	41.82	22.64	31.63	39.11	26.51	13.56	22.06	370.68
FG.2017.13	22.54	24.07	33.59	42.55	49.24	40.00	20.57	30.57	38.48	25.43	21.05	28.69	376.77
LA.2011.03	21.44	24.35	40.49	34.96	56.59	56.21	42.65	40.40	42.72	33.99	22.43	22.76	438.99
LA.2011.01	0.00	1.39	10.47	0.62	10.60	0.75	0.00	0.00	0.00	0.00	0.00	0.00	23.83
FG.2016.14	14.53	15.17	18.41	13.31	21.62	24.13	14.97	18.48	20.11	15.71	4.75	14.25	195.46
FG.2016.16	12.49	12.67	21.66	19.92	26.77	17.29	12.25	20.26	22.54	12.47	3.04	13.13	194.48
IS.2011.29	9.26	5.55	14.19	8.74	18.60	11.60	14.00	7.35	6.55	5.34	3.45	8.82	113.45
IS.2011.33	8.78	5.47	15.70	7.76	11.13	24.88	14.26	20.81	23.28	25.26	11.85	8.74	177.92
IS.2011.34	0.00	0.39	6.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.81
FG.2017.09	13.13	12.11	20.47	21.53	18.17	5.43	0.00	8.51	12.03	10.44	5.18	13.24	140.23
FG.2013.29	24.96	21.78	40.05	31.48	64.14	66.06	43.05	48.94	51.66	47.02	32.42	32.02	503.59
DE.2011.14	25.52	21.49	39.73	27.84	65.55	49.21	19.44	30.95	34.09	40.31	26.14	24.06	404.33
FG.2017.14	28.54	20.06	27.98	38.16	47.97	44.65	21.09	37.59	42.38	35.16	31.73	31.98	407.29
FG.2017.16	28.56	20.67	28.93	39.88	45.52	47.81	19.41	39.53	41.52	35.86	31.74	35.04	414.47
FG.2017.17	26.06	19.93	28.40	35.89	48.81	46.14	22.77	40.40	42.92	38.17	32.46	31.29	413.25

Figure 76: FG Distances heatmap by month (1-12 months, 2017-2019, scale by row)

The green group shows a very clear homogeneous trend of greater displacement in month 6, and some of its members also present a high displacement in month 3. Likewise in the winter (months 12, 1 and 2) they present low levels of displacement.

In contrast to the green group, the other groups generally present higher levels of displacement during months 12 and 1.

In the red group there seems to be shared behavior in pairs, however the data from this group has some major continuity problems, so to confirm this activity in pairs, other figures (shown later on in this work) will also be observed.

The month with the highest levels of displacement is not always month 6. In the case of the pink, for the orange and blue groups, in general they have greater displacement in month 5, although some exceptions of these groups do have greater displacement in month 6.

Month 9 stands out for moderately high levels, although it is not the busiest month. Month 3 is when the animals return to a higher level of activity after winter. The blue and pink group present a high level of homogeneity in their behavior, the values among their members are very similar.

Possible further research questions:

- Why does it seem that behavior in winter is not always the same? Does it have something to do with the size of the group, whether the groups of animals are more or less active in winter?
- What does it depend on, whether the month with the greatest displacement is month 5 or month 6? both happened with different groups of animals.

- ### 5.2.3 VG Distances heatmap by month (1-12 months, 2017-2019, scale by table)

This heatmap is made in exactly the same way as for the FG area, which was previously explained. The only difference is that the values it shows belong to animals from the VG area.

VG Heatmap comparing all the values from all the shown animals, by months													
ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	Total
DE.2011.25	8.403	5.3703	11.818	0	0.3823	2.0621	6.1043	2.9541	3.702	3.377	5.951	12.312	62.435
IS.2011.21	19.122	18.683	25.199	19.636	15.967	25.462	20.349	26.445	23.488	26.457	21.385	27.643	269.83
IS.2011.26	21.145	17.161	19.764	13.441	11.32	31.437	13.7	23.397	23.066	29.921	27.385	28.113	259.85
VG.2013.01	18.662	16.43	17.642	12.111	12.948	20.431	6.6866	21.196	24.855	26.2	24.147	28.634	229.94
IS.2011.23	17.419	15.601	19.051	21.098	12.619	19.998	12.63	21.539	19.61	20.175	20.428	27.519	227.69
IS.2011.27	18.751	16.028	18.157	16.208	16.305	26.936	8.2583	20.862	23.239	24.247	26.865	29.402	245.26
IS.2011.20	19.065	16.034	17.522	20.362	14.659	19.808	8.6865	21.374	23.744	17.41	20.047	27.889	226.6
IS.2011.25	0	0	0	0	0	0	0	0	0	3.5917	1.0377	0	4.6293
DE.2011.20	0	0.8067	5.7672	0.3488	6.8121	19.521	12.403	5.7317	1.9723	0	0	0	53.363
IS.2011.39	28.29	27.801	41.103	22.737	57.134	73.034	38.486	37.538	42.97	49.394	35.518	37.496	491.5
VG.2013.08	12.063	13.466	25.63	7.5817	31.081	49.423	43.699	24.305	29.441	26.791	10.573	19.351	293.41
VG.2013.09	25.607	23.594	27.724	20.815	38.513	47.268	24.468	36.82	39.604	42.779	25.53	25.104	377.82
IS.2011.37	14.2	13.53	16.233	7.0025	15.475	25.607	24.843	15.913	19.508	12.224	9.0709	21.045	194.65
IS.2011.38	0	5.7731	24.658	6.4552	25.972	35.681	17.276	11.521	10.323	4.9794	3.355	0	146
IS.2011.36	16.167	12.685	13.356	17.023	26.346	21.021	0	22.776	23.696	37.308	25.381	15.578	231.34
DE.2011.27	25.334	24.074	22.079	21.762	30.349	36.932	28.963	40.175	37.646	37.766	33.263	30.189	368.53
VG.2013.02	25.824	26.941	37.841	29.079	31.334	35.561	17.383	35.225	33.861	30.367	30.761	27.946	362.12
DE.2011.23	23.073	22.207	35.776	19.301	42.397	50.502	41.389	41.989	40.408	33.633	28.657	27.682	407.01
FG.2013.32	22.213	23.912	36.605	24.318	38.145	41.944	27.028	34.502	32.236	24.28	23.823	21.058	350.06
IS.2011.22	24.618	25.122	28.38	29.721	31.352	28.343	13.487	30.264	30.891	29.851	29.542	26.091	327.66
VG.2013.10	23.358	23.801	24.508	26.088	31.076	28.124	12.569	31.32	30.822	28.233	30.799	26.689	317.39
VG.2013.11	20.848	22.011	20.714	25.432	24.978	31.131	24.94	34.111	26.2	22.308	21.822	18.827	293.32
IS.2011.10	30.062	26.624	42.384	29.64	51.166	58.347	36.384	45.508	44.381	49.645	39.264	35.991	489.4
IS.2011.13	23.904	24.397	31.895	24.777	37.095	38.243	26.121	18.314	21.139	22.986	23.705	29.518	322.09
IS.2011.01	27.354	23.376	28.567	30.825	35.605	35.732	14.591	34.223	38.175	41.06	35.3	33.54	378.35
DE.2011.18	24.681	23.593	48.753	38.821	37.238	47.03	21.274	29.358	32.535	40.321	31.817	31.302	406.72
DE.2011.19	19.834	18.363	36.757	34.175	24.904	29.174	20.245	29.396	33.351	34.732	26.585	27.197	334.71
DE.2011.21	19.96	17.542	27.77	30.636	23.446	26.26	11.293	20.599	21.413	29.585	23.107	24.772	276.39

Figure 77: VG Distances heatmap by month (1-12 months, 2017-2019, scale by table)

The highest value occurs in month 6, it is the animal ID IS.2011.39 of the pink group and it is a value that stands out by far compared to the others in the same month. This animal also has the highest accumulated KM in total in the 3 years and in this area (total value) it also stands out by far from the others, there are only a few animals that come close.

All groups, except red, have 1 member who moves (displaces) much more than the other members of the group. The common values of "normal" displacement members range from approximately 200 to 300km normally, but the "leading" animals in this sector accumulate more than 400km in total.

Very low values in the case of DE.2011.25, are due to data quality, lack of data over long periods of time. However, the animal is kept in the table because it does have some months with data that can be useful in specific cases and for the record.

It is difficult to observe trends in this heatmap made with scale by table, however it is slightly noticeable that month 6 is the month with the greatest activity.

Possible further research questions:

- Once again, a few animals are observed that stand out for the great distances traveled. Could this be a certain method of identifying the group leader or a crucial member of the group?

- ### 5.2.4 VG Distances heatmap by month (1-12 months, 2017-2019, scale by row)

This heatmap is made in exactly the same way as for the FG area, which was previously explained. The only difference is that the values it shows belong to animals from the VG area.

VG Heatmap by rows, indicating the scale on every row individually (by months)													
ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	Total
DE.2011.25	8.40	5.37	11.82	0.00	0.38	2.06	6.10	2.95	3.70	3.38	5.95	12.31	62.44
IS.2011.21	19.12	18.68	25.20	19.64	15.97	25.46	20.35	26.44	23.49	26.46	21.39	27.64	269.83
IS.2011.26	21.14	17.16	19.76	13.44	11.32	31.44	13.70	23.40	23.07	29.92	27.39	28.11	259.85
VG.2013.01	18.66	16.43	17.64	12.11	12.95	20.43	6.69	21.20	24.86	26.20	24.15	28.63	229.94
IS.2011.23	17.42	15.60	19.05	21.10	12.62	20.00	12.63	21.54	19.61	20.18	20.43	27.52	227.69
IS.2011.27	18.75	16.03	18.16	16.21	16.31	26.94	8.26	20.86	23.24	24.25	26.87	29.40	245.26
IS.2011.20	19.07	16.03	17.52	20.36	14.66	19.81	8.69	21.37	23.74	17.41	20.05	27.89	226.60
IS.2011.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.59	1.04	0.00	4.63
DE.2011.20	0.00	0.81	5.77	0.35	6.81	19.52	12.40	5.73	1.97	0.00	0.00	0.00	53.36
IS.2011.39	28.29	27.80	41.10	22.74	57.13	73.03	38.49	37.54	42.97	49.39	35.52	37.50	491.50
VG.2013.08	12.06	13.47	25.63	7.58	31.08	49.42	43.70	24.30	29.44	26.79	10.57	19.35	293.41
VG.2013.09	25.61	23.59	27.72	20.81	38.51	47.27	24.47	36.82	39.60	42.78	25.53	25.10	377.82
IS.2011.37	14.20	13.53	16.23	7.00	15.48	25.61	24.84	15.91	19.51	12.22	9.07	21.04	194.65
IS.2011.38	0.00	5.77	24.66	6.46	25.97	35.68	17.28	11.52	10.32	4.98	3.36	0.00	146.00
IS.2011.36	16.17	12.69	13.36	17.02	26.35	21.02	0.00	22.78	23.70	37.31	25.38	15.58	231.34
DE.2011.27	25.33	24.07	22.08	21.76	30.35	36.93	28.96	40.17	37.65	37.77	33.26	30.19	368.53
VG.2013.02	25.82	26.94	37.84	29.08	31.33	35.56	17.38	35.23	33.86	30.37	30.76	27.95	362.12
DE.2011.23	23.07	22.21	35.78	19.30	42.40	50.50	41.39	41.99	40.41	33.63	28.66	27.68	407.01
FG.2013.32	22.21	23.91	36.60	24.32	38.15	41.94	27.03	34.50	32.24	24.28	23.82	21.06	350.06
IS.2011.22	24.62	25.12	28.38	29.72	31.35	28.34	13.49	30.26	30.89	29.85	29.54	26.09	327.66
VG.2013.10	23.36	23.80	24.51	26.09	31.08	28.12	12.57	31.32	30.82	28.23	30.80	26.69	317.39
VG.2013.11	20.85	22.01	20.71	25.43	24.98	31.13	24.94	34.11	26.20	22.31	21.82	18.83	293.32
IS.2011.10	30.06	26.62	42.38	29.64	51.17	58.35	36.38	45.51	44.38	49.64	39.26	35.99	489.40
IS.2011.13	23.90	24.40	31.89	24.78	37.10	38.24	26.12	18.31	21.14	22.99	23.70	29.52	322.09
IS.2011.01	27.35	23.38	28.57	30.83	35.60	35.73	14.59	34.22	38.18	41.06	35.30	33.54	378.35
DE.2011.18	24.68	23.59	48.75	38.82	37.24	47.03	21.27	29.36	32.53	40.32	31.82	31.30	406.72
DE.2011.19	19.83	18.36	36.76	34.18	24.90	29.17	20.24	29.40	33.35	34.73	26.59	27.20	334.71
DE.2011.21	19.96	17.54	27.77	30.64	23.45	26.26	11.29	20.60	21.41	29.59	23.11	24.77	276.39

Figure 78: VG Distances heatmap by month (1-12 months, 2017-2019, scale by row)

The red group shows a high trend of activity in month 12, which seems strange and contrasting with the trends previously observed where the highest activity months were in summer. What is most striking is that it is the entire group that shows this trend and is the only group in the entire research that shows these levels of activity in month 12 as a whole. At the same time, this group also shows low activity in month 7, a behavior that it shares with the green group. In 2017 (see below in this document) the data quality of the red group was very low at the beginning, there is not much data, this could be the reason influencing this table. So, for the case of this red group, the analysis needs to be by year and cannot be considering the 3 years together.

All groups show similarly low activity in months 1 and 2. The busiest month in general is month 6, the same as in the FG area. The difference is that if it were not for month 12 of the red group, group 6 would be followed by group 5 in greater activity.

5.3 Distances by daytime along 3 years (2017-2019)

The following heatmaps show the travel levels in KM per hour of the day. This means, how many KM each of the animals traveled in total in each of the hours of the day 0-23, over the 3 years. This allows us to have a vision of the normal daily routine of these animals. The heatmap made with scale by table and the heatmap made with scale by row are also shown as evidence, demonstrating that the trends are easier to observe when made with scale by row in this case as well.

- 5.3.1 FG Distances heatmap by daytime (0-23 hours, 2017-2019, scale by table)

This table shows how the heatmap made with the scale by table technique looks like. The results are good. Some trends and already be observed, but not in an individual way as in the case of scale by row.

FG Heatmap comparing all the values from all the shown animals, by daytime

ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	0	Total
FG.2016.03	5.37	4.18	4.31	4.41	6.70	7.17	4.94	3.10	3.03	3.18	5.77	9.69	15.55	17.92	18.42	23.52	32.96	33.47	27.75	20.23	11.28	9.04	6.61	6.08	284.68
FG.2016.05	5.00	4.53	4.28	3.79	3.83	2.45	2.51	1.24	1.67	1.13	3.30	5.81	9.69	13.05	13.63	19.05	25.82	28.00	26.97	23.21	13.73	10.84	7.88	6.41	237.83
FG.2016.07	3.19	2.84	2.02	2.63	2.15	2.38	1.66	1.16	1.02	1.03	2.19	5.58	8.90	10.94	13.14	19.00	21.26	23.67	22.93	21.25	13.00	9.38	6.48	4.79	202.60
IS.2011.02	5.74	3.88	4.13	4.17	6.31	6.47	4.36	3.07	2.89	3.12	5.90	10.61	15.60	18.20	18.14	23.68	30.43	30.61	28.30	20.91	11.54	9.55	7.17	6.41	281.19
IS.2011.04	3.09	2.84	3.73	4.19	6.13	7.12	4.33	2.06	2.81	3.44	4.87	8.81	13.39	16.60	17.16	21.17	27.13	28.24	23.15	18.04	10.48	6.67	4.97	3.97	244.39
IS.2011.05	5.33	4.23	4.48	4.26	5.80	7.27	5.43	3.97	3.99	3.23	5.50	10.75	15.53	16.70	17.59	23.28	33.78	31.54	29.50	21.88	11.48	8.06	5.13	5.42	284.13
IS.2011.11	3.05	3.82	5.08	7.92	13.81	12.41	8.23	6.15	7.17	8.04	10.77	16.04	22.40	27.81	27.54	29.83	32.31	34.94	30.87	22.93	11.62	5.99	4.81	3.47	357.02
IS.2011.12	7.70	5.94	6.28	6.00	8.57	9.17	5.42	3.10	3.36	3.44	8.62	13.18	19.03	19.18	19.65	23.57	28.72	32.93	34.78	30.47	20.66	13.38	8.93	6.33	338.43
IS.2011.14	4.02	2.99	1.78	2.21	3.96	5.21	3.83	2.81	2.52	2.96	3.75	7.79	11.93	13.29	14.21	20.48	26.68	26.59	24.99	19.23	12.19	8.54	6.98	6.07	235.00
IS.2011.15	2.92	2.78	1.89	2.38	2.06	1.62	1.77	1.00	1.23	0.97	1.85	4.58	6.82	10.13	12.46	17.18	20.27	21.73	21.05	18.77	12.80	9.00	5.98	4.38	185.64
FG.2016.12	2.60	3.14	2.78	3.33	3.56	1.81	0.48	0.26	0.87	0.78	2.33	4.61	8.61	13.53	16.57	16.46	12.96	9.36	5.58	4.28	2.46	1.65	1.43	2.60	122.04
FG.2016.13	2.42	2.89	2.53	3.05	3.14	1.56	0.52	0.30	0.48	0.37	1.59	3.92	6.52	11.02	14.32	15.41	11.49	8.16	5.22	3.31	1.92	1.54	1.45	2.19	105.33
FG.2016.15	3.32	3.28	3.09	3.12	3.21	1.98	0.53	0.19	0.68	0.54	1.46	3.95	5.92	8.94	12.45	12.63	10.70	8.66	5.64	4.48	2.52	1.72	1.37	2.16	102.54
FG.2016.17	3.24	3.84	3.53	3.77	4.32	2.32	0.86	0.51	1.22	1.24	3.30	6.12	9.45	13.67	16.22	15.98	12.59	7.68	5.32	3.64	2.48	1.74	1.50	2.29	126.84
FG.2016.18	5.41	6.81	6.04	5.91	5.68	2.56	0.79	0.69	1.29	1.75	4.30	7.27	10.92	15.16	17.56	15.54	13.82	8.93	6.05	4.93	3.14	2.60	2.93	3.97	154.06
FG.2017.18	2.64	2.52	3.71	3.97	2.10	0.91	0.41	0.72	0.48	2.67	5.88	10.38	13.94	14.73	14.44	11.48	11.80	9.34	9.38	8.13	5.81	4.00	2.90	2.28	144.61
IS.2011.32	4.27	5.31	5.73	5.17	5.16	2.33	1.29	1.30	1.68	4.05	8.99	16.40	22.57	27.07	28.60	24.32	22.79	16.29	11.92	7.87	4.28	2.66	2.28	3.22	235.54
FG.2013.01	3.02	3.49	4.04	3.51	3.19	1.88	0.47	0.37	0.66	1.15	2.10	3.97	7.17	10.90	13.54	13.21	12.80	7.89	6.54	6.08	3.65	2.64	2.40	3.28	117.97
FG.2017.11	2.31	3.35	4.29	7.71	7.51	9.55	5.88	5.55	4.32	5.84	8.62	14.07	18.84	25.67	26.75	32.57	34.24	34.46	36.44	31.66	19.95	10.47	5.97	3.20	359.24
FG.2017.12	2.66	3.63	4.62	7.76	7.94	9.15	5.75	5.37	3.73	5.97	7.90	13.99	19.28	25.27	28.77	33.10	35.59	36.88	35.84	33.09	22.29	12.33	6.18	3.58	370.68
FG.2017.13	2.77	3.82	4.59	8.11	8.42	8.77	5.15	4.79	3.27	6.12	9.17	14.88	20.48	27.41	29.22	35.13	34.88	36.53	35.39	33.11	22.25	12.07	6.73	3.68	376.77
LA.2011.03	2.14	2.55	2.23	5.54	8.87	10.61	8.15	6.82	6.69	7.65	11.90	19.15	26.14	34.31	37.85	42.68	43.20	42.00	41.01	35.89	21.99	11.98	6.52	3.11	438.99
LA.2011.01	0.33	0.32	0.15	0.06	0.26	0.16	0.18	0.52	0.41	0.24	0.32	0.48	0.66	1.62	1.54	1.69	2.73	2.98	2.91	2.10	1.47	1.20	0.70	0.81	23.83
FG.2016.14	4.51	5.05	5.26	5.29	4.79	3.36	1.74	1.61	1.41	3.27	5.67	10.32	15.02	21.61	23.62	21.43	19.11	13.82	10.35	6.11	3.96	2.64	2.11	3.40	195.46
FG.2016.16	3.87	4.24	5.40	5.44	4.01	1.85	0.60	0.64	1.06	2.73	5.38	11.42	16.86	22.45	21.39	18.23	16.12	12.45	13.58	10.02	6.39	4.26	2.69	3.41	194.48
IS.2011.29	2.08	2.89	2.08	2.34	3.10	1.60	1.25	1.15	0.72	1.95	3.13	6.17	8.32	12.78	16.06	14.72	10.40	6.92	5.71	3.27	1.60	1.21	1.52	2.49	113.45
IS.2011.33	5.57	7.51	5.45	5.74	5.57	2.86	2.00	1.70	2.09	3.78	6.76	12.46	16.76	20.43	23.74	20.19	14.73	8.07	4.95	1.41	0.78	0.67	1.34	3.36	177.92
IS.2011.34	0.00	0.11	0.15	0.07	0.08	0.02	0.00	0.00	0.09	0.14	0.13	0.19	0.39	0.63	0.76	1.04	0.77	1.16	0.26	0.38	0.17	0.13	0.08	0.10	6.81
FG.2017.09	3.44	3.63	5.15	5.21	2.89	1.15	0.62	0.40	0.81	1.56	4.51	7.14	11.04	14.88	15.24	11.67	11.47	8.95	8.98	7.84	4.65	3.19	2.69	3.14	140.23
FG.2013.29	5.84	6.64	6.71	11.56	13.59	12.40	10.65	10.01	11.33	13.84	18.76	25.57	34.16	43.11	41.63	49.39	50.38	44.26	39.32	23.85	12.52	7.69	5.83	4.56	503.59
DE.2011.14	2.87	2.15	3.94	6.22	7.50	9.34	9.01	7.46	8.73	11.18	13.62	20.09	28.65	38.27	39.19	44.88	41.90	37.42	28.65	19.37	10.28	6.20	3.94	3.46	404.33
FG.2017.14	6.05	7.77	7.59	11.39	10.82	8.21	6.51	4.12	4.64	8.57	11.50	19.18	24.72	30.98	29.78	36.54	41.08	33.10	31.64	26.80	18.07	13.76	8.25	6.21	407.29
FG.2017.16	7.27	7.84	8.42	11.39	10.01	6.27	5.78	3.72	4.87	9.58	12.95	19.91	25.59	31.53	31.64	38.34	38.87	34.19	32.09	27.34	18.07	12.70	8.78	7.32	414.47
FG.2017.17	6.55	7.92	7.18	11.48	11.74	8.89	6.92	4.21	4.46	8.40	11.45	20.17	26.33	31.64	31.87	37.52	39.45	34.04	32.65	25.87	17.55	12.45	7.88	6.62	413.25

Figure 79: FG Distances heatmap by daytime (0-23 hours, 2017-2019, scale by table)

- 5.3.2 FG Distances heatmap by daytime (0-23 hours, 2017-2019, scale by row)

This heatmap shows the same values as the previous one, the only difference is how the color scale of the KM heatmap is made (white-blue-purple), with a scale by row, to compare the different observable trends.

FG Heatmap by rows, indicating the scale on every row individually (by daytime)																									
ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	0	Total
FG.2016.03	5.37	4.18	4.31	4.41	6.70	7.17	4.94	3.10	3.03	3.18	5.77	9.69	15.55	17.92	18.42	23.52	32.96	33.47	27.75	20.23	11.28	9.04	6.61	6.08	284.68
FG.2016.05	5.00	4.53	4.28	3.79	3.83	2.45	2.51	1.24	1.67	1.13	3.30	5.81	9.69	13.05	13.63	19.05	25.82	28.00	26.97	23.21	13.73	10.84	7.88	6.41	237.83
FG.2016.07	3.19	2.84	2.02	2.63	2.15	2.38	1.66	1.16	1.02	1.03	2.19	5.58	8.90	10.94	13.14	19.00	21.26	23.67	22.93	21.25	13.00	9.38	6.48	4.79	202.60
IS.2011.02	5.74	3.88	4.13	4.17	6.31	6.47	4.36	3.07	2.89	3.12	5.90	10.61	15.60	18.20	18.14	23.68	30.43	30.61	28.30	20.91	11.54	9.55	7.17	6.41	281.19
IS.2011.04	3.09	2.84	3.73	4.19	6.13	7.12	4.33	2.06	2.81	3.44	4.87	8.81	13.39	16.60	17.16	21.17	27.13	28.24	23.15	18.04	10.48	6.67	4.97	3.97	244.39
IS.2011.05	5.33	4.23	4.48	4.26	5.80	7.27	5.43	3.97	3.99	3.23	5.50	10.75	15.53	16.70	17.59	23.28	33.78	31.54	29.50	21.88	11.48	8.06	5.13	5.42	284.13
IS.2011.11	3.05	3.82	5.08	7.92	13.81	12.41	8.23	6.15	7.17	8.04	10.77	16.04	22.40	27.81	27.54	29.83	32.31	34.94	30.87	22.93	11.62	5.99	4.81	3.47	357.02
IS.2011.12	7.70	5.94	6.28	6.00	8.57	9.17	5.42	3.10	3.36	3.44	8.62	13.18	19.03	19.18	19.65	23.57	28.72	32.93	34.78	30.47	20.66	13.38	8.93	6.33	338.43
IS.2011.14	4.02	2.99	1.78	2.21	3.96	5.21	3.83	2.81	2.52	2.96	3.75	7.79	11.93	13.29	14.21	20.48	26.68	26.59	24.99	19.23	12.19	8.54	6.98	6.07	235.00
IS.2011.15	2.92	2.78	1.89	2.38	2.06	1.62	1.77	1.00	1.23	0.97	1.85	4.58	6.82	10.13	12.46	17.18	20.27	21.73	21.05	18.77	12.80	9.00	5.98	4.38	185.64
FG.2016.12	2.60	3.14	2.78	3.33	3.56	1.81	0.48	0.26	0.87	0.78	2.33	4.61	8.61	13.53	16.57	16.46	12.96	9.36	5.58	4.28	2.46	1.65	1.43	2.60	122.04
FG.2016.13	2.42	2.89	2.53	3.05	3.14	1.56	0.52	0.30	0.48	0.37	1.59	3.92	6.52	11.02	14.32	15.41	11.49	8.16	5.22	3.31	1.92	1.54	1.45	2.19	105.33
FG.2016.15	3.32	3.28	3.09	3.12	3.21	1.98	0.53	0.19	0.68	0.54	1.46	3.95	5.92	8.94	12.45	12.63	10.70	8.66	5.64	4.48	2.52	1.72	1.37	2.16	102.54
FG.2016.17	3.24	3.84	3.53	3.77	4.32	2.32	0.86	0.51	1.22	1.24	3.30	6.12	9.45	13.67	16.22	15.98	12.59	7.68	5.32	3.64	2.48	1.74	1.50	2.29	126.84
FG.2016.18	5.41	6.81	6.04	5.91	5.68	2.56	0.79	0.69	1.29	1.75	4.30	7.27	10.92	15.16	17.56	15.54	13.82	8.93	6.05	4.93	3.14	2.60	2.93	3.97	154.06
FG.2017.18	2.64	2.52	3.71	3.97	2.10	0.91	0.41	0.72	0.48	2.67	5.88	10.38	13.94	14.73	14.44	11.48	11.80	9.34	9.38	8.13	5.81	4.00	2.90	2.28	144.61
IS.2011.32	4.27	5.31	5.73	5.17	5.16	2.33	1.29	1.30	1.68	4.05	8.99	16.40	22.57	27.07	28.60	24.32	22.79	16.29	11.92	7.87	4.28	2.66	2.28	3.22	235.54
FG.2013.01	3.02	3.49	4.04	3.51	3.19	1.88	0.47	0.37	0.66	1.15	2.10	3.97	7.17	10.90	13.54	13.21	12.80	7.89	6.54	6.08	3.65	2.64	2.40	3.28	117.97
FG.2017.11	2.31	3.35	4.29	7.71	7.51	9.55	5.88	5.55	4.32	5.84	8.62	14.07	18.84	25.67	26.75	32.57	34.24	34.46	36.44	31.66	19.95	10.47	5.97	3.20	359.24
FG.2017.12	2.66	3.63	4.62	7.76	7.94	9.15	5.75	5.37	3.73	5.97	7.90	13.99	19.28	25.27	28.77	33.10	35.59	36.88	35.84	33.09	22.29	12.33	6.18	3.58	370.68
FG.2017.13	2.77	3.82	4.59	8.11	8.42	8.77	5.15	4.79	3.27	6.12	9.17	14.88	20.48	27.41	29.22	35.13	34.88	36.53	35.39	33.11	22.25	12.07	6.73	3.68	376.77
LA.2011.03	2.14	2.55	2.23	5.54	8.87	10.61	8.15	6.82	6.69	7.65	11.90	19.15	26.14	34.31	37.85	42.68	43.20	42.00	41.01	35.89	21.99	11.98	6.52	3.11	438.99
LA.2011.01	0.33	0.32	0.15	0.06	0.26	0.16	0.18	0.52	0.41	0.24	0.32	0.48	0.66	1.62	1.54	1.69	2.73	2.98	2.91	2.10	1.47	1.20	0.70	0.81	23.83
FG.2016.14	4.51	5.05	5.26	5.29	4.79	3.36	1.74	1.61	1.41	3.27	5.67	10.32	15.02	21.61	23.62	21.43	19.11	13.82	10.35	6.11	3.96	2.64	2.11	3.40	195.46
FG.2016.16	3.87	4.24	5.40	5.44	4.01	1.85	0.60	0.64	1.06	2.73	5.38	11.42	16.86	22.45	21.39	18.23	16.12	12.45	13.58	10.02	6.39	4.26	2.69	3.41	194.48
IS.2011.29	2.08	2.89	2.08	2.34	3.10	1.60	1.25	1.15	0.72	1.95	3.13	6.17	8.32	12.78	16.06	14.72	10.40	6.92	5.71	3.27	1.60	1.21	1.52	2.49	113.45
IS.2011.33	5.57	7.51	5.45	5.74	5.57	2.86	2.00	1.70	2.09	3.78	6.76	12.46	16.76	20.43	23.74	20.19	14.73	8.07	4.95	1.41	0.78	0.67	1.34	3.36	177.92
IS.2011.34	0.00	0.11	0.15	0.07	0.08	0.02	0.00	0.00	0.09	0.14	0.13	0.19	0.39	0.63	0.76	1.04	0.77	1.16	0.26	0.38	0.17	0.13	0.08	0.10	6.81
FG.2017.09	3.44	3.63	5.15	5.21	2.89	1.15	0.62	0.40	0.81	1.56	4.51	7.14	11.04	14.88	15.24	11.67	11.47	8.95	8.98	7.84	4.65	3.19	2.69	3.14	140.23
FG.2013.29	5.84	6.64	6.71	11.56	13.59	12.40	10.65	10.01	11.33	13.84	18.76	25.57	34.16	43.11	41.63	49.39	50.38	44.26	39.32	23.85	12.52	7.69	5.83	4.56	503.59
DE.2011.14	2.87	2.15	3.94	6.22	7.50	9.34	9.01	7.46	8.73	11.18	13.62	20.09	28.65	38.27	39.19	44.88	41.90	37.42	28.65	19.37	10.28	6.20	3.94	3.46	404.33
FG.2017.14	6.05	7.77	7.59	11.39	10.82	8.21	6.51	4.12	4.64	8.57	11.50	19.18	24.72	30.98	29.78	36.54	41.08	33.10	31.64	26.80	18.07	13.76	8.25	6.21	407.29
FG.2017.16	7.27	7.84	8.42	11.39	10.01	6.27	5.78	3.72	4.87	9.58	12.95	19.91	25.59	31.53	31.64	38.34	38.87	34.19	32.09	27.34	18.07	12.70	8.78	7.32	414.47
FG.2017.17	6.55	7.92	7.18	11.48	11.74	8.89	6.92	4.21	4.46	8.40	11.45	20.17	26.33	31.64	31.87	37.52	39.45	34.04	32.65	25.87	17.55	12.45	7.88	6.62	413.25

Figure 80: FG Distances heatmap by daytime (0-23 hours, 2017-2019, scale by row)

The hours of greatest activity show homogeneity behavior between groups, and show differences between each of the groups. The clarity of these trends by group seems to be clear and strong evidence that the group identification technique used, works well and is reliable.

The hours 17, 18, and 19 are the busiest hours for the green group (the biggest group). Hours 15 and 16 are the busiest for the red group. The hours 16, 17, 18 and 19 are the busiest for the pink group. Hours 13, 14 and 15 are the busiest hours for the orange group. Hours 16 and 17 are the busiest for the blue group.

The hours of least activity have fewer differences between groups than the hours of greatest activity, meaning they look more homogeneous. Hours 8 and 9 are the least active in general, although hour 10 also shows very low levels of activity.

The red group shows a high homogeneous behavior, especially before hour 12.

Possible further research question:

- What is the factor that causes the difference in times of greatest activity between groups? Could it be that the greatest activity is caused by the stimulation of feeding, but being in a semi-natural environment, the animals go to the feeding area at different times? This is a result of semi-natural conditions. Would it be different in conditions of total freedom?

- ### 5.3.3 VG Distances heatmap by daytime (0-23 hours, 2017-2019, scale by row)

VG Heatmap by rows, indicating the scale on every row individually (by daytime)																									
ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	0	Total
DE.2011.25	0.96	0.87	1.17	1.05	1.14	1.21	1.53	1.24	1.79	2.18	4.09	4.66	5.99	6.81	6.04	6.63	5.14	3.52	1.96	1.47	0.92	0.69	0.60	0.78	62.44
IS.2011.21	1.92	1.14	1.47	1.71	2.80	2.41	3.34	4.29	4.85	6.68	11.82	19.18	27.31	29.81	24.56	22.64	23.05	21.14	19.65	15.13	10.95	7.00	3.95	3.04	269.83
IS.2011.26	1.72	1.96	3.49	4.65	6.80	5.34	7.15	7.48	6.66	7.96	16.87	23.94	29.60	31.19	24.81	22.68	18.92	16.11	9.55	4.83	3.36	1.49	1.74	1.54	259.85
VG.2013.01	3.13	2.82	3.76	5.36	6.40	4.14	4.19	3.85	3.84	5.19	12.65	18.97	24.09	24.97	18.40	15.44	15.34	15.37	11.83	10.67	7.57	5.29	3.72	2.95	229.94
IS.2011.23	2.10	1.22	1.23	1.86	3.09	2.55	2.87	3.39	3.89	5.55	10.12	15.14	23.28	24.75	19.03	17.72	20.11	17.99	15.86	12.96	9.81	6.46	4.25	2.47	227.69
IS.2011.27	3.31	2.37	3.78	4.75	6.17	4.58	4.39	4.36	4.37	5.92	14.71	21.38	28.65	30.97	24.03	18.21	15.17	14.23	11.10	7.93	5.37	3.80	3.27	2.45	245.26
IS.2011.20	3.84	2.20	1.48	3.16	2.94	1.62	1.59	1.65	2.44	3.84	9.16	14.03	21.78	24.18	18.32	15.50	18.09	16.54	15.84	15.43	12.04	9.80	6.60	4.52	226.60
IS.2011.25	0.06	0.12	0.17	0.20	0.31	0.07	0.02	0.02	0.03	0.01	0.19	0.29	0.53	0.73	0.38	0.26	0.37	0.23	0.12	0.23	0.08	0.02	0.07	0.13	4.63
DE.2011.20	1.09	0.75	0.61	0.90	1.72	2.77	1.89	1.65	1.47	2.21	2.85	3.14	4.27	5.31	5.03	2.66	2.11	2.79	2.51	2.94	2.18	0.92	0.74	0.87	53.36
IS.2011.39	1.91	2.11	2.46	5.43	8.52	14.27	14.34	12.36	15.60	23.90	29.97	38.95	46.74	48.45	47.39	45.80	41.13	35.66	26.50	15.14	6.97	3.55	2.35	1.98	491.50
VG.2013.08	0.62	1.12	1.34	2.56	5.33	9.63	10.91	8.14	10.34	13.90	19.42	21.58	27.03	25.58	27.85	26.81	25.33	23.03	17.00	8.46	3.82	1.78	1.29	0.51	293.41
VG.2013.09	1.70	1.62	2.27	4.55	7.63	11.59	10.38	8.81	10.66	16.55	22.97	27.66	34.03	35.28	36.57	37.37	32.95	29.16	20.95	12.56	6.12	2.97	1.76	1.72	377.82
IS.2011.37	0.41	0.55	0.46	0.92	2.56	5.18	5.93	4.36	5.64	9.07	13.95	15.98	19.61	18.26	18.83	19.00	17.08	14.91	10.22	5.94	2.77	1.73	0.79	0.52	194.65
IS.2011.38	0.48	0.83	1.11	2.23	3.72	4.92	4.28	2.89	3.91	5.48	6.33	8.92	12.56	12.99	13.71	12.50	12.57	13.78	11.10	6.93	2.55	1.06	0.66	0.48	146.00
IS.2011.36	1.63	1.51	2.09	4.22	5.69	7.76	5.24	5.32	6.17	9.08	12.56	15.52	20.85	22.52	22.35	23.55	19.43	16.64	11.88	7.99	4.86	1.84	1.23	1.39	231.34
DE.2011.27	5.04	5.22	6.19	7.87	8.93	10.09	7.60	7.05	7.30	14.23	25.38	31.17	33.69	32.27	28.34	25.22	26.10	23.68	21.91	15.36	10.08	5.92	5.03	4.84	368.53
VG.2013.02	6.63	6.78	7.29	6.89	8.05	7.81	4.75	3.54	6.03	9.81	18.27	26.67	32.92	32.60	27.55	23.79	24.80	22.41	22.65	21.59	15.56	10.96	7.38	7.40	362.12
DE.2011.23	8.45	9.81	11.04	13.09	15.93	16.00	8.23	6.63	6.86	11.12	17.26	22.65	31.48	30.67	27.15	24.57	27.35	25.95	29.83	24.49	14.93	9.09	7.43	7.01	407.01
FG.2013.32	8.44	6.92	7.88	8.93	9.31	6.73	3.85	1.87	3.04	4.79	8.62	13.57	20.66	21.36	20.46	18.12	23.20	24.50	31.77	34.97	26.65	20.32	13.54	10.55	350.06
IS.2011.22	6.76	6.91	7.66	7.37	9.27	6.44	3.69	2.35	3.06	4.74	9.01	13.08	20.11	21.96	19.07	17.00	20.85	23.93	27.96	29.80	25.78	18.97	12.31	9.60	327.66
VG.2013.10	7.16	7.64	7.62	7.92	8.66	5.88	4.03	2.54	3.28	4.38	8.50	13.61	19.83	21.53	17.65	17.47	21.29	21.78	25.80	28.33	23.63	18.50	11.75	8.63	317.39
VG.2013.11	4.54	5.89	6.63	7.61	9.11	9.80	5.39	4.33	4.82	6.92	11.35	16.46	22.20	21.31	19.57	18.16	21.40	21.74	23.94	20.55	12.52	8.33	5.51	5.23	293.32
IS.2011.10	7.84	10.04	14.78	18.90	20.24	13.21	10.10	7.36	6.13	10.67	17.83	26.87	37.31	44.27	42.24	39.90	39.44	35.32	32.72	21.66	11.96	7.78	6.27	6.56	489.40
IS.2011.13	5.04	6.71	9.15	11.64	12.12	7.17	5.74	3.59	2.63	6.95	12.75	19.39	25.50	31.58	29.90	28.86	25.35	23.30	21.04	14.20	7.54	4.42	3.47	4.04	322.09
IS.2011.01	4.90	6.87	9.59	11.77	13.05	8.71	6.09	4.61	4.99	11.45	19.15	28.03	36.69	42.08	37.37	35.34	29.77	22.11	17.03	11.47	6.32	4.19	3.09	3.67	378.35
DE.2011.18	7.13	8.10	9.80	9.88	9.52	3.89	2.36	4.14	4.74	7.61	14.14	20.74	30.38	31.90	30.28	32.09	34.62	36.56	33.12	28.62	18.95	12.68	8.23	7.25	406.72
DE.2011.19	5.83	6.69	6.90	6.41	5.04	2.62	1.33	2.23	2.73	6.24	12.27	17.69	27.04	27.50	23.23	23.26	27.39	28.35	27.75	26.54	19.25	13.58	8.32	6.51	334.71
DE.2011.21	5.81	5.77	6.84	6.00	4.01	1.15	0.90	1.38	2.50	4.92	9.63	15.63	20.34	21.75	17.21	17.85	23.35	24.74	24.24	21.97	15.63	11.28	7.69	5.80	276.39

Figure 81: VG Distances heatmap by daytime (0-23 hours, 2017-2019, scale by row)

Unlike the FG area, the hours of greatest activity show more homogeneity between groups in the VG area from hours 13 -14. The hours of least activity show less uniformity between groups in the VG area.

The green, orange and pink groups show a high level of homogeneity of KM among their same group.

The hours of least activity are before 11, but the pink and red group have lower activity from 1-3 and the blue, orange and green groups have lower activity of 7-9.

5.4 FG Distances heatmap by month + climate, in 3 years separately

This approach is once again visualizing 12 months in the heatmap**, but this time each of the tables shows the results of 1 year at a time**, which obviously allows us to see values in a more specific way. In this section it is also possible to appreciate the data quality, since periods where data is not available for some animals can be seen. Whenever the value is 0, this means that there was no data on the positions set of this animal in this month, which is why its accumulated distance traveled is 0.

A section of rows that include the most relevant weather information has been added, also presented in the form of a heatmap. In total these tables include 3 heatmaps, linking the values between them with the help of the rows and columns, but as such, the colors of the scales of the 3 heatmaps are independent of each other.

- ### 5.4.1 FG Distances heatmap in 1 year + climate (1-12 months, 2017 scale by row)

This heatmap presents the results of the FG area in 2017. As already mentioned, here it is already possible to appreciate in more detail the quality of the data, so it can be seen why it is important when exploring a dataset of this type, to go from the more general to the more specific in a gradual way.

FG 2017, distances in KM, by months. Each row is a different KM heatmap													
ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	Total
FG.2016.03	0.00	1.02	7.40	0.76	9.40	11.93	8.90	3.84	4.67	6.29	8.70	8.29	71.18
FG.2016.05	0.00	0.67	6.85	0.60	4.13	8.62	9.83	3.58	4.48	5.34	7.85	6.58	58.53
FG.2016.07	0.00	0.73	8.53	0.81	5.24	8.83	9.82	3.59	1.13	4.63	8.10	5.90	57.31
IS.2011.02	0.00	0.96	8.63	1.01	9.43	9.97	9.17	4.03	4.71	5.77	8.30	6.99	68.96
IS.2011.04	0.00	0.70	6.81	0.00	3.32	8.55	9.84	3.48	4.24	5.37	9.83	5.87	57.99
IS.2011.05	0.00	0.79	9.16	0.00	3.88	9.78	12.53	4.74	6.16	6.01	8.52	7.67	69.25
IS.2011.11	0.00	2.12	16.92	1.74	32.68	46.04	19.98	6.37	4.93	9.43	3.14	6.23	149.57
IS.2011.12	0.00	0.78	7.35	0.00	3.36	8.88	9.94	3.77	4.03	5.59	8.05	6.34	58.10
IS.2011.14	0.00	0.93	8.12	0.83	8.73	9.62	9.39	3.65	4.99	5.68	7.65	6.44	66.04
IS.2011.15	0.00	0.73	8.74	0.35	4.64	9.28	10.25	4.14	4.59	6.46	8.49	6.15	63.81
FG.2016.12	0.00	0.49	6.42	0.89	7.69	11.38	13.58	5.20	4.84	4.66	5.35	9.40	69.87
FG.2016.13	0.00	0.53	6.59	0.94	7.58	10.51	13.14	5.08	4.77	4.90	5.23	9.82	69.09
FG.2016.15	0.00	0.46	6.43	0.84	6.09	10.07	14.25	5.03	4.75	4.75	4.47	9.67	66.80
FG.2016.17	0.00	0.53	6.45	0.81	4.55	10.84	14.78	5.29	4.82	4.83	4.85	10.00	67.75
FG.2016.18	0.00	0.44	6.28	0.79	4.62	10.58	14.64	5.28	4.86	4.71	4.91	9.88	66.99
FG.2017.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IS.2011.32	0.00	0.62	8.10	0.00	3.70	10.19	14.22	5.32	5.10	5.18	5.67	10.71	68.81
FG.2013.01	0.00	0.63	6.76	0.00	3.85	6.80	8.35	3.17	4.11	7.19	6.83	10.23	57.92
FG.2017.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.01	8.80	13.59	28.39
FG.2017.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.04	8.08	13.87	27.99
FG.2017.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.42	6.92	12.98	25.31
LA.2011.01	0.00	1.42	10.48	0.63	10.64	0.73	0.00	0.00	0.00	0.00	0.00	0.00	23.90
LA.2011.03	0.00	0.98	5.48	0.56	11.83	14.51	15.49	7.10	6.12	11.02	9.98	14.40	97.48
FG.2016.14	0.00	0.46	6.07	0.28	6.66	12.75	14.97	7.94	6.75	6.43	3.56	8.25	74.12
FG.2016.16	0.00	0.42	0.32	0.09	1.20	0.56	0.03	0.00	0.00	1.99	2.60	7.96	15.18
FG.2017.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.88	3.56	7.53	12.98
IS.2011.29	0.00	0.54	5.53	0.00	6.93	11.23	14.00	7.38	6.55	5.31	3.60	8.95	70.03
IS.2011.33	0.00	0.47	5.83	0.19	7.60	11.72	14.26	7.62	6.31	6.47	4.16	8.82	73.45
IS.2011.34	0.00	0.48	6.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.83
FG.2017.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.42	13.49	12.69	32.59
FG.2017.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.50	13.52	13.85	33.86
FG.2017.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.66	13.59	12.30	32.54
FG.2013.29	0.00	0.93	9.00	0.16	14.34	16.68	18.49	6.15	7.36	10.69	12.93	14.02	110.75
DE.2011.14	0.00	0.89	11.79	0.80	14.84	18.69	18.91	6.44	8.60	15.33	15.98	15.25	127.53
Outside Temperature TX5 (°C)	NA	18.61	16.95	9.61	21.86	30.42	30.06	29.23	15.64	12.38	5.42	2.95	
Inside Humidity (%)	NA	61.61	64.61	62.91	61.49	55.65	57.62	56.26	65.99	69.64	74.61	76.63	
Solar Radiation TX4	NA	NA	18.048	97.291	256.39	351.84	336.22	182.12	95.362	48.019	8.6206	22.496	
Rain Amount TX4 (mm)	NA	NA	0.0071	0.0141	0.0064	0.015	0.0281	0.018	0.0404	0.0075	0.0108	0.0096	
Wind Speed TX4 (k/hr)	NA	NA	1.8645	7.5924	5.5029	5.0041	4.7403	4.7705	4.1722	4.7054	4.6824	5.5965	

Figure 82: FG Distances heatmap by month in 1 year + climate (1-12 months, 2017 scale by row)

In the first column there is no data, because the data collection began in month 2 of 2017. Month 2 has little data; it is not until month 3 when there is a significant increase in the data obtained.

There is 1 animal ID (red) FG.2017.18 which is somewhat strange, it has no values in any of the months. When reviewing the following years, it is seen that this animal was introduced at the end of 2018 and from then on it shows values. On the contrary, the animal ID IS.2011.34 shows values from the beginning, but very quickly it stops having values and in the following years it does not have any either. Reviewing the official record, it is seen that this animal died or was removed from the enclosure at the time it stopped having data.

3 members of the blue group were introduced together in month 10, the other 2 members had already been in the enclosure since the beginning. Month 4 shows data problems, there seems to be almost no data that month.

There are animals that show a high level of mobility in month 12, however this may be due to the fact that these animals were introduced in month 10, after the months of greatest mobility had already passed, therefore it can be deduced that from 3 months that have a record, month 12 is the month with the most mobility, however there is a lack of data from the rest of the year to make a correct comparison.

The hottest months and with the most solar radiation (6 and 7) are those that at the same time show higher levels of displacement. In addition to heat and solar radiation, it seems that humidity has a correlation with the increase in animal mobility. In the 11th and 12th month, humidity increases, heat and solar radiation do not increase, and displacement increases (although less than in summer).

The IS.2011.11 animal from the green group has a total of 149.57 KM accumulated in 2017, which is an extremely high number compared to the other animals.

Possible further research question:

- How strong or significant is the correlation between KM displacement and humidity in the environment?

- 5.4.2 FG Distances heatmap in 1 year + climate (1-12 months, 2018 scale by row)

The following heatmap works in the same way as the one from 2017, but with data from 2018. This year is the one with the best data quality.

FG 2018, distances in KM, by months. Each row is a different KM heatmap													
ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	Total
FG.2016.03	9.42	9.02	11.19	11.14	7.45	13.97	0.00	8.19	10.82	13.50	6.43	3.21	104.33
FG.2016.05	9.12	7.91	10.61	10.42	7.33	12.03	0.00	8.24	11.15	14.15	6.35	3.17	100.49
FG.2016.07	7.00	5.68	8.13	9.09	4.20	8.78	0.00	8.07	8.66	7.68	3.52	2.66	73.47
IS.2011.02	8.59	7.12	11.41	10.69	7.61	13.61	0.00	9.59	12.21	15.13	7.69	3.05	106.69
IS.2011.04	8.69	8.71	13.49	18.49	2.41	9.56	0.00	8.48	9.07	8.90	5.83	3.64	97.28
IS.2011.05	8.51	8.40	12.92	15.25	6.96	12.54	0.00	8.18	11.37	14.19	6.49	2.71	107.51
IS.2011.11	7.96	6.56	11.30	12.05	6.00	11.50	0.00	10.21	11.12	11.24	8.35	4.97	101.26
IS.2011.12	8.85	7.65	10.26	12.49	7.64	12.55	0.00	8.36	11.51	14.89	7.70	3.93	105.82
IS.2011.14	8.08	8.54	11.56	12.50	6.31	9.68	0.00	0.00	0.00	0.00	0.06	3.10	59.83
IS.2011.15	6.50	5.75	8.43	10.45	4.35	8.44	0.00	7.10	9.11	7.54	4.35	3.01	75.05
FG.2016.12	8.24	4.34	6.23	10.23	12.23	11.80	0.00	0.00	0.00	0.00	0.00	0.00	53.07
FG.2016.13	8.45	4.64	5.82	12.20	5.52	0.84	0.00	0.00	0.00	0.00	0.00	0.00	37.47
FG.2016.15	8.59	4.83	5.89	10.30	7.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	37.17
FG.2016.17	9.02	5.25	6.60	10.28	6.87	12.15	0.00	9.87	0.36	0.00	0.00	0.00	60.40
FG.2016.18	8.78	4.77	5.99	13.68	12.53	11.37	0.00	11.62	15.94	3.61	0.00	0.00	88.29
FG.2017.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.30	5.30
IS.2011.32	9.34	5.56	6.34	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.14	6.15	28.00
FG.2013.01	8.37	4.87	5.97	9.01	10.41	7.20	0.00	10.43	5.23	0.00	0.00	0.00	61.49
FG.2017.11	11.31	9.47	13.54	21.84	21.50	14.57	0.00	12.12	15.88	11.64	4.85	7.97	144.69
FG.2017.12	11.48	9.64	13.54	22.11	22.18	15.78	0.00	12.35	16.62	11.73	5.13	8.38	148.95
FG.2017.13	11.85	9.92	13.37	21.05	21.62	13.92	0.00	12.09	15.60	10.32	4.43	7.34	141.52
LA.2011.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LA.2011.03	11.80	9.55	14.31	22.39	21.73	12.86	0.00	11.06	15.31	10.69	4.78	8.42	142.89
FG.2016.14	8.50	5.22	9.42	13.00	14.98	11.46	0.00	10.65	13.37	9.32	1.15	6.15	103.22
FG.2016.16	7.38	4.23	7.45	10.34	11.90	8.58	0.00	8.20	11.22	7.41	0.43	5.26	82.39
FG.2017.09	6.91	3.35	6.45	10.45	9.23	5.46	0.00	8.50	12.03	8.63	1.60	5.94	78.56
IS.2011.29	9.29	5.15	8.73	8.70	11.64	0.33	0.00	0.00	0.00	0.00	0.00	0.00	43.84
IS.2011.33	8.90	5.20	9.97	7.62	3.57	13.13	0.00	13.29	16.99	18.90	7.88	0.00	105.46
IS.2011.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FG.2017.14	12.52	9.55	10.41	17.86	24.46	20.36	0.00	22.53	24.48	21.92	9.88	8.21	182.20
FG.2017.16	13.07	9.43	10.96	19.50	24.29	22.33	0.00	22.56	23.52	22.05	9.52	9.48	186.69
FG.2017.17	12.52	9.33	10.37	16.20	24.64	19.90	0.00	23.35	23.73	22.71	9.88	8.56	181.18
FG.2013.29	14.11	10.00	13.77	16.57	26.15	23.89	0.00	21.74	23.47	23.35	9.96	8.75	191.75
DE.2011.14	14.47	9.45	12.59	15.01	24.71	20.92	0.00	24.46	25.49	24.96	10.22	9.01	191.30
Outside Temperature TX5 (°C)	3.88	1.62	8.03	19.37	21.01	27.97	NA	28.74	23.44	13.72	9.32	5.89	
Inside Humidity (%)	79.53	81.13	78.38	65.97	62.32	64.99	NA	55.06	67.00	67.90	75.66	80.28	
Solar Radiation TX4	21.92412	53.94589	111.4076	108.1351	142.0538	291.5354	NA	246.8124	189.7156	64.20766	75.5036	59.37307	
Rain Amount TX4 (mm)	0.009164	0.010918	0.006145	0.00918	0.01079	0.014626	NA	0.004743	0.023336	0.000605	0.007301	0.004446	
Wind Speed TX4 (k/hr)	4.698089	5.435132	6.630371	5.604772	3.652102	4.223634	NA	4.23865	4.038177	4.485484	5.245524	6.643471	

Figure 83: FG Distances heatmap by month in 1 year + climate (1-12 months, 2018 scale by row)

Month 7 is the only one with data problems, there is no data in this month at all.

The blue group and the pink group show high displacement homogeneity among the members of their groups.

Animal ID LA.2011.01 does not have data, but in 2017 it did, then it had a death/out event. From then on it does not show data again.

In the "total" column, which shows the KM accumulated in the year, it is also possible to see trends by groups, a yellow color for the green and orange group, orange color for the pink group and red color for the blue group. Once again a clear confirmation that the group identification technique works efficiently.

The red group has data problems starting in the middle of the year. It is needed to be careful in its analysis and only consider first half of the year.

The 2 clearest trends with the climate of 2017 are maintained in 2018, that is, with the increase in heat and solar radiation, the displacement increased.

The correlation of humidity with displacement is not as clear in 2018 as it seemed to be in 2017.

Up to this point, after the observations made previously, it seemed that the months of most mobility were undoubtedly months 5 and 6, however in 2018 month 4 also presents very high levels, on par with the levels of months 5 and 6. The months that homogeneously have the least displacement are 12, 1 and 2.

Possible further research question:

- Why does month 4 this year present high levels of displacement? when normally (as seen in 2017) those levels begin in month 5.

- 5.4.3 FG Distances heatmap in 1 year + climate (1-12 months, 2019 scale by row)

The following heatmap shows the FG values in 2019. This is not the year with the best data quality, there are some months (10, 11 and 12) that are generally bad, with a lack of data, but there are also animals that throughout the year do not present data at all, and it is not that they have had a death/out event, in theory, many of these animals were still in the enclosure, just without collecting data. This is mainly because the tags with sensors have a limited battery, and when the battery runs out, replacement is not easy to do. Despite this, this year has enough data to make some observations.

FG 2019, distances in KM, by months. Each row is a different KM heatmap													
ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	Total
FG.2016.03	5.66	5.04	10.54	4.62	9.16	17.38	15.27	12.67	10.46	6.18	5.40	7.01	109.39
FG.2016.05	5.45	4.96	10.29	10.43	7.28	8.07	7.94	7.24	7.42	2.82	3.00	4.23	79.12
FG.2016.07	4.06	4.82	7.79	7.50	7.30	7.99	8.74	7.30	7.75	2.55	2.42	3.85	72.07
IS.2011.02	5.39	4.84	9.43	5.76	9.12	15.59	13.95	12.73	10.50	6.30	5.99	6.99	106.59
IS.2011.04	3.91	5.62	11.19	5.33	7.54	9.80	12.93	11.08	10.64	4.60	4.23	4.21	91.07
IS.2011.05	4.47	4.63	9.35	6.15	8.84	15.55	14.68	12.26	10.30	6.57	6.50	6.75	106.05
IS.2011.11	5.32	8.92	13.80	6.72	11.16	12.33	15.50	13.98	10.46	6.13	3.29	0.00	107.60
IS.2011.12	5.77	11.61	16.96	25.02	17.88	20.19	16.29	15.75	16.28	12.75	7.14	9.06	174.69
IS.2011.14	4.84	5.03	9.37	5.79	9.54	14.64	14.47	13.04	11.45	7.41	6.43	7.85	109.85
IS.2011.15	4.30	4.50	7.89	7.61	6.32	6.76	7.27	4.12	0.00	0.00	0.00	0.00	48.77
FG.2016.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FG.2016.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FG.2016.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FG.2016.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FG.2016.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FG.2017.18	4.98	9.23	14.63	13.46	11.38	14.18	15.29	15.49	16.14	8.28	6.80	8.18	138.02
IS.2011.32	6.50	10.53	16.09	13.34	9.83	11.28	15.91	14.49	14.29	8.60	7.62	9.07	137.54
FG.2013.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FG.2017.11	10.00	13.54	20.35	21.33	26.67	26.70	23.90	19.41	21.35	4.33	0.00	0.00	187.58
FG.2017.12	9.24	14.36	21.51	21.64	28.08	26.19	22.64	19.21	22.57	8.99	0.65	0.00	195.07
FG.2017.13	10.00	14.21	20.31	21.50	27.66	26.25	20.57	18.55	22.92	9.91	10.00	8.56	210.42
LA.2011.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LA.2011.03	9.74	13.89	20.70	12.01	23.05	29.04	27.15	22.38	21.43	12.51	8.01	0.00	199.92
FG.2016.14	6.08	9.68	2.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	18.74
FG.2016.16	5.27	8.17	13.95	9.53	13.66	8.40	12.24	12.15	11.32	3.26	0.00	0.00	97.95
FG.2017.09	6.34	8.93	14.03	11.11	8.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	49.37
IS.2011.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IS.2011.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IS.2011.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FG.2017.14	10.39	10.59	17.62	20.30	23.57	24.38	21.09	15.11	17.93	6.94	8.68	11.37	187.96
FG.2017.16	11.43	11.34	18.02	20.38	21.30	25.82	19.41	17.01	18.00	7.34	8.95	11.93	190.93
FG.2017.17	11.41	10.73	18.09	19.70	24.17	26.32	22.77	17.16	19.20	8.85	9.40	10.71	198.49
FG.2013.29	10.69	10.97	17.36	14.71	23.80	25.81	24.56	21.23	20.95	13.17	9.65	9.54	202.43
DE.2011.14	11.31	11.33	15.53	12.12	26.15	9.70	0.54	0.14	0.00	0.00	0.00	0.00	86.81
Outside Temperature TX5 (°C)	2.27	5.87	11.35	12.76	NA	NA	NA	NA	NA	NA	NA	NA	
Inside Humidity (%)	78.36	73.26	62.61	56.60	64.74	62.35	55.67	62.76	NA	NA	NA	NA	
Solar Radiation TX4	46.30777	44.50267	87.5989	50.58954	201.0042	237.5311	254.817	97.66001	NA	NA	NA	NA	
Rain Amount TX4 (mm)	0.009303	0.002628	0.002972	0.000474	0.000107	1.56E-05	0.001586	0	NA	NA	NA	NA	
Wind Speed TX4 (k/hr)	5.710037	6.200742	6.371623	7.068526	5.804076	3.965495	4.019224	4.117254	NA	NA	NA	NA	

Figure 84: FG Distances heatmap by month in 1 year + climate (1-12 months, 2019 scale by row)

In the red group, only 1 animal has data, so analyzing the group this year is not possible. The green group shows better data quality than all the others, as it contains also more animals, the information is more complete, making it a good candidate for deeper and more specific group analysis.

Within the months that have data, the correlations of displacement with climate remain as in previous years, except for humidity, which cannot be clearly observed in 2019 because there is no data for the last 3 months of the year. Temperature and solar radiation show a positive correlation with displacement, with the detail that the most relevant months (5, 6 and 7) do not show temperature data.

Despite the quality of the data, clear trends of displacement by groups can still be observed in the "total" column. From 2017 to 2019, the animal in the green group with the most KM per year has changed, in 2019 it is a new animal ID IS.2011.14

Possible further research questions:

- What does the change of animal that accumulates significantly more KM mean?

5.5 FG distances heatmap by week in 1 year + climate, in 3 years separately

In this section the analysis now moves on to a much more specific overview, in fact, it is the most specific view in the distance perspective of this work. In this approach, the information is displayed by week in a year, that is, there are 53 columns for each year and there are 3 tables, one for 2017, 2018 and 2019, which are separated. The accumulated total values column is no longer displayed, because the values are the same as in the previous section (only in the totals column).

The part that continues to be shown is the weather. Cells with "NA" mean that there is not data from that moment.

In these tables it is much easier to see the quality data, but it becomes more difficult to see trends in the KM heatmap.

- ## 5.5.1 FG Distances heatmap in 1 year + climate (1-53 weeks, 2017 scale by row)

This heatmap shows the distance traveled values of the FG group in 2017 per week. The decimals have been reduced to 1 only, in order to improve the visualization, due to the large size of the table.

FG 2017, distances in KM, by weeks. Each row is a different KM heatmap

ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
FG.2016.03	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.8	2.2	2.0	1.5	0.0	0.0	0.0	0.0	0.8	2.2	2.8	3.2	0.3	1.7	3.5	3.0	2.4	2.2	1.2	2.0	2.7	2.3	2.4	0.3	1.7	0.0	0.0	0.0	0.0	2.1	2.6	1.0	1.7	1.5	0.9	2.6	2.3	2.0	1.8	1.6	1.6	1.9	2.2	2.0	0.4
FG.2016.05	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	1.6	2.2	1.8	1.2	0.0	0.0	0.0	0.0	0.6	0.6	1.0	1.3	0.2	1.6	1.7	2.3	2.4	1.6	0.9	2.8	2.6	2.4	2.1	0.5	2.1	0.0	0.0	0.0	0.0	2.2	2.3	1.3	0.7	1.4	0.9	2.3	2.0	1.7	2.0	1.3	1.5	1.4	1.7	1.5	0.2
FG.2016.07	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	1.6	2.7	2.3	1.9	0.0	0.0	0.0	0.0	0.8	1.1	1.1	1.8	0.2	1.9	1.8	2.0	2.6	1.6	0.9	3.1	2.6	2.4	2.0	0.6	2.0	0.0	0.0	0.0	0.0	0.7	0.4	0.3	1.2	1.5	0.7	2.3	2.1	2.0	1.7	1.4	1.4	1.2	1.5	1.2	0.3
IS.2011.02	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	2.1	2.5	2.2	1.9	0.0	0.0	0.0	0.0	1.0	2.3	3.0	2.9	0.3	1.8	2.9	2.3	2.4	1.5	1.2	2.5	2.4	2.5	2.4	0.5	1.9	0.0	0.0	0.0	0.0	2.1	2.6	1.2	1.0	1.6	1.0	2.3	2.3	1.9	1.5	1.3	1.5	1.6	2.0	1.5	0.4
IS.2011.04	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	1.9	2.1	1.4	1.4	0.0	0.0	0.0	0.0	0.0	0.3	0.7	1.2	0.2	1.7	1.8	1.8	2.4	1.8	0.9	2.8	2.7	2.6	2.1	0.6	1.7	0.0	0.0	0.0	0.0	2.3	1.9	1.2	0.7	1.8	0.7	2.5	2.5	2.3	2.0	1.6	1.3	1.4	1.3	1.3	0.3
IS.2011.05	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	1.9	2.9	2.2	2.1	0.0	0.0	0.0	0.0	0.0	0.5	0.7	1.3	0.2	1.9	1.9	2.1	2.9	2.0	1.2	3.5	3.5	3.3	2.5	0.7	2.6	0.0	0.0	0.0	0.0	3.0	3.2	1.5	1.1	1.5	1.1	2.0	2.2	1.9	2.2	1.3	1.4	1.7	2.0	2.0	0.3
IS.2011.11	0.0	0.0	0.0	0.0	0.0	0.0	2.1	0.0	4.8	6.2	3.4	2.5	0.0	0.0	0.0	0.0	1.7	5.5	10.6	11.1	0.8	8.3	10.9	10.6	12.5	8.5	2.7	7.2	5.1	3.9	4.0	0.4	2.8	0.2	0.0	0.0	0.0	2.3	2.7	1.8	2.8	2.6	1.0	3.3	1.1	0.0	0.0	0.3	1.4	1.4	1.6	1.2	0.3
IS.2011.12	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	1.7	2.4	2.0	1.3	0.0	0.0	0.0	0.0	0.0	0.3	0.6	1.2	0.2	1.8	1.8	2.4	2.5	1.4	1.0	2.7	2.7	2.5	2.2	0.6	2.0	0.0	0.0	0.0	0.0	1.9	2.1	1.3	0.8	1.7	0.8	2.2	2.1	2.0	1.8	1.2	1.6	1.3	1.7	1.3	0.2
IS.2011.14	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	2.2	2.2	2.3	1.6	0.0	0.0	0.0	0.0	0.8	2.1	2.8	2.6	0.3	1.8	3.2	2.1	2.0	1.5	1.3	2.8	2.4	2.2	2.4	0.4	1.7	0.0	0.0	0.0	0.0	2.1	2.9	1.0	1.2	1.5	0.9	2.2	2.0	1.9	1.7	1.2	1.3	1.5	1.8	1.4	0.2
IS.2011.15	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	1.7	2.5	2.3	2.2	0.0	0.0	0.0	0.0	0.4	0.9	1.3	1.3	0.3	1.7	1.9	2.2	2.7	1.8	0.9	3.2	2.8	2.5	2.2	0.6	2.2	0.0	0.0	0.0	0.0	2.5	2.1	1.1	1.6	1.7	1.0	2.6	2.3	2.1	1.4	1.5	1.4	1.3	1.7	1.2	0.2
FG.2016.12	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.1	2.0	1.5	1.8	0.0	0.0	0.0	0.0	0.9	2.8	2.4	1.6	0.0	1.6	3.4	2.3	3.2	1.7	1.2	3.8	4.5	3.2	2.8	0.7	2.5	0.2	0.0	0.0	0.0	2.2	2.7	1.3	1.2	1.4	0.6	0.5	1.3	1.2	1.3	1.8	1.9	2.3	2.4	1.7	0.4
FG.2016.13	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.2	2.2	1.6	1.7	0.0	0.0	0.0	0.0	0.9	2.7	2.3	1.5	0.0	1.8	3.3	2.2	2.7	1.5	1.1	3.4	4.4	3.1	3.0	0.7	2.3	0.1	0.0	0.0	0.0	2.4	2.3	1.2	1.4	1.5	0.5	0.5	1.4	1.0	1.2	1.8	2.0	2.8	2.4	1.7	0.4
FG.2016.15	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.0	1.8	1.8	1.8	0.0	0.0	0.0	0.0	0.8	1.8	1.6	1.5	0.1	1.5	3.0	2.2	2.6	1.7	1.2	4.3	4.4	3.5	2.8	0.7	2.2	0.2	0.0	0.0	0.0	2.3	2.5	1.3	1.3	1.5	0.5	0.5	1.1	1.1	0.8	2.0	1.8	2.5	2.3	1.8	0.4
FG.2016.17	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.9	2.0	1.7	1.9	0.0	0.0	0.0	0.0	0.8	1.0	1.2	1.3	0.1	1.8	3.2	2.3	2.9	1.7	1.4	4.1	4.6	3.6	3.4	0.7	2.0	0.3	0.0	0.0	0.0	2.5	2.3	1.3	1.2	1.4	0.6	0.8	1.2	1.0	1.1	1.7	1.9	2.6	2.4	2.0	0.5
FG.2016.18	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	1.0	2.1	1.6	1.6	0.0	0.0	0.0	0.0	0.8	0.8	1.1	1.5	0.2	1.8	3.1	2.3	2.6	1.8	1.2	4.2	4.7	3.5	3.1	0.6	2.2	0.2	0.0	0.0	0.0	2.6	2.2	1.4	1.1	1.5	0.5	0.6	1.4	1.1	1.1	1.6	1.6	2.8	2.5	1.9	0.5
FG.2017.18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IS.2011.32	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	1.4	2.3	2.2	2.2	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.5	0.0	1.9	2.7	2.0	2.8	1.8	1.1	3.8	4.4	3.8	3.3	0.7	2.1	0.4	0.0	0.0	0.0	2.7	2.4	1.2	1.2	1.8	0.6	0.8	1.5	1.3	1.2	1.9	2.3	2.8	2.4	2.1	0.5
FG.2013.01	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	1.4	1.9	1.4	2.0	0.0	0.0	0.0	0.0	0.0	0.1	1.2	1.3	0.2	1.7	2.6	1.7	1.0	0.7	0.9	3.2	2.1	1.8	1.0	0.8	1.7	0.2	0.0	0.0	0.0	1.6	2.5	1.8	2.3	1.9	0.8	1.0	2.2	1.4	1.6	1.8	2.2	2.7	2.4	1.7	0.5
FG.2017.11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	2.9	1.4	2.0	2.4	2.1	1.8	2.2	2.9	2.9	3.2	2.9	0.8
FG.2017.12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	2.9	1.3	2.0	2.2	1.9	1.7	2.1	3.2	2.7	3.3	3.0	0.9
FG.2017.13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	2.8	1.0	1.6	1.6	1.7	1.5	2.1	2.9	2.7	3.1	2.7	0.7
LA.2011.01	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	2.4	5.5	2.6	0.0	0.0	0.0	0.0	0.0	0.6	2.4	3.9	3.5	0.2	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LA.2011.03	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	1.5	2.3	1.7	0.0	0.0	0.0	0.0	0.0	0.6	2.1	3.8	3.6	0.2	3.0	3.8	3.5	3.5	2.8	1.3	4.3	5.1	3.7	4.0	0.7	3.2	0.2	0.0	0.0	0.0	2.7	3.4	2.5	2.6	3.6	1.4	2.2	2.7	2.4	2.0	2.7	3.4	3.0	3.2	2.9	0.8
FG.2016.14	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.0	1.8	1.6	1.7	0.0	0.0	0.0	0.0	0.3	0.4	2.2	2.2	0.2	2.3	2.7	2.9	4.0	2.5	1.3	3.8	4.6	4.0	4.0	0.8	4.0	0.3	0.0	0.0	0.0	3.3	3.5	1.7	2.6	1.4	0.4	1.1	1.2	0.3	0.6	1.1	1.9	1.7	2.2	1.7	0.4
FG.2016.16	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.1	0.7	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.9	0.3	0.5	1.0	0.3	0.7	0.7	1.6	1.8	2.0	1.7	0.5
FG.2017.09	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.8	0.5	0.5	1.3	0.7	0.6	1.3	1.5	1.5	1.9	1.6	0.4
IS.2011.29	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.0	1.4	1.7	1.5	0.0	0.0	0.0	0.0	0.0	0.8	2.4	2.4	0.1	1.8	2.2	2.9	3.5	2.1	1.2	3.8	4.0	3.9	4.1	0.7	3.3	0.3	0.0	0.0	0.0	3.2	3.3	2.1	1.5	1.1	0.4	0.8	1.2	0.7	0.6	1.2	1.7	1.9	2.5	1.7	0.5
IS.2011.33	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.1	1.7	1.4	1.7	0.0	0.0	0.0	0.0	0.2	1.1	2.8	2.2	0.2	1.8	2.2	2.9	3.6	2.5	1.3	3.9	4.5	3.7	3.9	0.6	3.7	0.3	0.0	0.0	0.0	3.0	3.3	2.2	2.2	1.4	0.4	1.0	1.4	0.5	0.9	1.2	1.9	1.8	2.4	1.7	0.4
IS.2011.34	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	1.3	1.8	1.7	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2017.14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	3.0	1.5	3.1	2.7	3.8	3.0	3.5	2.6	3.2	2.9	2.7	0.2
FG.2017.16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	3.1	1.6	3.2	2.7	3.9	2.9	3.6	2.7	3.6	3.1	2.9	0.3
FG.2017.17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	3.3	1.6	3.2	2.5	4.2	2.8	3.2	2.7	3.1	3.0	2.5	0.2
FG.2013.29	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	1.6	2.8	2.2	2.4	0.0	0.0	0.0	0.0	0.2	2.8	5.1	3.7	0.5	3.4	4.4	4.5	4.5	2.0	1.1	6.2	5.1	4.5	4.4	0.8	2.5	0.0	0.0	0.0	0.0	3.6	3.7	2.6	2.8	2.5	1.3	3.0	2.8	3.6	2.8	3.5	3.0	3.3	2.9	3.2	0.4
DE.2011.14	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	2.0	3.7	3.0	3.1	0.0	0.0	0.0	0.0	0.8	2.7	5.0	4.3	0.6	3.5	5.1	5.1	5.1	2.1	1.2	5.9	5.5	4.7	4.8	0.7	2.5	0.1	0.0	0.0	0.0	3.7	4.9	2.9	4.5	3.8	1.9	4.4	3.3	4.7	3.1	3.9	3.2	3.8	3.5	3.2	0.3
Outside Temperature TX5 (°C)	NA	NA	NA	NA	NA	NA	18.6	NA	20	20.7	16.1	10.6	NA	NA	NA	NA	9.61	16.5	21.9	25.4	NA	31.7	24.6	30.4	35.7	32.2	35.3	26	32.5	27.9	37	24.2	25.3	14.5	NA	NA	NA	15.1	16.2	14.5	13.7	12.1	9.79	8.23	8.01	4.2	5.26	0.73	1.86	3.34	3.89	2.89	7.33
Inside Humidity (%)	NA	NA	NA	NA	NA	NA	61.5	NA	64.9	65.1	63.4	64.9	NA	NA	NA	NA	62.9	62.8	62.9	60.9	61.8	58.3	59.8	55	52	53.4	53.5	58.8	56.7	58.9	55.2	58.5	57.2	61	NA	NA	NA	65.1	66.9	68.5	68.8	69	72.8	72.5	73.9	74.6	75.3	76.3	76.5	76.5	76.9	76.6	76
Solar Radiation TX4	NA	NA	NA	NA	NA	NA	0	NA	0	0	12	61	NA	NA	NA	NA	97.3	174	292	278	41.2	307	257	377	445	353	409	252	406	312	335	131	112	0.23	NA	NA	NA	97.5	93.2	93	55.9	20.1	12.9	22.4	8.5	9.93	7.07	9.09	22.2	15.7	25.7	27.2	22.4
Rain Amount TX4 (mm)	NA	NA	NA	NA	NA	NA	0.00	NA	0.00	0.00	0.01	0.02	NA	NA	NA	NA	0.01	0.03	0.00	0.00	0.04	0.00	0.02	0.00	0.00	0.05	0.00	0.06	0.00	0.03	0.00	0.00	0.03	0.13	NA	NA	NA	0.08	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.03	0.02	0.00	0.00	0.02	0.00
Wind Speed TX4 (k/hr)	NA	NA	NA	NA	NA	NA	0	NA	0	0	1.76	5.8	NA	NA	NA	NA	7.59	4.68	5.94	6.49	1.61	4.04	4.76	5.48	5.07	5.83	4.92	4.25	4.91	5.04	5.21	5.53	4.18	3.25	NA	NA	NA	4.9	3.43	5.8	3.24	2.62	7.58	5.23	2.14	5.3	7.09	4.97	7.45	5.91	6.56	3.17	3.1

Figure 85: FG Distances heatmap by week in 1 year + climate (1-53 weeks, 2017 scale by row)

Weeks 1,2,3,4,5,6, 8, 13, 14, 15, 16, 21, 34, 35, 36 and 37 have a data quality that cannot be analyzed, there is no data.

The trends of KM displacement levels by season of the year continue to be observable. Although it could be questioned whether the low levels in some seasons are a consequence of the lack of data, but this can be compared and confirmed by observing the same season in other years that do have data in that season.

Climate-related trends also remain, but in this heatmap it is easier to observe an apparent correlation between humidity and the increase in KM displacement.

- ## 5.5.2 FG Distances heatmap in 1 year + climate (1-53 weeks, 2018 scale by row)

The following heatmap shows the values of the results per week of the animals in FG. This year is the year with the best quality data, but there is a data hole in months 27, 28, 29 and 30.

FG 2018, distances in KM, by weeks. Each row is a different KM heatmap

ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
FG.2016.03	2.2	2.1	1.5	2.6	2.1	2.2	2.5	1.7	1.9	3.3	3.4	2.1	2.2	3.3	3.7	3.6	0.4	0.9	1.4	1.8	2.3	1.8	2.8	3.5	5.1	2.0
FG.2016.05	1.5	2.1	1.6	2.5	2.4	1.8	2.4	1.4	1.9	2.5	3.5	2.3	1.8	3.2	3.8	3.4	0.0	0.6	1.3	1.4	2.5	2.2	2.3	3.4	3.9	1.8
FG.2016.07	1.3	1.7	1.2	1.9	1.4	1.5	1.6	0.9	1.4	2.0	2.5	2.0	1.4	3.0	2.9	3.2	0.0	0.0	0.4	1.3	1.5	2.2	1.5	2.4	2.9	0.8
IS.2011.02	1.8	2.1	1.3	2.3	1.8	1.7	2.1	1.2	1.7	3.3	3.6	2.0	2.3	3.1	3.8	3.5	0.1	0.8	1.3	1.7	2.7	2.0	2.7	3.5	4.8	1.9
IS.2011.04	1.5	1.9	1.5	2.6	2.2	2.0	2.7	1.7	1.7	3.4	5.0	2.6	2.1	6.7	6.6	5.2	0.0	0.0	0.2	0.9	0.5	1.7	1.4	2.9	3.1	1.3
IS.2011.05	1.4	2.2	1.4	2.3	2.3	1.9	2.6	1.4	1.9	3.5	4.3	2.3	2.4	4.1	5.3	5.7	0.0	0.7	1.1	1.5	2.4	2.2	2.4	3.1	4.6	1.6
IS.2011.11	1.6	1.8	1.1	2.4	1.8	1.6	2.0	0.9	1.5	2.8	3.9	2.3	2.1	4.7	3.6	3.8	0.0	0.2	0.9	1.8	2.2	1.8	2.1	3.6	3.4	1.5
IS.2011.12	1.5	1.6	1.6	2.6	2.5	1.8	2.2	1.6	1.5	2.4	3.1	2.2	2.1	3.5	4.4	4.3	0.2	0.9	1.2	1.6	2.7	1.9	2.6	3.3	4.2	1.8
IS.2011.14	1.1	1.7	1.4	2.5	2.2	1.9	2.7	1.6	1.8	3.2	3.3	2.3	2.5	3.7	4.7	4.0	0.0	0.6	1.0	1.5	2.1	2.0	2.3	3.6	2.9	0.0
IS.2011.15	1.2	1.7	1.0	1.6	1.8	1.3	1.6	1.0	1.3	2.4	2.4	1.9	1.5	3.3	3.5	3.1	0.6	0.1	0.6	1.5	1.4	1.6	1.5	2.1	2.9	1.0
FG.2016.12	1.4	1.9	1.1	2.7	1.9	1.1	1.9	0.6	0.1	1.2	2.1	1.7	1.3	2.5	2.1	1.9	2.7	3.1	2.7	3.2	3.2	1.9	2.4	3.0	4.1	1.6
FG.2016.13	1.3	2.0	1.3	2.8	1.8	1.2	2.0	0.6	0.2	1.2	2.2	1.5	1.0	2.0	2.4	4.0	3.3	1.6	1.3	1.4	1.7	0.5	0.4	0.0	0.0	0.0
FG.2016.15	1.4	1.9	1.2	2.9	2.0	1.2	2.0	0.6	0.3	1.1	2.0	1.7	1.1	2.1	2.1	1.7	3.3	3.6	3.8	1.3	0.0	0.0	0.0	0.0	0.0	0.0
FG.2016.17	1.6	1.8	1.4	2.7	2.4	1.1	2.4	0.6	0.2	1.1	2.3	1.9	1.4	2.4	2.3	2.2	2.5	2.4	1.8	0.3	2.0	2.1	2.2	3.2	4.1	1.7
FG.2016.18	1.5	1.9	1.4	2.6	2.0	1.2	2.1	0.6	0.3	1.0	1.9	1.7	1.3	2.4	2.5	3.3	3.9	6.5	3.4	1.1	2.2	1.6	1.7	3.4	4.0	1.6
FG.2017.18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IS.2011.32	1.7	2.1	1.3	2.7	2.3	1.2	2.6	0.8	0.3	1.2	2.1	2.0	1.1	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2013.01	1.4	1.5	1.2	2.9	2.1	1.2	1.8	0.8	0.3	0.8	2.4	1.5	1.2	1.9	1.8	1.6	2.0	4.3	2.6	2.2	2.5	0.9	1.4	2.2	2.0	1.3
FG.2017.11	2.6	2.7	1.7	2.6	2.7	2.4	2.8	1.6	1.8	3.0	5.0	3.3	2.1	5.4	5.3	5.3	4.5	5.2	4.5	5.1	6.1	3.5	2.6	4.1	4.7	1.7
FG.2017.12	2.6	2.7	1.6	2.6	2.9	2.5	2.9	1.5	1.9	2.9	5.1	3.3	2.1	5.6	5.3	5.2	4.6	5.4	4.6	5.2	6.4	3.5	3.0	4.4	4.9	2.1
FG.2017.13	2.7	2.9	1.7	2.6	3.0	2.6	2.9	1.6	1.9	2.8	5.4	3.1	1.8	5.5	5.1	4.8	4.3	5.3	4.7	5.0	6.0	3.6	2.9	3.8	4.4	1.3
LA.2011.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LA.2011.03	2.7	2.9	1.7	2.7	3.2	2.4	2.9	1.6	1.6	2.8	5.3	3.8	2.2	5.8	6.1	4.4	4.5	5.6	4.5	5.3	6.1	2.8	2.5	3.9	4.2	1.2
FG.2016.14	1.5	1.9	1.4	2.3	2.0	1.3	2.0	1.0	0.2	2.4	3.1	1.9	2.0	3.0	3.2	1.8	3.6	5.0	4.6	3.2	2.8	1.7	2.4	3.1	3.3	1.7
FG.2016.16	1.2	1.9	1.3	1.9	1.7	1.0	1.7	0.7	0.1	2.5	2.1	1.4	1.5	2.4	2.3	1.2	3.2	4.0	3.2	2.9	2.3	1.4	1.8	2.6	2.4	1.2
FG.2017.09	1.3	1.5	1.0	2.2	1.3	0.6	1.7	0.6	0.1	1.5	2.3	1.5	1.1	2.2	2.0	2.3	2.6	4.0	3.2	1.5	1.5	0.9	1.1	0.9	1.8	1.2
IS.2011.29	1.4	2.1	1.4	3.0	1.8	1.1	2.2	1.1	0.3	2.6	2.7	2.0	1.5	2.6	2.2	0.9	2.0	4.1	3.7	2.5	1.8	0.9	0.0	0.0	0.0	0.0
IS.2011.33	1.5	1.9	1.4	2.7	2.2	1.1	2.1	0.9	0.3	2.7	3.4	2.4	1.6	3.2	2.3	2.1	0.0	0.0	0.0	0.2	2.1	2.2	2.2	3.6	4.4	2.0
IS.2011.34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2017.14	2.1	2.5	2.8	3.2	2.8	3.1	3.0	1.5	1.4	2.5	3.2	2.3	2.0	4.0	3.4	4.6	3.9	6.7	6.4	5.7	6.2	2.9	4.0	5.5	7.2	2.1
FG.2017.16	2.5	2.7	2.8	3.2	2.6	3.4	2.8	1.5	1.5	2.6	3.6	2.2	2.1	4.1	4.2	4.4	5.7	5.0	4.6	6.8	6.8	3.7	4.0	6.6	7.7	2.4
FG.2017.17	2.2	2.5	2.9	3.2	2.7	3.0	3.0	1.4	1.4	2.4	3.3	2.4	1.9	3.9	3.6	3.4	3.6	6.3	5.9	6.1	6.6	2.8	3.9	5.4	6.9	2.3
FG.2013.29	2.5	3.4	2.6	3.7	3.2	3.0	3.1	1.6	1.5	3.1	4.9	3.1	2.4	5.1	4.1	4.8	1.9	4.8	6.7	6.2	7.2	3.7	4.4	6.9	8.4	2.4
DE.2011.14	2.6	2.8	2.8	4.0	3.1	3.1	3.0	1.6	1.4	2.8	4.2	2.5	2.6	4.7	4.3	3.9	1.6	4.6	6.3	5.4	7.1	3.4	4.1	5.9	7.4	2.2
Outside Temperature TX5 (°C)	4.91	3.95	2.49	2.47	5.34	1.76	2.75	2.33	-5	7.65	9.52	2.02	NA	NA	NA	22.7	18.3	18.6	19.5	17.7	26.2	30.4	28.1	26.4	29.5	26.3
Inside Humidity (%)	77.7	79.6	80	80.6	79.6	80.9	81.3	82	80.9	80.4	78.2	78.3	76.2	72.8	66.3	62.5	61.5	61.6	58.8	64.5	63.7	65.2	66.1	68.8	62.3	61.2
Solar Radiation TX4	20.8	8.4	30.2	24.4	22.5	39.4	48.4	68.4	136	99.1	77.5	174	122	133	116	104	85.8	61.3	96.3	117	255	313	256	242	317	373
Rain Amount TX4 (mm)	0.01	0.02	0.01	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.02	0.00	0.00	0.02	0.01	0.01	0.02	0.01	0.00	0.03	0.02	0.00	0.03
Wind Speed TX4 (k/hr)	3.96	5.01	7.33	3.97	3.4	3.75	5.49	5.97	11.6	4.49	6.61	8.19	6.69	6.47	6.75	5.24	3.47	5.33	3.65	2.88	2.48	4.24	3.02	4.21	4.49	5.64

ID Sow	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
FG.2016.03	0.0	0.0	0.0	0.0	0.4	1.9	1.0	2.4	2.8	2.0	2.4	2.8	3.1	3.1	4.0	3.1	2.6	2.2	1.9	1.3	1.3	0.9	0.7	0.5	0.8	1.0	0.2
FG.2016.05	0.0	0.0	0.0	0.0	0.4	1.4	1.3	2.5	2.9	1.8	2.7	3.0	3.0	3.2	4.3	3.5	2.5	2.2	2.1	1.7	1.0	0.2	0.5	0.6	0.8	0.9	0.3
FG.2016.07	0.0	0.0	0.0	0.0	0.6	0.9	1.5	2.5	2.6	1.8	2.9	1.8	1.9	1.0	2.7	1.8	1.7	1.0	0.9	0.8	0.9	0.5	0.2	0.6	0.5	1.0	0.3
IS.2011.02	0.0	0.0	0.0	0.0	0.5	2.0	1.5	2.8	3.1	2.2	2.6	3.3	3.5	3.6	4.3	3.3	3.1	2.5	2.0	1.4	1.3	1.6	0.5	0.7	0.6	1.0	0.3
IS.2011.04	0.0	0.0	0.0	0.0	0.7	1.5	1.6	2.1	2.7	1.5	2.8	2.1	2.2	1.5	2.7	2.2	1.8	1.7	2.0	1.2	1.1	0.8	0.9	0.7	0.6	1.1	0.3
IS.2011.05	0.0	0.0	0.0	0.0	0.4	1.8	1.3	2.3	2.7	2.2	2.4	2.9	3.2	3.5	4.0	3.2	2.9	2.1	1.9	1.4	1.1	1.0	0.5	0.5	0.6	0.9	0.2
IS.2011.11	0.0	0.0	0.0	0.0	0.8	1.9	2.0	2.8	2.9	1.9	3.0	2.7	3.0	2.1	3.2	2.4	2.7	2.1	2.5	1.9	2.1	1.0	0.9	1.1	0.9	1.5	0.4
IS.2011.12	0.0	0.0	0.0	0.0	0.4	1.7	1.3	2.3	3.0	1.9	2.6	3.2	3.2	3.6	4.2	3.8	2.7	2.2	2.1	1.5	1.0	1.9	0.7	0.9	0.8	1.2	0.3
IS.2011.14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.6	0.7	0.5	1.1	0.2
IS.2011.15	0.0	0.0	0.0	0.0	0.6	0.6	1.3	2.4	2.3	2.0	3.0	2.0	1.8	1.4	2.8	1.6	1.5	0.8	1.1	0.7	1.1	1.1	0.6	0.6	0.6	1.0	0.3
FG.2016.12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2016.13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2016.15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2016.17	0.0	0.0	0.0	0.0	0.7	3.4	2.3	2.9	0.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2016.18	0.0	0.0	0.0	0.0	0.6	3.2	2.3	2.4	3.9	3.1	3.6	4.9	3.1	3.6	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2017.18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	1.0	1.2	1.7	0.6
IS.2011.32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.2	1.2	1.2	1.9	0.6
FG.2013.01	0.0	0.0	0.0	0.0	0.4	1.9	2.7	2.6	3.2	2.3	1.9	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2017.11	0.0	0.0	0.0	0.0	1.0	2.5	2.6	2.8	3.8	4.3	3.5	4.7	2.7	2.2	3.4	3.0	2.3	1.7	1.5	1.2	0.9	0.6	1.7	1.7	1.4	2.5	0.4
FG.2017.12	0.0	0.0	0.0	0.0	1.0	2.8	2.4	3.0	3.8	4.0	3.9	5.1	2.9	2.3	3.5	3.0	2.3	1.7	1.6	1.4	1.0	0.6	1.9	1.8	1.4	2.5	0.5
FG.2017.13	0.0	0.0	0.0	0.0	1.0	2.6	2.3	2.7	4.0	4.0	3.8	4.7	2.5	1.9	3.3	2.5	1.8	1.7	1.4	1.2	0.9	0.4	1.6	1.9	1.2	2.0	0.4
LA.2011.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LA.2011.03	0.0	0.0	0.0	0.0	1.0	2.6	2.1	2.4	3.5	4.2	3.5	4.5	2.3	2.0	3.1	2.7	2.3	1.9	1.5	1.1	0.8	0.6	1.5	1.8	1.5	2.7	0.4
FG.2016.14	0.0	0.0	0.0	0.0	0.5	2.0	2.6	2.6	3.7	3.3	3.1	2.8	3.4	2.0	2.8	1.8	2.4	1.0	0.3	0.1	0.2	0.1	0.7	1.3	1.1	2.2	0.6
FG.2016.16	0.0	0.0	0.0	0.0	0.4	1.3	1.6	2.2	3.2	2.7	2.6	2.6	2.7	1.7	2.1	1.8	1.6	0.6	0.0	0.1	0.0	0.1	0.6	1.1	1.1	2.0	0.4
FG.2017.09	0.0	0.0	0.0	0.0	0.4	1.7	2.1	2.1	2.8	3.2	2.7	2.7	2.6	2.2	2.3	1.6	2.0	1.1	0.5	0.4	0.2	0.1	0.6	1.4	1.1	2.1	0.5
IS.2011.29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IS.2011.33	0.0	0.0	0.0	0.0	0.8	3.3	2.6	3.4	3.9	3.3	4.0	5.1	3.5	4.3	4.3	5.0	4.2	3.1	3.2	1.9	1.0	0.2	0.0	0.0	0.0	0.0	0.0
IS.2011.34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2017.14	0.0	0.0	0.0	0.0	1.5	3.9	4.3	6.4	7.3	4.8	6.4	6.2	5.3	5.7	5.4	6.0	4.5	3.2	2.8	2.7	1.7	0.8	1.4	2.0	1.0	2.8	1.0
FG.2017.16	0.0	0.0	0.0	0.0	1.6	4.0	4.1	6.3	7.3	4.9	5.9	6.0	5.0	5.8	5.2	5.8	4.8	3.3	2.7	2.3	1.7	0.9	1.6	2.4	1.3	3.0	1.0
FG.2017.17	0.0	0.0	0.0	0.0	1.5	4.4	4.9	6.2	7.2	4.9	6.1	5.9	5.0	5.9	5.5	6.1	4.8	3.6	2.8	2.4	1.7	0.8	1.5	2.7	1.1	2.9	0.4
FG.2013.29	0.0	0.0	0.0	0.0	1.3	3.9	4.3	6.2	6.8	4.8	5.7	6.2	5.1	5.7	5.8	6.3	5.2	3.6	2.9	2.3	1.6	1.0	1.4	2.3	1.1	3.0	0.8
DE.2011.14	0.0	0.0	0.0	0.0	1.4	4.2	4.9	7.0	7.7	4.9	6.5	6.5	5.7	6.7	6.4	6.7	5.0	3.3	3.0	2.5	1.6	1.0	1.3	2.7	1.1	3.1	0.8
Outside Temperature TX5 (°C)	NA	NA	NA	NA	34.3	31.1	28.7	29.9	24	23.2	24.5	NA	NA	NA	NA	NA	12.3	15.2	13.2	13.5	2.25	2.75	6.79	3.25	4.21	8.56	6.73
Inside Humidity (%)	NA	NA	NA	NA	57.2	58.1	56.6	51.6	56.1	74.5	63.7	64	66.8	NA	NA	NA	67.4	69.4	73.8	75.6	77.7	81.3	80.2	80	81.1	80.4	79.1
Solar Radiation TX4	NA	NA	NA	NA	277	242	257	249	219	183	192	221	46	NA	NA	NA	48.5	59.3	69.1	127	23.3	108	42.4	38.4	77.5	75	74.3
Rain Amount TX4 (mm)	NA	NA	NA	NA	0.00	0.01	0.00	0.00	0.03	0.01	0.01	0.00	0.15	NA	NA	NA	0.00	0.00	0.00	0.00	0.03	0.01	0.00	0.00	0.01	0.00	0.03
Wind Speed TX4 (k/hr)	NA	NA	NA	NA	3.05	3.71	3.95	4.44	4.8	3.88	3.42	4.8	3.92	NA	NA	NA	3.97	3.98	5.45	2.71	2.05	10.6	4.52	4.89	7.06	8.85	9.04

Figure 86: FG Distances heatmap by week in 1 year + climate (1-53 weeks, 2017 scale by row)

The correlation between humidity and KM displacement that seems to exist in 2017, in 2018 does not show evidence to confirm it.

It is more difficult to observe trends in this type of visualization by weeks. The field that is observed in more detail is the climate.

- 5.5.3 FG Distances heatmap in 1 year + climate (1-53 weeks, 2019 scale by row)

This Heatmap shows the KM displacement results per week of animals in FG, per week. Unfortunately, the year 2019 has several animals without data throughout the year, which makes it almost impossible to analyze these groups this year.

FG 2019, distances in KM, by weeks. Each row is a different KM heatmap

ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
FG.2016.03	1.3	0.5	1.4	1.8	1.1	1.8	0.7	1.0	1.7	2.8	2.4	1.7	2.9	2.1	1.1	0.0	0.9	1.7	2.1	1.6	2.9	2.0	3.3	3.4	4.0	4.9	4.5	2.7	3.4	3.7	2.9	4.0	3.8	2.9	1.2	2.0	3.4	1.7	2.4	2.2	1.7	0.9	1.7	0.6	1.9	1.2	1.3	1.1	1.7	2.1	2.0	0.9	0.3
FG.2016.05	1.2	0.9	1.4	1.3	1.0	1.6	0.8	1.0	1.9	2.8	2.5	1.9	2.2	2.2	2.4	2.7	2.3	2.4	1.8	1.4	1.6	1.4	1.7	1.9	2.3	1.7	1.8	1.9	2.4	1.6	1.3	2.5	2.1	1.3	0.6	2.0	2.3	1.0	1.8	1.4	0.9	0.1	0.6	0.0	0.7	0.8	0.7	0.8	0.8	1.1	1.5	0.6	0.1
FG.2016.07	0.8	0.5	1.2	1.1	0.8	2.0	0.6	1.2	1.1	1.4	2.0	1.7	1.9	1.8	1.7	1.8	1.5	2.8	2.3	1.5	1.3	0.7	1.7	2.3	1.9	1.7	2.0	1.9	2.6	1.9	1.4	2.8	2.0	1.2	0.5	2.1	2.5	1.2	1.6	1.3	0.9	0.2	0.5	0.1	0.7	0.7	0.4	0.6	0.8	1.2	1.3	0.5	0.1
IS.2011.02	1.3	0.8	1.4	1.3	1.0	1.8	0.6	0.9	1.5	2.5	2.2	1.7	2.4	2.4	2.1	0.2	0.5	1.8	2.0	1.5	3.0	2.0	3.1	2.7	3.9	4.6	3.8	2.6	3.1	3.2	3.3	3.8	3.9	2.9	0.9	1.8	3.4	1.9	2.6	2.1	1.6	1.1	1.9	0.5	2.0	1.4	1.5	1.2	1.7	2.1	2.0	1.0	0.3
IS.2011.04	0.6	0.5	1.1	1.2	1.0	1.7	0.8	1.4	2.2	2.5	3.0	2.4	2.0	2.0	1.7	1.9	0.0	0.6	1.5	1.8	2.4	1.6	1.9	2.2	2.8	2.2	2.3	2.6	3.6	3.7	2.5	3.6	3.6	2.0	0.8	1.7	3.0	2.1	3.1	1.8	1.4	0.5	1.3	0.3	1.5	0.8	1.2	0.7	1.1	1.2	1.2	0.6	0.2
IS.2011.05	1.2	0.7	1.1	1.0	1.0	1.2	0.8	0.9	2.3	2.9	2.3	1.4	1.9	1.9	2.0	1.3	0.3	1.5	2.1	1.4	3.1	1.8	3.1	2.6	4.1	4.4	3.9	2.7	3.1	3.7	3.0	3.6	3.7	2.7	1.1	1.9	3.2	1.8	2.5	2.1	1.8	0.9	1.9	0.8	2.6	1.4	1.3	1.3	2.0	1.7	1.9	1.0	0.2
IS.2011.11	1.0	0.7	1.5	1.6	0.9	2.2	1.6	2.4	3.4	3.5	3.2	2.8	3.0	3.3	2.4	0.1	0.7	1.6	2.8	2.5	2.9	2.1	2.3	2.5	4.0	2.7	3.3	3.2	3.9	4.2	3.0	4.7	4.3	2.6	0.7	1.8	3.3	1.9	2.9	2.1	1.6	0.7	1.7	0.5	1.7	1.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0
IS.2011.12	1.3	0.8	1.4	1.5	1.3	3.3	2.4	3.2	3.0	3.6	4.3	4.6	3.2	4.9	6.4	6.8	5.6	4.7	4.8	4.3	3.8	2.8	4.2	4.4	5.0	5.2	4.3	4.2	4.0	3.1	2.8	5.0	5.2	3.3	1.0	3.5	5.6	3.0	3.0	3.8	3.2	1.5	3.8	1.6	2.7	1.1	1.4	1.9	1.9	3.5	2.6	0.8	0.3
IS.2011.14	1.3	0.7	1.3	1.1	1.0	1.7	0.6	1.0	1.9	3.0	2.2	1.6	1.8	2.2	2.0	0.8	0.3	1.6	2.2	1.6	3.1	2.3	3.0	2.7	3.6	3.9	3.3	2.7	3.4	3.7	3.2	3.8	4.0	2.9	1.2	2.1	3.5	2.0	2.9	2.2	2.0	1.1	2.2	0.8	2.3	1.5	1.5	1.0	2.1	2.2	2.3	1.0	0.3
IS.2011.15	0.8	0.6	1.2	1.2	0.9	1.5	0.6	1.2	1.1	1.5	2.1	1.7	2.0	1.9	1.6	1.7	1.5	2.9	2.1	1.2	0.9	0.7	1.8	1.4	2.0	1.2	1.3	1.5	2.2	1.6	1.7	2.5	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2016.12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2016.13	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2016.15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2016.17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2016.18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2017.18	0.9	1.0	1.3	0.8	1.5	1.3	1.7	3.4	3.7	3.2	3.6	3.5	2.6	3.1	3.4	2.7	2.7	3.8	3.1	2.3	2.2	2.3	2.5	3.6	3.1	3.8	3.0	3.8	3.9	3.6	3.3	4.8	4.5	3.4	1.3	3.2	4.7	3.7	3.9	2.5	2.5	1.2	2.3	0.5	2.7	1.3	1.5	1.3	2.2	2.1	2.5	1.1	0.3
IS.2011.32	1.2	1.3	1.8	1.2	1.8	1.6	1.8	3.6	4.3	3.7	4.1	3.6	2.8	3.3	3.1	2.3	3.0	4.1	3.4	2.9	0.9	0.9	2.0	3.0	3.0	2.6	3.0	3.7	4.3	3.6	3.5	3.8	4.2	3.5	1.4	2.4	3.9	3.4	3.8	2.5	2.5	1.2	2.5	0.6	2.8	1.6	1.9	1.3	2.3	2.4	2.9	1.0	0.5
FG.2013.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2017.11	1.3	1.4	3.5	2.3	2.0	2.5	3.0	4.5	4.1	4.4	4.9	4.8	4.3	4.3	4.9	4.1	5.2	8.3	4.9	5.6	6.4	5.9	6.4	6.2	6.2	6.2	4.7	5.2	5.3	5.8	5.8	6.1	6.2	3.9	1.1	3.7	6.4	4.3	5.5	4.5	1.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2017.12	1.0	1.3	3.4	2.1	2.1	2.5	3.1	4.8	4.7	4.6	5.1	5.2	4.5	4.5	5.0	4.3	5.3	7.8	5.7	6.0	7.0	5.9	5.7	6.1	6.1	6.5	4.8	4.4	4.9	5.6	5.9	6.1	6.0	3.7	1.3	4.4	7.2	5.0	5.2	3.5	2.2	1.0	3.0	0.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2017.13	1.3	1.6	3.3	2.2	2.3	2.4	2.8	5.0	4.4	4.5	5.0	5.0	3.9	4.3	5.0	4.3	5.2	8.5	5.2	5.4	6.8	6.1	6.2	6.2	6.2	6.0	3.8	4.0	4.8	5.0	5.9	6.2	5.5	3.8	1.0	4.5	6.9	5.1	5.3	3.9	2.6	1.1	2.7	0.8	4.3	2.0	2.2	1.4	2.0	2.9	2.4	0.8	0.4
LA.2011.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LA.2011.03	1.3	1.4	3.5	2.2	1.9	2.4	2.7	4.8	4.9	4.6	4.8	4.7	4.3	4.5	5.0	1.8	0.8	2.9	4.3	4.5	6.9	6.0	7.3	6.1	6.4	7.4	5.7	6.2	6.3	6.3	6.2	6.4	6.1	5.2	2.1	3.5	6.0	4.0	6.1	5.4	3.2	1.2	3.3	1.2	4.0	2.6	1.3	0.1	0.0	0.0	0.0	0.0	0.0
FG.2016.14	1.1	1.1	1.6	1.3	1.8	1.6	1.9	2.8	3.1	1.8	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2016.16	0.8	1.0	1.5	0.9	1.6	1.4	1.7	2.4	3.5	3.1	3.3	3.3	2.4	2.5	2.4	1.8	1.9	3.1	4.2	2.4	2.9	2.6	2.5	1.4	1.8	2.1	1.7	2.7	3.6	2.9	2.9	3.5	3.8	2.4	0.9	2.4	3.4	2.2	2.8	1.6	1.1	0.3	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2017.09	1.0	1.2	1.4	1.6	1.9	1.9	1.7	2.3	3.6	3.0	3.0	3.2	3.0	2.6	2.5	3.0	2.5	2.1	2.8	2.3	2.1	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IS.2011.29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IS.2011.33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IS.2011.34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FG.2017.14	1.5	1.6	3.7	2.7	1.5	2.3	1.7	3.3	3.7	4.4	3.8	4.4	3.5	3.6	4.4	5.2	4.8	6.0	5.3	5.2	5.6	5.2	5.8	6.2	6.1	4.9	5.6	3.8	5.7	4.3	3.8	4.2	5.3	3.4	0.9	3.3	5.7	3.5	4.9	3.5	1.9	0.4	1.3	0.3	2.5	1.7	2.4	2.1	2.2	3.4	3.8	1.3	0.7
FG.2017.16	1.7	1.5	3.8	3.2	1.9	2.6	1.8	3.5	4.0	4.5	3.8	4.2	3.5	3.8	4.6	5.1	4.7	6.3	4.9	4.8	5.3	3.5	4.8	6.8	6.8	5.9	6.6	3.6	4.6	3.5	4.1	4.5	5.7	3.7	1.1	4.1	5.7	4.0	3.9	2.6	2.5	0.8	1.3	0.5	2.6	2.0	2.5	1.9	2.4	3.4	4.0	1.4	0.7
FG.2017.17	1.7	1.5	4.2	2.8	1.7	2.4	1.5	3.4	3.8	4.4	3.8	4.2	3.9	3.7	4.4	5.1	4.4	5.9	5.8	5.2	5.7	5.3	5.8	6.7	6.6	5.7	6.2	4.2	5.5	5.0	4.7	4.9	5.9	3.4	0.9	2.6	5.8	4.1	5.7	4.2	2.7	0.5	1.9	0.5	2.9	2.1	2.4	2.1	1.8	3.4	3.5	1.3	0.7
FG.2013.29	1.6	1.6	3.5	2.9	1.7	2.6	1.5	3.4	4.0	3.8	3.5	4.5	4.1	3.8	4.7	3.3	1.7	4.3	5.4	4.4	6.1	6.1	6.3	5.7	5.2	6.7	5.4	5.3	5.6	6.0	5.5	6.6	5.6	4.9	1.9	3.4	6.1	4.0	6.1	4.9	3.6	1.3	3.5	1.4	3.6	2.6	1.6	1.8	1.9	2.8	3.0	1.2	0.7
DE.2011.14	1.4	1.8	4.0	3.0	1.8	2.9	1.9	3.1	3.7	3.6	3.1	3.9	3.4	3.3	3.9	1.4	2.2	4.8	5.5	5.8	6.8	6.0	6.3	2.5	0.0	0.0	0.1	0.1	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Outside Temperature TX5 (°C)	2.77	3.26	4.04	-0.7	4.2	3.65	4.4	5.5	9.34	11.4	9.1	13.7	12.2	13.2	12.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inside Humidity (%)	79.4	80	77.5	78.3	78	77.6	75.2	72	65.4	63.6	63.3	62.5	60.2	57.1	59.8	56.6	52.9	56.3	60.5	65.6	67.6	68.7	65.2	60.7	60.1	62.6	55.6	53.9	55	52.9	65.9	63.4	62.4	57.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Solar Radiation TX4	44.8	45.5	42.2	46.8	39.5	77.6	31.2	37.1	34.7	47	62.3	153	104	66.4	67.4	34.3	43.2	126	269	175	219	189	249	223	178	251	266	202	258	257	267	80.5	72.4	100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rain Amount TX4 (mm)	0.02	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wind Speed TX4 (k/hr)	7.48	9.31	5.69	3.95	4.16	4.12	7.5	5.63	7.71	6.83	5.7	6.84	6.65	6.17	8.61	5.36	6.07	6.8	6.93	10	4.15	3.97	3.94	3.64	3.76	3.93	3.79	4.2	3.84	3.76	4.94	3.13	4.78	7.17	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Figure 87: FG Distances heatmap by week in 1 year + climate (1-53 weeks, 2019 scale by row)

In the red group there is only 1 animal with data, so it is not possible to analyze the group this year. In the orange group there are 3 animals without data, and the other 3 have data but not all year, 2 of them do not even have half of the year. which makes the analysis of this group difficult this year.

The Green Group However, as in the previous years, shows a very good data quality, values with which at first glance it can be analyzed well. In fact, this group is studied more thoroughly in a section later, by “Group Stability”. There are no climate data in the last part of the year, so it cannot be seen what happens with the possible humidity correlation observed in 2017. The temperature and solar radiation correlation with KM displacement seems to be fulfilled in the expected way.

5.6 VG Distances heatmap by month + climate, in 3 years separately

This section is once again visualizing 12 months in the heatmap, but here each of the tables shows the results of 1 year at a time, which obviously allows to see values in a more specific way. As mentioned before, in this section it is also possible to appreciate the data quality, since the periods where data is not available for some animals can be seen. Whenever the value is 0, this means that there was no data on the positions of this animal in this month, which is why its accumulated distance traveled is 0.

So, in total these tables include 3 heatmaps per table, linking the values between them with the help of the rows and columns, but as such, the colors of the scales of the 3 heatmaps are independent of each other.

- ### 5.6.1 VG Distances heatmap in 1 year + climate (1-12 months, 2017 scale by row)

This table presents the results of the VG area in 2017. Data quality takes great importance in analysis with this temporality, because as seen below, it is not a minor issue, there are many temporary spaces without data. In this Heatmap to the result on the colors scale, it is directly affected by the low amount of data at the beginning and mid -year, because in theory, as the other Heatmaps have behaved, the highest values must be in the month 4-7 approximately, but in this Heatmap are in the months 10, 11 and 12. For the simple reason that there are not enough data in the other months.

VG 2017, distances in KM, by months. Each row is a different KM heatmap													
ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	Total
DE.2011.25	0.00	0.80	3.41	0.00	0.38	2.06	6.10	2.95	3.70	3.38	5.95	12.31	41.05
IS.2011.21	0.00	0.70	7.18	0.76	5.18	6.84	6.87	4.15	3.39	9.79	5.12	10.02	59.99
IS.2011.26	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.09	9.68	10.24	29.07
VG.2013.01	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.00	0.00	5.74	7.04	10.58	23.45
IS.2011.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.59	1.04	0.00	4.63
IS.2011.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.72	4.67	10.21	19.60
IS.2011.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.88	8.92	11.48	24.28
IS.2011.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.67	4.59	10.10	15.37
IS.2011.38	0.00	1.05	11.41	0.58	16.49	24.40	3.30	0.00	0.00	0.00	0.00	0.00	57.23
IS.2011.39	0.00	1.15	11.75	0.62	15.78	24.62	12.05	0.00	0.00	15.48	14.11	14.89	110.45
VG.2013.08	0.00	0.87	10.77	0.66	16.76	25.47	20.92	9.68	10.37	15.51	1.28	0.00	112.29
IS.2011.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.80	13.49	14.48	43.76
VG.2013.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.48	12.60	14.06	38.14
IS.2011.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DE.2011.27	0.00	1.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.65	13.96	10.97	37.70
VG.2013.02	0.00	1.45	10.72	0.00	0.00	0.00	0.00	0.00	0.00	10.23	13.22	11.95	47.58
DE.2011.23	0.00	1.15	10.14	1.01	14.37	20.03	15.57	7.77	6.78	10.39	11.14	9.69	108.04
FG.2013.32	0.00	1.06	12.35	1.05	11.19	13.06	9.16	5.41	5.91	7.83	10.66	10.33	88.01
IS.2011.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.70	12.67	12.24	33.62
VG.2013.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.28	13.58	12.71	34.57
VG.2013.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.29	12.57	11.55	31.40
IS.2011.10	0.00	1.56	12.51	1.06	17.46	25.47	21.32	9.71	6.84	17.30	20.06	18.39	151.69
IS.2011.13	0.00	0.88	5.72	0.32	7.62	14.75	13.80	5.58	5.67	17.12	16.78	15.24	103.50
DE.2011.20	0.00	0.81	5.77	0.35	6.81	19.52	12.40	5.73	1.97	0.00	0.00	0.00	53.36
IS.2011.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.03	17.16	15.61	45.80
DE.2011.18	0.00	0.97	15.44	0.81	12.86	20.23	8.04	0.00	0.00	11.10	16.40	13.05	98.89
DE.2011.19	0.00	0.95	13.15	1.27	6.95	8.33	8.65	5.95	7.22	11.25	11.66	10.59	85.96
DE.2011.21	0.00	0.90	7.56	1.10	4.77	6.89	0.24	0.00	0.00	6.69	10.97	10.34	49.45
Outside Temperature TX5 (°C)	NA	18.59	17.57	9.33	21.28	28.66	28.07	28.58	15.82	13.31	5.97	3.74	
Inside Humidity (%)	NA	62.04	64.70	63.18	62.03	55.78	58.07	56.77	66.30	69.73	74.64	77.05	
Solar Radiation TX4	NA	0	21.70261	115.4508	275.472	315.8695	296.0911	201.4684	118.378	70.44616	22.15054	39.84285	
Rain Amount TX4 (mm)	NA	0	0.008193	0.016768	0.005421	0.009788	0.026211	0.020015	0.043988	0.007782	0.012535	0.011949	
Wind Speed TX4 (k/hr)	NA	0	1.542525	7.414459	5.41979	4.777318	4.644666	4.465527	4.607054	4.612357	4.226771	5.475814	

Figure 88: VG Distances heatmap by month in 1 year + climate (1-12 months, 2017 scale by row)

There are few animals with a good quality of enough data to analyze, which is unfortunate because in fact the climate data is excellent in this year, it could have contributed with much more information.

Despite the little data, there is information that can be used, more specifically in 2 ways, by observing specific cells to respond specific questions, or processing the Heatmap more to allow more information compaction and make visible trends. Due to blank spaces and alterations in the color scale due to the lack of data, it is not possible to analyze trends correctly with this Heatmap.

- ### 5.6.2 VG Distances heatmap in 1 year + climate (1-12 months, 2018 scale by row)

This Heatmap shows the results of animals in VG, in 2018, for weeks.

VG 2018, distances in KM, by months. Each row is a different KM heatmap													
ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	Total
DE.2011.25	8.40	4.57	8.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.39
IS.2011.21	7.84	6.12	5.49	5.71	7.53	7.43	0.00	11.98	10.93	9.91	8.33	7.55	88.82
IS.2011.26	10.06	8.68	11.57	5.03	9.20	19.45	0.00	12.56	12.74	13.98	9.34	8.45	121.06
VG.2013.01	9.66	8.64	10.36	4.70	7.31	13.92	0.00	11.70	13.91	14.75	9.48	8.93	113.36
IS.2011.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IS.2011.23	7.75	4.94	6.69	7.58	8.41	9.03	0.00	11.74	10.73	9.52	7.80	7.91	92.11
IS.2011.27	9.71	8.67	10.69	7.34	10.04	20.33	0.00	12.66	12.92	14.40	9.11	8.50	124.38
IS.2011.20	9.12	5.37	5.72	6.26	7.24	8.64	0.00	12.80	10.27	8.82	7.86	9.04	91.15
IS.2011.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IS.2011.39	15.96	12.40	12.80	14.48	25.05	20.38	0.00	21.97	23.43	21.30	12.23	11.11	191.11
VG.2013.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57	9.77	10.35
IS.2011.36	16.04	12.49	13.36	17.02	26.35	21.02	0.00	22.78	23.70	21.51	11.89	1.10	187.25
VG.2013.09	14.72	10.79	11.90	14.12	22.80	19.20	0.00	21.43	21.87	19.79	11.15	10.24	178.01
IS.2011.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.49	10.49
DE.2011.27	12.77	9.70	8.74	15.04	15.45	15.08	0.00	19.04	17.46	15.04	9.75	8.75	146.83
VG.2013.02	14.58	9.93	11.13	16.56	15.97	16.28	0.00	18.62	17.71	14.44	10.33	9.62	155.17
DE.2011.23	12.54	8.94	10.04	10.50	14.26	10.00	0.00	14.49	14.47	13.67	8.23	8.01	125.14
FG.2013.32	13.14	10.75	10.72	13.37	12.81	13.85	0.00	15.58	14.56	13.23	10.00	7.77	135.76
IS.2011.22	14.33	11.65	12.12	17.72	16.05	12.34	0.00	16.58	19.07	16.01	10.25	9.17	155.27
VG.2013.10	13.37	11.22	9.18	15.43	15.00	13.08	0.00	17.19	18.81	15.36	10.29	8.90	147.82
VG.2013.11	11.78	9.78	8.46	13.60	14.27	11.44	0.00	15.15	14.99	15.01	9.26	7.28	131.02
IS.2011.10	13.95	9.71	12.00	15.02	19.52	18.10	0.00	21.22	20.97	22.50	10.48	8.15	171.64
IS.2011.13	12.40	9.16	9.85	12.64	17.04	11.20	0.00	0.00	0.00	0.00	0.00	5.95	78.23
DE.2011.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IS.2011.01	12.44	9.01	11.33	15.29	21.71	20.74	0.00	21.40	22.18	20.73	10.42	8.27	173.53
DE.2011.18	14.65	8.63	13.65	20.16	12.66	14.17	0.00	15.18	16.30	17.62	7.56	10.68	151.27
DE.2011.19	10.95	5.24	8.41	16.46	10.27	10.26	0.00	10.27	12.36	14.70	6.78	9.47	115.17
DE.2011.21	10.98	5.27	6.77	14.33	9.43	9.59	0.00	9.49	9.30	14.73	5.35	7.20	102.43
Outside Temperature TX5 (°C)	3.67	0.53	5.94	19.83	21.24	23.85	NA	26.46	21.47	13.29	6.89	3.59	
Inside Humidity (%)	79.65	81.26	78.84	66.05	62.88	65.58	NA	56.16	68.50	68.21	76.38	80.41	
Solar Radiation TX4	25.66971	43.03867	96.61114	135.5091	165.1432	191.1163	NA	202.351	146.9249	63.88112	54.11012	38.84759	
Rain Amount TX4 (mm)	0.009086	0.011689	0.006921	0.013923	0.01969	0.012059	NA	0.008079	0.031182	0.000175	0.007341	0.003993	
Wind Speed TX4 (k/hr)	4.622486	5.826074	6.124686	5.64133	3.818712	3.551838	NA	4.038412	4.071313	4.49292	5.181997	5.383428	

Figure 89: VG Distances heatmap by month in 1 year + climate (1-12 months, 2018 scale by row)

There are some animals that show very high (purple) values in months where those levels are not so common, but it can be seen that this is because in the other months these animals do not have data. This is the case of ID animals of 2011.25 (red), vg.2013.08 (pink) and IS.2011.37 (rose).

The Green Group, which is one of the small ones, shows very similar levels of displacement among all its members.

In the same way as in FG, in VG, in the column of total accumulated KM values, it is possible to see behavioral trends per group. Animals have similar values to the other members of their group.

- ### 5.6.3 VG Distances heatmap in 1 year + climate (1-12 months, 2019 scale by row)

This Heatmap presents the results of animals in VG, in 2019, for weeks. The last 3 months of the year practically do not have data.

FG 2019, distances in KM, by months. Each row is a different KM heatmap													
ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	Total
DE.2011.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IS.2011.21	9.03	11.87	12.54	13.16	3.26	11.23	13.48	10.32	9.16	6.76	7.93	10.07	118.81
IS.2011.26	9.69	8.42	8.20	8.41	2.12	11.98	13.70	10.83	10.32	6.85	8.37	9.43	108.32
VG.2013.01	8.32	7.79	7.28	7.41	5.63	6.50	6.62	9.50	10.94	5.71	7.62	9.13	92.45
IS.2011.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IS.2011.23	8.60	10.66	12.36	13.52	4.20	10.97	12.63	9.79	8.88	5.93	7.96	9.40	114.91
IS.2011.27	8.48	7.35	7.47	8.87	6.26	6.60	8.26	8.21	10.32	5.97	8.83	9.42	96.04
IS.2011.20	9.02	10.66	11.80	14.10	7.42	11.17	8.69	8.58	13.47	7.92	7.59	8.75	119.15
IS.2011.38	0.00	4.72	13.25	5.87	9.48	11.34	13.98	11.52	10.32	4.98	3.36	0.00	88.82
IS.2011.39	11.02	14.25	16.55	7.63	16.30	28.38	26.44	15.57	19.54	12.62	9.19	11.49	188.97
VG.2013.08	11.06	12.60	14.86	6.92	14.32	24.17	22.78	14.63	19.07	11.28	8.72	9.58	169.99
IS.2011.36	0.13	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32
VG.2013.09	10.59	12.80	15.82	6.70	15.71	28.33	24.47	15.39	17.73	11.51	1.78	0.80	161.63
IS.2011.37	11.46	13.53	16.23	7.00	15.48	25.78	24.84	15.91	19.51	12.22	9.07	10.56	181.60
DE.2011.27	10.96	13.25	13.33	6.72	14.90	22.18	28.96	21.13	20.19	11.08	9.56	10.47	182.72
VG.2013.02	10.89	15.56	15.99	12.52	15.36	19.62	17.38	16.60	16.15	5.69	7.21	6.38	159.37
DE.2011.23	9.12	12.12	15.60	7.79	13.77	20.76	25.82	19.73	19.16	9.58	9.28	9.98	172.70
FG.2013.32	8.95	11.81	13.53	9.90	14.15	15.10	17.87	13.52	11.77	3.23	3.16	2.95	125.95
IS.2011.22	9.83	13.48	16.26	12.00	15.31	16.25	13.49	13.69	11.82	5.14	6.62	4.68	138.56
VG.2013.10	9.63	12.58	15.33	10.66	16.08	15.22	12.57	14.13	12.01	4.59	6.93	5.08	134.80
VG.2013.11	9.06	12.23	12.25	11.83	10.71	19.99	24.94	18.96	11.21	0.01	0.00	0.00	131.20
IS.2011.10	13.13	15.35	17.87	13.56	14.18	14.77	15.06	14.58	16.57	9.84	8.72	9.45	163.09
IS.2011.13	10.41	14.35	16.32	11.82	12.43	12.30	12.32	12.74	15.46	5.86	6.92	8.32	139.26
DE.2011.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IS.2011.01	12.00	14.37	17.23	15.53	13.90	14.99	14.59	12.82	15.99	7.30	7.71	9.66	156.10
DE.2011.18	9.35	13.99	19.67	17.85	11.72	12.63	13.23	14.18	16.24	11.60	7.86	7.57	155.89
DE.2011.19	8.24	12.17	15.20	16.45	7.68	10.59	11.59	13.18	13.76	8.79	8.15	7.14	132.93
DE.2011.21	8.42	11.38	13.44	15.21	9.25	9.78	11.05	11.11	12.12	8.17	6.79	7.23	123.95
Outside Temperature TX5 (°C)	2.54	7.32	10.86	14.04	NA	NA	NA	NA	NA	NA	NA	NA	
Inside Humidity (%)	78.40	73.79	62.96	56.57	65.17	62.64	NA	62.54	NA	NA	NA	NA	
Solar Radiation TX4	41.74	75.25	94.11	124.28	180.47	232.27	NA	77.83	NA	NA	NA	NA	
Rain Amount TX4 (mm)	0.01	0.00	0.01	0.00	0.00	0.00	NA	0.00	NA	NA	NA	NA	
Wind Speed TX4 (k/hr)	5.98	6.49	6.04	7.20	5.76	4.01	NA	4.21	NA	NA	NA	NA	

Figure 90: VG Distances heatmap by month in 1 year + climate (1-12 months, 2019 scale by row)

It is clear that there are trends also this year in the column of total accumulated KM values. They are trends in groups, where group members have similar values to the other members of the group.

The Green Group has very homogeneous values, but it is strange that its most displacement months are months 3 and 4, and not months later as 5-7. It does not seem to be due to the data quality, because these animals do have values all along the year.

Possible further research questions:

- What can the more activity of the Green Group be due to months 3 and 4, and not in months later in the year?

5.7 VG distances heatmap by week in 1 year + climate, in 3 years separately

These heatmaps show the KM displacement results of the group of animals in VG. As mentioned previously, this visualization is the most specific in terms of temporality, since it is possible to see the data quality in a very precise way by weeks throughout a full year. However, observing trends becomes more complicated with such a broad temporal visualization. But it is useful to check the usefulness of data from previous heatmaps and check if the data quality is good enough to carry out analysis of specific animals at a specific point in time.

- ## 5.7.1 VG Distances heatmap in 1 year + climate (1-53 weeks, 2017 scale by row)

This heatmap shows the results only from 2017, showing the best data quality from week 40. This is because at the beginning of the year (first 6 weeks) data was not yet collected and some animals were incorporated after others.

VG 2017, distances in KM, by weeks. Each row is a different KM heatmap

ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
DE.2011.25	0	0	0	0	0	0	0.72	0	0.75	1.99	0.61	0.14	0	0	0	0	0	0	0	0	0	0.47	0.19	0.32	1.36	0.11	0.49	1.45	2.13	1.27	2.06	0.27	1.39	0	0	0	0	1.47	2.23	2.58	0	0.04	0.26	1.23	0.03	1.38	2.21	2.28	2.6	3.38	2.39	2.49	0.76
IS.2011.21	0	0	0	0	0	0	0.7	0	1.47	2.49	1.89	1.33	0	0	0	0	0.76	1.17	1.36	1.75	0.03	1.48	1.6	1.71	1.95	0.96	0.61	1.85	2.13	1.48	2.49	0.6	1.85	0	0	0	0	1.45	1.94	4.92	2.24	1.92	0.36	0.98	0	1.42	1.81	1.71	2.36	2.91	1.84	1.63	0.81
IS.2011.26	0	0	0	0	0	0	0.07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.86	2.93	2.37	1.39	2.97	1.15	2.38	2.64	2.7	2.74	3.16	1.48	1.76	0.47
VG.2013.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.01	0	0	0	0	0.01	0	0.06	0.01	0	0	0	0	0	0	0	0	0	0.52	1.53	1.85	0.82	2.13	0.24	1.68	2.33	2.47	2.62	3.37	1.44	1.71	0.65
IS.2011.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.41	0.62	1.46	0.46	1.49	0.13	0.06	0	0	0	0	0	0	0
IS.2011.23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.82	1.72	0.54	1.18	0	1.04	1.81	1.88	2.41	2.84	2.05	1.57	0.76
IS.2011.27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.31	0.81	0.79	2.26	0.39	1.91	2.94	3.17	3.17	3.64	1.67	1.7	0.51
IS.2011.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.37	0.72	0	1.25	1.68	1.96	2.32	2.7	1.77	1.77	0.83
IS.2011.38	0	0	0	0	0	0	1.05	0	2.78	3.48	2.81	2.34	0	0	0	0	0.58	3.12	5.18	5.31	0.42	3.94	5.63	6.26	7.4	3.62	1.56	1.74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IS.2011.39	0	0	0	0	0	0	1.15	0	2.59	3.67	2.94	2.54	0	0	0	0	0.62	2.86	4.76	5.11	0.55	4.12	5.24	6.16	6.93	4.69	1.85	6.74	3.45	0	0	0	0	0	0	0	0	0	0	1.56	5.48	4.45	2.3	3.72	3.6	3.19	3.06	2.99	3.46	4.32	2.87	2.82	0.65
VG.2013.08	0	0	0	0	0	0	0.87	0	2.37	3.4	2.66	2.35	0	0	0	0	0.66	2.95	5.21	5.62	0.4	4.3	5.92	6.34	7.04	4.44	1.72	6.22	6.07	5.14	6.2	0.85	4.05	0.34	0	0	0	4.67	5.7	4.01	3.98	4.01	1.98	2.8	0	0	0	0	0	0	0	0	0
IS.2011.36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.92	4.89	5.08	2.13	3.86	3.64	2.61	2.83	3.08	3.45	4.07	2.94	2.66	0.6
VG.2013.09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.39	4.41	2.08	3.51	3.16	2.81	2.69	2.8	3.21	3.9	3	2.63	0.54
IS.2011.37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
DE.2011.27	0	0	0	0	0	0	1.13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.98	3.6	3.05	2.26	3.7	3.12	3.67	3.17	2.86	2.06	2.41	2.33	2.43	0.93
VG.2013.02	0	0	0	0	0	0	1.4	0	2.34	3.79	2.64	1.99	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.91	3.16	2.71	3.1	3.27	3.44	3.05	2.42	2.15	2.65	2.84	2.99	0.7
DE.2011.23	0	0	0	0	0	0	1.15	0	2.34	3.45	2.22	2.13	0	0	0	0	1.01	3.01	4.07	4.52	0.25	4.41	4.72	4.59	4.74	4.09	1.27	4.19	4.4	4.2	4.77	0.56	3.6	0.35	0	0	0	3.47	3.31	2.15	2.76	2.47	2.07	2.31	2.93	2.94	2.55	1.96	1.78	2.39	1.69	2.26	0.97
FG.2013.32	0	0	0	0	0	0	1.05	0	2.54	3.97	3.18	2.66	0	0	0	0	1.05	2.59	3.55	2.92	0.71	2.69	3.08	3.19	3.6	1.93	0.79	3.7	2.06	2.42	2.4	0.46	2.6	0.14	0	0	0	3.11	2.8	1.62	2.43	1.99	1.13	1.74	3.01	2.4	2.53	2.41	2.26	2.4	2.02	2.36	0.55
IS.2011.22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.39	4.1	2.2	2.71	3.4	3.94	2.4	1.79	2.44	3.68	2.32	2.62	0.63
VG.2013.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.32	3.66	2.21	2.51	3.94	3.92	2.83	2.01	2.71	3.2	3.01	2.61	0.64
VG.2013.11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.25	2.92	2.13	2.46	2.98	3.69	2.64	2.51	2.4	2.95	2.52	2.29	0.66
IS.2011.10	0	0	0	0	0	0	1.56	0	2.43	4.31	3.18	2.6	0	0	0	0	1.06	2.81	4.89	5.9	0.6	5.64	5.35	6.63	6.51	4.6	2.21	5.6	6.16	5.63	5.9	1.05	4.07	0.41	0	0	0	3.14	3.7	2.61	4.22	4.38	3.2	6.18	4.99	5.03	3.58	4.49	4.2	4.71	3.71	3.83	0.6
IS.2011.13	0	0	0	0	0	0	0.88	0	1.14	2.04	1.48	1.07	0	0	0	0	0.32	1.28	2	2.57	0.35	2.67	3.52	3.79	3.93	2.28	1.01	4.15	4.08	3.67	3.31	0.4	2.57	0.2	0	0	0	2.28	3.4	3.74	4.24	3.98	2.61	4.98	3.71	4.57	3.43	3.77	3.44	3.91	3.28	3.05	0.43
DE.2011.20	0	0	0	0	0	0	0.72	0	1.76	2.06	1.48	0.55	0	0	0	0	0.35	0.97	1.65	2.17	0.15	3.89	4.25	4.88	5.15	3.24	1.22	2.65	4.03	3.34	3.48	0.39	2.92	0.11	0	0	0	1.97	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IS.2011.01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.53	3.17	3.58	2.69	4.66	3.43	4.11	3.91	4.52	4.28	3.34	3.07	2.92	0.59
DE.2011.18	0	0	0	0	0	0	0.97	0	3.25	5.57	3.81	2.81	0	0	0	0	0.81	2.26	3.38	4.74	0.27	3.93	4.51	5.2	5.71	3.1	1.46	5.3	1.28	0	0	0	0	0	0	0	0	0	0	0.38	1.76	4.8	2.8	3.54	5.2	3.61	3.5	2.28	2.36	4.92	3.42	1.47	0.51
DE.2011.19	0	0	0	0	0	0	0.95	0	2.65	4.35	3.43	2.71	0	0	0	0	1.27	1.89	2.57	1.7	0	1.36	1.89	2.05	1.88	1.93	0.66	2.44	2.71	1.94	3.43	0.55	2.76	0.13	0	0	0	3.17	4.06	2.7	1.82	3.47	2.1	2.59	3.78	2.66	2.63	1.5	1.98	3.65	3.1	1.15	0.36
DE.2011.21	0	0	0	0	0	0	0.9	0	1.05	2.49	1.89	2.13	0	0	0	0	1.1	1.82	1.22	1.39	0	0.57	1.87	1.48	2	1.3	0.24	0	0	0	0	0	0	0	0	0	0	0	0	0.18	1.32	2.77	1.53	1.78	3.14	2.98	2.72	1.54	1.85	3.77	2.86	1.23	0.32
Outside Temperature TX5 (°C)	NA	NA	NA	NA	NA	NA	18.6	NA	20.1	20.7	16.4	11.5	NA	NA	NA	NA	9.33	18.1	20.1	24.8	NA	29.2	24.8	27.8	32.1	29.7	34.6	25.7	29.9	25.4	34	25.8	25.1	15.3	NA	NA	NA	15	16.7	14.5	14.3	14.5	10.7	9.81	8.02	4.65	5.47	2.38	2.74	3.65	4.72	3.5	5.82
Inside Humidity (%)	NA	NA	NA	NA	NA	NA	4.02	NA	10.7	8.61	10.4	11.2	NA	NA	NA	NA	8.33	15.5	17.5	22.3	16.4	26.5	22.1	25.1	28.8	25.9	30.1	23.1	26.7	22.8	31.2	24	25	15.8	NA	NA	NA	13.8	16.2	13.9	14.1	14.7	11.2	9.8	8.61	5.3	5.95	2.47	2.45	3.88	4.71	3.35	6.22
Solar Radiation TX4	NA	NA	NA	NA	NA	NA	0	NA	0	0	21.8	78.6	NA	NA	NA	NA	115	224	275	308	75	311	275	329	354	292	390	253	346	256	298	202	141	28	NA	NA	NA	110	128	99	73.4	67.8	26.6	58.3	15.8	17	16.9	34.1	42.9	25.6	37.5	50.5	33.7
Rain Amount TX4 (mm)	NA	NA	NA	NA	NA	NA	0.00	NA	0.00	0.00	0.02	0.02	NA	NA	NA	NA	0.02	0.02	0.00	0.00	0.09	0.00	0.01	0.01	0.00	0.03	0.01	0.06	0.00	0.03	0.00	0.00	0.03	0.07	NA	NA	NA	0.09	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.00	0.02	0.03	0.02	0.00	0.01	0.01	0.04
Wind Speed TX4 (k/hr)	NA	NA	NA	NA	NA	NA	0	NA	0	0	1.6	5.52	NA	NA	NA	NA	7.41	4.43	5.54	6.63	1.84	4.07	4.62	5.21	4.57	5.38	4.68	4.47	4.73	4.84	4.72	6.33	3.86	3.8	NA	NA	NA	5.67	3.49	5.42	3.12	2.72	6.63	5.26	2.29	4.88	5.64	4.48	7.42	5.05	7.65	3.58	2.95

Figure 91: VG distances heatmap by week in 1 year + climate, in 3 years separately

The expected trends (observed in previous tables) are partially visible in the time sections that do have data, such as the months of greatest activity, homogeneous activity between groups and the relationship of activity with ambient temperature and solar radiation.

- ## 5.7.2 VG Distances heatmap in 1 year + climate (1-53 weeks, 2018 scale by row)

The following heatmap shows the KM displacement results of the VG animals in the year 2018.

VG 2018, distances in KM, by weeks. Each row is a different KM heatmap																																																					
ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
DE.2011.25	2.72	1.53	1.58	1.61	1.29	1.36	1.43	0.85	0.91	1.72	2.41	2.57	1.41	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IS.2011.21	2.29	1.18	1.72	1.9	1.11	1.84	2.37	0.88	0.96	1.47	1.73	1.2	0.8	1.35	1.4	1.47	0.66	2.62	1.97	1.33	1.78	1.43	1.11	1.64	2.01	1.9	0	0	0	0	0.87	2.55	2.55	2.64	4.25	3	2.47	2.09	2.32	2.51	2.34	1.79	2.79	1.92	1.98	1.71	1.72	1.65	1.41	1.72	1.33	2.46	0.64
IS.2011.26	2.31	1.56	2.12	2.78	1.49	2.21	3.03	1.68	2.02	2.97	3.77	2.74	1.62	2.09	1.45	0.73	0.34	1.56	2.1	1.7	2.62	2.9	4.1	5.91	5.68	2.49	0	0	0	0	0.76	2.07	2.87	3.44	3.67	3.26	3.3	3.13	2.61	3.41	3.32	3.2	3.37	2.15	2.7	1.83	1.99	1.71	2.42	1.65	1.75	1.88	0.58
VG.2013.01	2.61	1.76	2	2.49	1.04	2.08	3.33	1.43	1.99	2.67	3.13	2.66	1.47	1.46	1.15	1.11	0.74	1.3	2.26	1.67	1.36	1.9	2.44	4.11	4.13	2.29	0	0	0	0	0.74	1.89	2.96	3.31	3.02	3.7	3.75	3.45	2.52	3.82	3.48	3.18	3.49	2.48	2.91	1.58	2.59	1.67	2.28	1.94	1.62	1.85	0.53
IS.2011.25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IS.2011.23	2.55	1.16	1.53	1.78	1.01	1.71	1.48	0.81	0.85	1.54	2.15	1.41	1.38	2.21	1.93	1.47	1.23	2.69	1.94	1.76	2.07	1.75	1.16	2.06	2.85	1.9	0	0	0	0	0.9	2.24	2.43	2.42	4.55	2.68	2.78	1.95	2.35	2.41	2.58	1.75	2.23	1.87	1.94	1.58	1.47	2.52	1.33	1.62	1.28	2.25	0.59
IS.2011.27	2.76	1.5	1.65	2.54	1.55	2	3.19	1.53	2.16	2.83	3.55	2.45	1.36	2.62	2.34	0.95	0.93	2.11	2.41	1.82	3.05	2.7	4.17	5.8	5.98	2.85	0	0	0	0	0.77	2.1	2.86	3.67	3.57	3.18	3.23	3.34	2.63	3.72	3.49	3.2	3.14	2.41	2.88	1.67	2.17	1.71	2.32	1.53	1.54	1.86	0.6
IS.2011.20	2.55	1.23	1.72	2.69	1.11	1.85	1.63	0.78	1.06	1.4	1.58	1.25	1.36	1.7	1.29	1.92	0.52	2.49	1.69	1.07	2.14	1.52	1.01	1.93	2.67	2.2	0	0	0	0	0.77	2.38	2.81	3.3	4.47	2.81	2.27	2.08	2.03	2.44	2.21	1.51	2.21	1.71	1.92	1.71	1.63	2.47	1.83	1.92	1.48	2.16	0.67
IS.2011.38	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IS.2011.39	2.46	3.13	2.76	5.4	3.02	3.78	4.58	1.9	1.57	2.84	4.41	2.73	2.57	4.41	4.65	2.7	1.68	5.1	4.83	5.79	7.49	5.13	4.55	4.82	5.55	3.21	0	0	0	0	1.28	4.57	3.83	6.18	6.82	5.82	5.58	6.17	4.58	5.3	5.38	4.79	5	3.12	3.7	2.35	2.2	2.63	2.78	2.71	1.75	2.84	0.66
VG.2013.08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.86	2.09	2.39	1.75	2.69	0.56
IS.2011.36	2.59	3.51	2.68	4.96	3.41	3.65	4.42	2.08	1.52	3.22	4.82	2.72	2.3	4.3	4.99	3.59	2.95	5.09	5.08	6.16	7.93	6.02	4.65	4.56	6.12	2.93	0	0	0	0	1.43	5.04	4.18	6.06	6.87	6.32	6.01	5.69	4.2	5.64	5.46	4.98	4.83	3.02	3.53	2.37	2.26	2.67	0.42	0	0	0	0
VG.2013.09	2.42	2.77	2.6	4.58	3.31	3.17	3.88	1.66	1.38	2.79	4.07	2.53	2.26	4.79	4.29	2.68	1.21	4.67	4.84	5.16	6.51	4.88	4.01	4.13	6.11	2.82	0	0	0	0	1.33	4.63	4.1	5.43	6.67	5.65	5.64	5.38	3.88	5.25	5.21	4.46	4.25	2.99	3.22	1.85	2.01	2.55	2.32	2.38	1.67	2.86	0.74
IS.2011.37	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.52	2.92	2.01	3.33	0.7
DE.2011.27	2.98	2.35	2.25	3.48	2.5	2.6	3.22	1.77	1.4	2.15	2.79	2.3	1.43	3.27	3.78	2.83	3.85	3.79	3.09	3.77	4.28	2.72	2.86	3.82	4.94	2.56	0	0	0	0	0.99	3.65	3.79	5.21	6.15	5.19	4.18	3.64	3.47	3.43	3.83	3.57	3.43	2.59	2.17	2.23	1.83	2.21	1.4	1.98	1.77	2.67	0.65
VG.2013.02	2.76	2.78	2.42	4.29	3.17	2.51	3.06	2.12	1.49	2.62	4.07	2.77	1.57	3.89	4.6	2.78	4.09	3.83	3.43	3.91	4.02	3.49	3.14	4.22	4.8	2.61	0	0	0	0	0.87	3.75	3.88	4.56	6.24	5.69	3.91	3.65	3.6	2.88	3.22	3.38	4.02	2.66	2.5	2.27	1.77	2.89	1.26	2.13	1.82	3.1	0.67
DE.2011.23	2.34	2.7	2.17	3.65	2.35	2.15	2.95	1.84	1.4	2.13	3.33	2.81	1.69	3.25	2.25	1.23	2.68	3.43	2.6	3.25	4.14	3.08	1.8	2.69	2.96	1.39	0	0	0	0	0.69	2.94	2.55	4.21	4.87	4.37	3.19	2.75	3.15	2.67	3.29	3.38	3.88	2.08	2.19	1.43	1.54	2.37	0.96	1.47	1.79	2.53	0.56
FG.2013.32	2.57	2.87	1.89	4.15	2.6	2.56	3.45	2.24	1.63	2.74	3.21	3.01	1.7	3.12	2.14	3.11	3.81	3.61	1.85	2.9	3.7	3.21	2.35	3.7	4.15	2.37	0	0	0	0	0.7	3.23	3.03	4.1	5.36	4.26	3.45	2.62	3.17	2.94	3.2	3.29	3.12	2.91	2.24	1.98	1.73	2.73	1.13	1.62	1.82	1.98	0.53
IS.2011.22	2.26	2.61	3.01	4.24	3.72	3.04	3.83	1.89	1.51	2.89	4.01	3.18	1.91	3.8	3.63	4.61	4.17	4.12	3.56	4.06	4.33	2.9	1.9	3.34	3.42	2.28	0	0	0	0	0.7	3.07	3.06	4.92	5.46	6.28	4.41	3.48	3.95	3.22	3.24	4.2	4.61	3.08	2.72	2.03	2.12	2.15	1.87	1.52	1.89	2.46	0.63
VG.2013.10	2.39	2.57	2.29	4.44	2.66	2.67	3.87	2.02	1.88	1.64	3.41	2.45	1.48	3.22	3.08	4.02	3.86	3.87	3.36	3.19	4.19	2.76	2.16	3.19	4.16	2.45	0	0	0	0	0.75	3.31	3.33	4.9	5.73	6.41	4.35	3.51	3.5	2.64	3.41	3.97	4.56	2.64	2.69	2.08	2.02	2.61	1.58	1.73	1.94	2.36	0.52
VG.2013.11	2.25	2.56	2.05	3.45	2.21	2.34	3.46	1.92	1.59	2.36	2.5	2.1	1.22	2.23	2.96	3.42	3.73	3.4	3.41	3.62	3.74	2.39	2.3	2.82	3.7	1.6	0	0	0	0	0.66	3.49	3.08	3.72	5.01	4.31	3.4	3.07	3.18	2.79	2.94	4.17	4.3	2.81	2.53	1.8	1.65	1.51	1.05	1.52	1.8	2.36	0.55
IS.2011.10	3.13	3.05	2.39	3.25	3.44	2.65	3.13	1.15	1.48	3.14	3.84	2.84	2.19	4.3	3.76	2.77	2.87	4.58	4	4.96	5.36	3.21	3.62	4.5	6.33	2.39	0	0	0	0	1.12	4.5	4.08	4.79	7.39	5.66	4.98	4.31	4.96	4.39	5.34	5.45	6.13	3.11	3.36	2.41	1.75	2.23	1.54	1.61	1.64	1.87	0.72
IS.2011.13	2.53	2.87	1.84	3.3	2.84	2.59	3.09	1.08	1.47	2.98	3.2	1.99	1.64	3.11	3.86	2.86	1.77	3.8	4.23	3.95	4.44	2.95	3.14	4.26	2.5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.29	1.6	1.33	2.18	0.55
DE.2011.20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
IS.2011.01	2.07	3.33	1.86	3.45	2.71	2.67	2.53	1.52	1.46	2.73	3.83	2.56	2.06	3.95	2.55	1.79	5.45	5.5	5.3	5.49	5.4	2.69	4.6	5.47	6.93	2.63	0	0	0	0	1.15	3.75	4.7	5.29	7.16	6.04	5.27	4.83	4.79	4.99	5.17	4.56	5.27	2.6	3.34	2.28	1.73	2.23	1.32	2.11	1.59	2.19	0.65
DE.2011.18	3.58	3.77	2.05	3.2	3.05	2.73	3.25	1.23	0.57	3.17	5.54	2.38	2.41	5.67	5.06	5.06	3.39	3.84	2.6	1.92	3.92	2.57	3.8	3.58	3.31	2.26	0	0	0	0	0.98	2.34	3.01	4.72	4.42	4.42	3.61	4.3	3.41	4.59	4.86	3.82	4	1.48	2.01	1.94	1.61	2	1.74	2.26	2.46	2.85	0.52
DE.2011.19	2.5	2.55	1.6	2.83	2.24	1.44	2.12	0.7	0.32	2.23	3.51	1.18	1.38	3.81	3.99	4.44	3.16	3.16	2.24	1.57	3.26	2.15	2.72	2.5	2.48	1.52	0	0	0	0	0.78	1.7	2.38	2.69	3.03	3.12	2.84	2.64	3.16	3.64	3.59	3.5	3.17	2.35	1.48	1.6	1.54	1.72	1.79	2.06	1.92	2.37	0.49
DE.2011.21	2.53	2.51	1.71	2.71	2	1.65	2.12	0.76	0.46	1.63	2.56	1.07	1.32	3.52	3.96	4.12	2.2	2.94	1.96	1.58	2.5	1.91	2.14	1.98	3.11	1.44	0	0	0	0	0.79	1.3	2.35	2.67	2.52	1.84	1.81	2.52	2.84	2.8	3.95	3.73	3.42	1.76	1.29	1.24	1.01	1	1.07	1.64	1.93	2.07	0.49
Outside Temperature TX5 (°C)	4.2	3.8	2.0	2.5	6.5	1.5	1.9	0.0	-8.0	6.7	8.6	-1.6	NA	NA	NA	22.4	18.9	20.3	21.6	18.7	22.9	24.3	24.1	24.3	24.6	20.7	NA	NA	NA	NA	30.1	27.7	25.7	28.2	22.8	20.8	23.6	NA	NA	NA	NA	NA	11.9	15.4	12.1	11.4	2.4	-0.7	4.5	2.4	2.1	7.0	6.8
Inside Humidity (%)	77.8	79.8	80.0	80.7	79.9	81.1	81.3	81.9	80.6	80.9	78.6	78.7	76.2	73.1	66.4	62.8	62.1	61.3	58.7	64.5	64.4	66.1	66.8	69.2	63.2	61.7	NA	NA	NA	NA	58.2	59.0	57.6	52.2	57.0	74.7	64.5	64.3	66.7	NA	NA	NA	68.0	69.4	73.9	75.3	77.7	80.8	80.4	80.3	81.0	80.3	79.0
Solar Radiation TX4	19	10	29	28	46	34	41	39	89	102	68	120	112	144	145	124	129	102	162	165	214	180	170	187	199	218	NA	NA	NA	NA	210	181	199	215	194	116	166	202	65	NA	NA	NA	45	65	49	97	18	44	33	24	45	52	85
Rain Amount TX4 (mm)	0.02	0.02	0.01	0.00	0.02	0.01	0.01	0.00	0.00	0.01	0.02	0.00	0.00	0.02	0.00	0.00	0.04	0.02	0.03	0.02	0.01	0.01	0.03	0.01	0.00	0.01	NA	NA	NA	NA	0.00	0.01	0.00	0.01	0.05	0.02	0.01	0.00	0.11	NA	NA	NA	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.01	0.00	0.02
Wind Speed TX4 (k/hr)	3.8	5.5	6.3	3.8	3.8	4.6	5.3	5.9	11.2	3.8	6.6	7.5	6.0	6.7	7.2	4.9	3.5	5.7	4.2	3.5	2.5	3.5	2.2	3.7	4.2	4.1	NA	NA	NA	NA	3.3	3.5	3.6	4.4	4.7	4.0	3.4	4.9	4.7	NA	NA	NA	3.8	4.2	4.4	2.7	2.1	7.0	4.5	4.2	5.5	7.8	9.1

Figure 92: VG Distances heatmap by week in 1 year + climate (1-53 weeks, 2018 scale by row)

The main trends are also confirmed for this year 2018. The seasons of greatest activity in the summer and least activity in the winter, as well as group behavior trends.

- ### 5.7.3 VG Distances heatmap in 1 year + climate (1-53 weeks, 2019 scale by row)

The following heatmap shows the results of VG in the year 2019, with notable poor data quality in the second part of the year, moreover for the climate.

VG 2019, distances in KM, by weeks. Each row is a different KM heatmap

ID Sow	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
DE.2011.25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IS.2011.21	1.3	1.3	2.6	2.7	2.0	3.2	2.7	2.9	3.2	3.1	2.2	2.9	3.0	3.4	3.2	3.0	3.2	1.7	1.6	0.4	0.0	0.2	1.7	2.9	2.9	2.8
IS.2011.26	1.3	1.2	3.1	2.3	2.3	2.4	2.1	2.1	1.7	2.1	1.8	2.0	1.6	1.5	1.8	2.3	2.3	1.6	1.1	0.0	0.0	0.2	1.7	3.1	3.2	3.2
VG.2013.01	1.2	1.3	3.0	1.8	2.0	2.0	2.0	1.6	1.8	1.4	1.8	1.9	1.6	1.5	1.3	2.0	2.0	1.6	1.5	1.2	1.3	0.9	1.2	1.7	1.8	1.6
IS.2011.25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IS.2011.23	1.1	1.5	2.6	2.2	2.0	2.9	2.4	2.6	3.0	3.0	2.2	3.0	2.9	3.1	3.3	3.1	3.3	2.8	2.0	0.4	0.0	0.2	1.4	2.8	3.1	2.8
IS.2011.27	1.1	1.0	3.5	1.7	1.8	2.0	2.1	1.4	1.7	1.5	2.0	1.8	1.5	1.5	1.2	2.6	2.3	2.3	1.5	0.9	1.7	1.2	1.4	1.1	1.7	2.2
IS.2011.20	1.4	1.1	2.4	2.8	2.2	2.6	2.4	2.6	3.0	2.6	1.8	3.1	3.1	3.4	3.3	3.4	3.4	2.4	1.7	1.4	1.6	1.6	1.8	2.9	3.5	2.4
IS.2011.38	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.2	3.4	3.5	3.0	2.8	2.5	3.1	2.1	0.0	0.5	1.4	2.1	2.4	2.4	1.8	2.0	2.6	3.2	2.7
IS.2011.39	1.3	1.0	4.0	3.2	2.7	3.7	3.3	3.4	4.0	3.5	4.3	3.9	3.2	3.0	3.5	0.1	1.0	1.7	3.0	4.3	4.0	4.5	6.2	7.0	6.9	6.7
VG.2013.08	1.3	1.0	4.3	2.9	2.9	3.3	2.6	3.1	3.8	2.8	3.8	3.3	3.0	3.1	2.9	0.2	0.8	1.0	2.8	3.5	3.8	4.2	5.3	5.6	5.7	5.9
IS.2011.36	0.0	0.0	0.0	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VG.2013.09	1.5	1.0	3.8	2.9	2.7	3.7	2.6	3.0	3.6	3.6	3.9	3.5	3.1	3.2	2.9	0.0	0.8	1.0	2.8	3.8	4.5	4.6	6.5	6.8	7.1	6.3
IS.2011.37	1.4	1.2	4.3	2.8	3.2	3.5	2.9	3.1	4.0	3.5	4.0	3.7	3.1	3.3	3.0	0.0	0.8	1.3	2.9	3.8	4.1	4.4	5.8	5.8	6.1	6.5
DE.2011.27	1.6	1.2	3.7	2.8	2.5	3.7	3.3	3.1	3.3	3.2	3.6	2.8	2.4	3.0	1.7	0.8	1.3	1.3	2.0	3.3	4.7	4.6	5.7	4.3	5.5	4.9
VG.2013.02	1.7	1.1	4.1	2.7	2.3	4.2	4.0	3.5	4.1	3.7	4.3	3.7	2.6	3.4	2.0	2.2	4.0	3.7	2.5	2.8	4.2	4.2	4.4	3.9	5.2	5.1
DE.2011.23	1.5	1.4	3.0	2.2	1.7	3.2	3.3	2.9	3.3	3.5	4.1	3.0	3.3	3.3	3.6	0.1	0.9	1.3	2.1	3.2	4.4	3.8	5.4	3.7	5.3	4.8
FG.2013.32	1.4	1.1	3.1	2.3	1.8	2.9	3.4	2.8	3.2	2.9	3.6	3.2	2.3	2.3	2.4	2.1	2.3	2.9	2.5	2.8	4.3	3.1	3.4	3.8	3.5	3.3
IS.2011.22	1.7	1.3	3.3	2.4	2.0	3.5	3.5	3.3	4.1	4.2	4.2	3.0	2.9	2.6	2.5	2.8	3.0	3.6	3.6	3.0	3.3	3.5	3.8	3.5	3.7	4.1
VG.2013.10	1.7	1.3	3.4	2.2	1.9	3.3	3.3	2.9	3.6	4.1	3.8	3.2	2.5	3.0	1.9	1.9	3.0	4.0	4.4	2.5	3.3	3.6	3.7	3.0	3.6	4.0
VG.2013.11	1.4	1.1	3.3	2.1	2.1	3.3	3.1	2.6	3.4	3.4	3.4	2.3	1.7	2.7	2.5	2.6	3.4	3.2	2.1	0.1	3.2	3.9	4.6	3.6	5.1	5.1
IS.2011.10	1.6	1.3	4.5	3.3	3.5	3.6	3.7	3.5	4.7	4.2	4.3	4.0	3.9	3.9	3.2	2.3	3.0	3.8	3.6	2.5	3.4	3.2	3.1	3.9	3.6	3.2
IS.2011.13	1.2	1.3	3.6	2.8	2.5	3.6	3.4	3.1	4.6	3.8	3.6	3.5	3.6	3.1	3.0	2.1	2.7	3.5	3.0	2.4	3.0	2.4	2.4	3.4	3.3	2.8
DE.2011.20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IS.2011.01	1.3	1.2	4.4	3.1	2.9	3.9	3.8	2.7	4.4	4.0	3.6	3.9	3.9	3.5	3.3	3.9	3.8	3.4	3.6	2.7	3.5	2.8	3.6	3.9	3.3	3.2
DE.2011.18	1.3	1.2	3.2	2.2	2.3	3.5	3.4	3.7	4.5	4.4	3.3	4.4	4.4	5.1	4.4	4.6	3.9	3.9	3.6	1.4	2.2	1.9	2.7	3.2	3.7	2.4
DE.2011.19	1.1	0.9	2.9	2.0	2.3	3.3	2.5	3.2	3.6	3.3	2.8	3.4	3.7	3.9	3.5	3.8	4.8	2.8	2.6	1.1	0.7	1.7	2.0	3.0	3.3	1.8
DE.2011.21	1.1	0.9	3.0	2.3	2.0	2.9	3.0	2.6	3.6	2.8	2.4	3.0	3.2	3.4	3.6	3.6	4.2	2.4	3.2	2.0	1.5	1.3	1.7	2.5	2.8	2.1
Outside Temperature TX5 (°C)	2.9	2.5	4.1	-0.2	4.5	4.6	5.9	8.4	9.6	11.8	8.8	12.3	12.0	13.9	14.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inside Humidity (%)	79.3	80.1	77.5	78.6	78.2	77.8	75.3	72.6	65.9	64.2	63.6	62.7	60.5	57.5	59.7	56.5	52.7	56.3	60.6	65.7	67.9	69.0	65.4	60.6	60.5	63.7
Solar Radiation TX4	27	31	34	63	40	93	56	94	58	79	66	134	123	112	142	143	108	174	236	138	195	163	235	275	197	213
Rain Amount TX4 (mm)	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Wind Speed TX4 (k/hr)	7.9	8.9	5.7	4.7	4.7	4.5	7.0	6.6	7.3	6.8	5.4	6.1	6.8	6.6	8.4	5.8	6.4	6.8	6.7	9.6	4.1	4.1	3.9	4.1	3.8	3.9

ID Sow	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53
DE.2011.25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IS.2011.21	3.7	3.2	3.5	2.9	2.4	2.7	3.1	2.7	0.5	1.8	2.7	1.8	2.4	1.8	1.7	0.4	2.7	0.8	2.7	1.9	1.7	1.4	2.3	3.3	3.1	0.9	0.4
IS.2011.26	3.6	3.3	3.3	3.2	2.4	2.9	3.2	2.7	0.6	1.9	2.8	1.8	3.0	2.3	1.7	0.3	2.7	0.7	2.8	2.2	2.0	1.4	2.4	3.1	2.8	0.6	0.5
VG.2013.01	1.2	1.4	2.0	1.3	1.9	2.3	3.0	2.4	0.9	2.5	2.4	1.9	2.8	3.3	1.3	0.6	1.3	0.6	2.5	1.8	1.9	1.2	2.3	3.0	2.3	1.0	0.5
IS.2011.25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IS.2011.23	3.5	3.0	3.3	2.7	2.3	2.5	2.9	2.6	0.5	1.5	2.6	1.9	2.4	2.0	1.3	0.3	2.3	0.6	2.7	1.9	1.8	1.4	2.1	3.2	3.0	0.8	0.4
IS.2011.27	2.1	1.8	2.1	1.4	1.9	2.3	2.6	2.0	0.6	2.5	2.3	1.3	2.9	3.2	1.8	0.5	1.1	0.8	3.2	1.7	2.6	1.2	2.3	2.9	2.5	1.2	0.5
IS.2011.20	3.3	1.1	2.1	1.9	1.4	2.5	2.8	2.0	0.6	2.1	4.3	2.7	3.1	4.1	2.3	0.8	1.6	0.5	2.8	1.6	1.8	1.3	2.0	3.2	2.3	0.9	0.3
IS.2011.38	3.3	2.9	3.9	3.4	2.5	3.6	3.4	2.4	0.8	2.2	2.8	1.9	2.9	1.9	1.2	0.5	1.6	0.4	1.8	1.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0
IS.2011.39	7.2	5.8	5.9	5.8	4.2	4.4	4.9	3.7	1.1	2.2	5.2	4.3	6.4	4.7	2.9	1.9	3.6	1.0	3.4	2.0	1.9	1.9	3.0	3.3	3.2	1.3	0.6
VG.2013.08	6.5	5.4	5.0	4.6	3.7	4.0	5.0	3.3	1.0	2.2	5.1	4.1	6.3	4.5	2.7	1.4	3.3	0.7	3.4	1.7	2.0	1.6	2.7	2.1	3.0	1.3	0.6
IS.2011.36	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VG.2013.09	6.7	5.9	5.4	4.9	4.4	4.3	4.9	3.4	1.0	2.3	4.6	3.8	5.7	4.7	2.8	1.5	3.1	0.8	0.6	0.6	0.1	0.4	0.1	0.3	0.2	0.2	0.0
IS.2011.37	7.1	5.5	5.5	5.0	4.3	3.9	5.4	3.8	1.1	2.5	5.1	4.4	6.1	4.5	3.2	1.7	3.4	0.9	3.3	2.0	2.1	1.7	2.8	2.8	3.0	1.4	0.6
DE.2011.27	7.0	6.9	6.3	6.5	5.7	5.3	5.9	5.6	2.0	3.4	5.6	4.2	5.8	4.1	2.9	1.1	3.1	1.1	3.8	2.4	1.5	1.7	2.5	3.3	3.1	1.2	0.5
VG.2013.02	4.0	3.9	4.2	4.0	3.8	5.6	4.3	3.6	1.0	3.7	5.0	3.3	3.4	2.5	1.0	0.9	1.7	0.4	2.7	1.4	1.2	1.8	1.0	2.1	2.1	0.8	0.4
DE.2011.23	5.7	5.9	5.9	5.6	5.8	4.7	5.6	5.0	2.1	3.2	5.3	4.5	4.9	3.5	2.5	0.8	3.1	1.0	3.5	2.1	1.6	1.9	1.9	3.3	3.2	1.1	0.6
FG.2013.32	4.2	4.5	4.4	3.7	3.3	5.0	3.4	2.8	0.8	2.1	4.5	2.8	2.1	1.4	0.7	0.4	1.0	0.0	1.0	0.8	0.4	1.0	0.3	1.2	0.9	0.4	0.2
IS.2011.22	3.5	2.9	3.0	3.0	3.6	4.5	3.7	2.8	0.7	2.3	3.7	2.2	2.8	2.4	1.2	0.6	1.7	0.1	2.2	1.3	1.4	1.7	0.4	1.9	1.5	0.6	0.4
VG.2013.10	3.0	2.6	2.7	3.2	3.4	4.8	3.8	3.2	0.5	2.7	4.4	2.3	2.3	1.5	1.3	0.7	1.4	0.1	2.2	1.3	1.6	1.8	0.7	1.9	1.6	0.6	0.3
VG.2013.11	5.4	5.5	5.8	6.0	5.0	4.7	5.7	4.6	2.0	3.0	5.1	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IS.2011.10	3.4	3.5	3.8	3.1	3.4	4.4	4.2	3.1	1.0	3.1	5.6	2.6	4.1	3.2	3.1	1.5	2.7	0.7	3.0	1.8	1.8	2.1	2.2	2.8	2.9	0.9	0.6
IS.2011.13	2.8	2.8	2.8	2.8	2.5	4.0	4.1	2.7	0.6	3.6	5.4	2.0	3.5	2.8	1.8	0.5	1.3	0.5	2.4	1.4	1.5	1.6	2.1	2.6	2.5	0.6	0.5
DE.2011.20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
IS.2011.01	3.9	3.2	3.6	3.0	2.6	4.0	3.6	3.3	0.7	2.8	4.5	2.3	5.1	3.4	2.5	0.7	1.7	0.3	2.9	1.4	1.9	1.5	2.4	3.3	2.5	0.8	0.6
DE.2011.18	2.9	2.8	3.2	2.9	3.4	4.2	4.0	3.2	1.2	3.0	4.8	3.3	4.3	4.0	3.4	1.3	3.2	0.6	2.5	1.6	1.3	2.3	1.7	2.3	2.3	0.9	0.3
DE.2011.19	2.4	2.5	2.7	2.7	2.7	3.8	3.7	3.0	1.3	2.7	4.3	2.7	3.4	3.4	2.3	0.9	2.5	0.4	2.7	1.7	1.6	2.2	1.6	2.0	2.1	0.9	0.5
DE.2011.21	2.7	2.2	2.8	2.6	2.5	2.9	3.5	2.3	1.1	1.8	4.1	2.8	2.7	3.1	2.6	0.6	2.0	0.5	1.9	1.2	1.8	1.9	1.8	1.9	2.3	0.8	0.4
Outside Temperature TX5 (°C)	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Inside Humidity (%)	56.4	54.5	55.0	53.5	66.4	63.0	62.3	57.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Solar Radiation TX4	208	167	265	288	182	61	48	146	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Rain Amount TX4 (mm)	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wind Speed TX4 (k/hr)	3.4	3.8	3.8	4.0	4.7	3.3	4.9	5.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Figure 93: VG Distances heatmap by week in 1 year + climate (1-53 weeks, 2019 scale by row)

5.8 Group stability

Finally, using the excellent overview obtained from the results previously shown, results regarding group stability are presented in this section, that is, the formation of groups and their stability over time.

This is achieved by calculating and analyzing the average distance of each of the animals with respect to another animal in the same area FG or VG. Therefore, the analysis shown is always shown with respect to only 1 animal.

The author fervently believes that to do a correct data analysis, the final analysis and conclusions must be able to tell a "story" with the data. Now the time has come to do that. This is how the data in tables becomes an understandable "story", with direction and meaning that can be understood in a simple way by anyone.

- ### 5.8.1 Description of the distance tables:

The tables shown below show, on the right side, a chronology of sections of years, like a timeline. While downwards, they show the average distance at which in this period of time, an animal was (in meters) from the animal analyzed in the table, and the animals are shown in an ascending order, but from up to down, therefore the highest values (animals further away in meters) are shown up close to the bottom of the table and the lowest values (animals closer) are shown up close to the high part of the table. This results in a very clear visualization of which animals were closest and furthest from the animal under analysis along the time.

Under the idea that animals that are part of a group are closer spatially to each other than those that are not part of the same group, it is expected that the animals shown above in the table most of the time are members of the group of the animal of the animal under analysis. To facilitate the visualization of the groups, the animals are shown with the color of the group in which they were previously identified.

- ### 5.8.2 Individuals observation (death/out event)

The following distance-chronology table shows the "history" of one of the few animals in this work that had an officially recorded death/out event, and with enough data before the event to be able to analyze it. The animal ID is IS.2011.33, it belonged to the orange group of FG and was in the enclosure for more than a year and a half, so there is a good period of data on it.

There are some records in the table that show the word NA instead of a numerical value, this simply indicates that at this time, data is not available for this animal, therefore it can be omitted from the analysis.

Animal under analysis: individual IS.2011.33 from FG, Orange group

Chronology of each calculation of how the animal ID IS.2011.33 related to the rest in terms of distance before it was death/out of the enclosure.

Distance average to other animals in meters in descendant order

Animal ID	2017-(1-3)	Animal ID	2017-(4-6)	Animal ID	2017-(7-9)	Animal ID	2017-(10-12)
IS.2011.29	16.93	IS.2011.29	14.51	IS.2011.29	17.24	FG.2016.14	13.52
FG.2016.15	17.87	FG.2016.14	16.59	FG.2016.14	19.07	FG.2016.16	16.73
FG.2016.14	17.90	FG.2016.15	26.82	FG.2016.18	28.70	IS.2011.29	17.00
FG.2016.13	18.06	FG.2016.17	28.08	FG.2016.15	29.39	FG.2017.09	19.65
FG.2016.17	18.21	IS.2011.32	28.56	IS.2011.32	29.60	FG.2013.01	21.15
IS.2011.34	18.30	FG.2016.18	28.62	FG.2016.17	30.30	FG.2016.17	22.48
FG.2016.12	18.31	FG.2016.13	28.77	FG.2016.12	30.96	IS.2011.32	23.57
FG.2016.18	18.58	FG.2013.01	29.02	FG.2013.01	31.34	FG.2016.12	23.76
IS.2011.32	19.62	FG.2016.12	29.19	FG.2016.13	31.49	FG.2016.15	24.30
FG.2013.01	19.93	IS.2011.02	33.18	LA.2011.03	37.15	FG.2016.13	24.97
FG.2016.16	27.66	IS.2011.14	33.41	IS.2011.02	38.31	FG.2016.18	25.43
LA.2011.03	28.40	FG.2016.03	34.67	IS.2011.14	38.80	FG.2016.03	33.38
FG.2013.29	30.35	LA.2011.03	35.45	FG.2016.03	39.29	IS.2011.15	35.29
LA.2011.01	31.27	LA.2011.01	35.92	FG.2016.07	40.18	FG.2017.13	39.60
FG.2016.05	34.37	FG.2016.16	37.22	IS.2011.05	40.19	IS.2011.11	39.78
IS.2011.04	34.90	IS.2011.15	39.93	FG.2016.05	40.63	FG.2017.11	40.07
IS.2011.12	35.70	IS.2011.12	40.32	IS.2011.12	41.37	FG.2017.12	40.53
FG.2016.07	37.31	FG.2016.07	41.23	IS.2011.04	41.92	FG.2016.07	40.54
FG.2016.03	37.48	FG.2016.05	41.81	IS.2011.15	42.06	LA.2011.03	42.46
IS.2011.05	38.12	IS.2011.05	42.72	IS.2011.11	45.94	IS.2011.02	43.58
IS.2011.15	39.08	IS.2011.04	43.04	DE.2011.14	48.87	IS.2011.14	45.20
DE.2011.14	40.42	FG.2013.29	44.28	FG.2016.16	49.65	IS.2011.04	48.11
IS.2011.14	40.50	DE.2011.14	47.98	FG.2013.29	49.76	IS.2011.05	48.60
IS.2011.02	40.56	IS.2011.11	64.93	LA.2011.01	NA	IS.2011.12	50.29
IS.2011.11	54.84	FG.2017.09	NA	FG.2017.09	NA	DE.2011.14	50.87
FG.2017.09	NA	FG.2017.13	NA	FG.2017.13	NA	FG.2017.17	51.64
FG.2017.13	NA	FG.2017.12	NA	FG.2017.12	NA	FG.2016.05	51.73
FG.2017.11	NA	FG.2017.11	NA	FG.2017.11	NA	FG.2017.14	51.96
FG.2017.12	NA	FG.2017.17	NA	FG.2017.17	NA	FG.2017.16	52.52
FG.2017.17	NA	FG.2017.14	NA	FG.2017.14	NA	FG.2013.29	53.32
FG.2017.14	NA	FG.2017.16	NA	FG.2017.16	NA	IS.2011.34	NA
FG.2017.16	NA	IS.2011.34	NA	IS.2011.34	NA	LA.2011.01	NA

Animal ID	2018-(1-3)	Animal ID	2018-(4-6)	Animal ID	2018-(7-9)	Animal ID	2018-(10-12)	Animal ID	2018-11
IS.2011.29	18.16	FG.2016.17	16.33	FG.2016.17	14.84	FG.2016.18	13.03	FG.2016.07	14.60
FG.2016.14	19.17	FG.2016.18	18.49	FG.2016.18	15.46	IS.2011.14	22.65	FG.2016.03	19.94
FG.2016.16	20.45	IS.2011.29	22.18	FG.2013.01	24.09	FG.2016.07	28.52	IS.2011.14	22.65
FG.2013.01	21.93	FG.2016.15	24.27	FG.2017.09	26.62	FG.2016.03	31.78	IS.2011.12	25.76
FG.2017.09	22.41	IS.2011.32	24.64	FG.2016.16	28.53	IS.2011.04	33.29	IS.2011.05	25.79
FG.2016.15	23.39	FG.2013.01	24.71	FG.2016.14	29.13	FG.2017.12	33.51	IS.2011.04	26.02
IS.2011.32	24.00	FG.2016.14	25.77	FG.2017.13	30.79	IS.2011.11	33.59	IS.2011.15	27.33
FG.2016.18	24.34	FG.2016.13	26.05	FG.2017.11	30.81	FG.2017.13	33.69	IS.2011.02	27.36
FG.2016.17	24.70	FG.2016.16	26.32	FG.2017.12	31.24	FG.2017.11	34.21	IS.2011.11	27.73
FG.2016.12	25.80	FG.2016.12	27.28	IS.2011.11	32.52	FG.2017.09	34.46	FG.2017.13	31.51
FG.2016.13	26.92	FG.2017.09	28.52	LA.2011.03	32.63	IS.2011.12	35.17	FG.2017.12	31.64
FG.2017.13	37.81	FG.2017.13	32.30	IS.2011.04	34.01	LA.2011.03	35.20	FG.2017.11	32.05
FG.2017.12	38.10	FG.2017.11	32.97	FG.2016.07	37.08	IS.2011.02	35.57	FG.2017.17	33.11
FG.2017.11	38.27	FG.2017.12	33.45	IS.2011.05	37.93	IS.2011.05	36.49	FG.2017.16	33.57
LA.2011.03	38.94	LA.2011.03	34.28	FG.2016.05	38.30	IS.2011.15	37.77	FG.2016.16	33.78
FG.2017.14	44.32	FG.2016.07	35.69	IS.2011.15	38.99	FG.2017.17	40.08	FG.2017.09	34.03
IS.2011.11	44.74	IS.2011.04	36.14	FG.2016.03	39.71	FG.2017.16	40.90	LA.2011.03	34.49
FG.2017.17	45.26	IS.2011.15	36.38	IS.2011.12	39.73	FG.2016.05	40.95	FG.2013.29	35.96
FG.2013.29	45.42	IS.2011.11	37.09	IS.2011.02	40.76	FG.2016.14	41.05	FG.2016.05	36.97
FG.2017.16	45.63	IS.2011.05	41.06	FG.2017.14	43.30	FG.2013.29	41.38	FG.2017.14	37.17
IS.2011.04	46.99	FG.2016.03	41.73	FG.2017.17	43.40	FG.2016.16	41.73	FG.2016.14	38.43
IS.2011.15	47.22	FG.2016.05	42.49	FG.2013.29	44.47	FG.2017.14	41.73	DE.2011.14	40.61
DE.2011.14	47.51	IS.2011.02	43.34	FG.2017.16	44.56	DE.2011.14	46.01	IS.2011.29	NA
IS.2011.05	49.01	FG.2017.17	43.56	DE.2011.14	45.71	IS.2011.29	NA	IS.2011.34	NA
IS.2011.12	49.82	FG.2017.14	43.60	IS.2011.29	NA	FG.2013.01	NA	FG.2016.18	NA
FG.2016.07	50.27	FG.2017.16	43.75	FG.2016.15	NA	FG.2016.15	NA	FG.2016.17	NA
FG.2016.03	50.85	IS.2011.12	43.75	IS.2011.32	NA	IS.2011.32	NA	FG.2013.01	NA
IS.2011.14	51.37	IS.2011.14	44.38	FG.2016.13	NA	FG.2016.17	NA	FG.2016.15	NA
FG.2016.05	52.36	FG.2013.29	44.99	FG.2016.12	NA	FG.2016.12	NA	IS.2011.32	NA
IS.2011.02	52.42	DE.2011.14	47.43	IS.2011.14	NA	FG.2016.13	NA	FG.2016.12	NA
LA.2011.01	NA	LA.2011.01	NA	LA.2011.01	NA	LA.2011.01	NA	FG.2016.13	NA
IS.2011.34	NA	IS.2011.34	NA	IS.2011.34	NA	IS.2011.34	NA	LA.2011.01	NA

Figure 94: Distance/chronology, individual IS.2011.33 from FG, Orange group

In these tables the groups formed are very clearly observed, in each of the columns with a period of time, the animals of each group are seen together, with a few exceptions.

In column 2017 (1-3), the orange group did not appear to be fully formed, although its members were not that far from each other. In fact, even in the time-shared matrices with other animals, which was where the groups were identified, it could be observed that the red and orange group were generally close to each other. In the column (2017 from 4-6), there are 3 members of the orange group together. the IS.2011.29, the FG.2016.14 and the IS.2011.33, the last one does not appear in the table, but it must be remembered that the table is made in relation to it.

The orange group always shows a lot of closeness with the red group.

At the end of the timeline, when the death/out event approaches, the animals in the orange group are increasingly farther away and those in the green group seem to get closer.

Observed: individual IS.2016.14 closest companion from IS.2011.33, from orange group FG.

The following table shows the distances with respect to FG's animal ID IS.2016.14, which was the companion that spent the most time with the previously observed animal that suffered a death/out event. This visualization is done with the intention of closely observing what happens in the death/out event, with the animal that suffers it and the animals close to it.

Chronology of each calculation of how the animal ID IS.2016.14 related to the rest in terms of distance including the before and after of the death/exit of the member of its group ID IS.2011.33

Death/out of IS.2011.33 (between 2018-11 and 2018-12)

Distance average to other animals in meters in descendant order

Animal ID	2017-(1-3)	Animal ID	2017-(4-6)	Animal ID	2017-(7-9)	Animal ID	2017-(10-12)	Animal ID	2018-(1-3)	Animal ID	2018-(4-6)	Animal ID	2018-(7-9)	Animal ID	2018-(10-12)	Animal ID	2018-11	Animal ID	2018-12	Animal ID	2019-(1-3)
FG.2016.13	14.35	IS.2011.29	15.84	IS.2011.29	17.28	IS.2011.33	13.52	IS.2011.29	14.94	FG.2016.16	15.03	FG.2016.16	14.22	FG.2016.16	12.32	FG.2016.16	12.89	FG.2016.16	9.44	FG.2016.16	10.87
FG.2016.12	14.42	IS.2011.33	16.59	IS.2011.33	19.07	FG.2016.16	13.56	FG.2016.16	15.16	IS.2011.29	16.57	FG.2017.09	17.00	FG.2017.09	16.51	FG.2016.07	16.23	FG.2017.09	14.01	FG.2017.09	13.85
FG.2016.18	14.78	FG.2016.15	25.74	FG.2016.15	27.97	FG.2017.09	19.43	FG.2017.09	18.97	FG.2013.01	23.00	FG.2013.01	21.13	IS.2011.32	18.00	IS.2011.15	23.14	IS.2011.32	18.00	IS.2011.32	16.22
FG.2016.15	14.98	FG.2016.13	26.32	FG.2016.12	29.03	IS.2011.29	20.67	IS.2011.33	19.17	FG.2017.09	23.42	FG.2016.17	26.25	IS.2011.14	29.34	FG.2017.09	24.90	IS.2011.04	25.34	IS.2011.05	24.83
FG.2016.17	15.47	FG.2016.17	26.62	FG.2013.01	29.61	FG.2013.01	21.70	FG.2013.01	21.38	FG.2016.13	23.83	FG.2016.18	26.48	FG.2017.13	30.22	LA.2011.03	28.66	FG.2017.13	28.20	FG.2016.05	25.94
IS.2011.34	16.79	FG.2016.12	27.36	FG.2016.18	29.62	FG.2016.17	24.83	FG.2016.15	22.10	IS.2011.33	25.77	IS.2011.33	29.13	FG.2017.11	30.89	FG.2017.12	35.73	IS.2011.11	28.95	IS.2011.14	26.41
FG.2013.01	17.51	FG.2016.18	27.97	IS.2011.32	30.01	FG.2016.12	25.50	FG.2016.18	22.75	FG.2016.12	26.34	FG.2017.13	29.71	LA.2011.03	31.19	FG.2017.13	36.39	IS.2011.05	29.00	IS.2011.04	27.49
IS.2011.32	17.53	IS.2011.32	28.04	FG.2016.13	30.12	FG.2016.18	25.63	FG.2016.12	23.60	FG.2016.17	27.44	IS.2011.04	30.12	FG.2017.12	31.64	IS.2011.33	38.43	FG.2017.11	29.21	FG.2016.03	27.61
IS.2011.29	17.87	FG.2013.01	28.88	FG.2016.17	30.76	FG.2016.15	25.65	FG.2016.17	24.01	FG.2016.18	27.56	LA.2011.03	30.59	IS.2011.04	32.49	FG.2017.11	38.49	IS.2011.14	29.34	IS.2011.02	27.94
IS.2011.33	17.90	IS.2011.14	32.46	IS.2011.02	34.42	IS.2011.32	25.66	IS.2011.32	24.77	FG.2016.15	27.96	FG.2016.07	30.68	IS.2011.15	33.45	FG.2016.03	44.94	IS.2011.15	29.71	FG.2017.13	28.48
FG.2013.29	26.06	IS.2011.02	33.24	LA.2011.03	34.64	FG.2016.13	26.35	FG.2016.13	25.16	FG.2017.13	33.88	FG.2017.11	30.94	FG.2016.07	34.42	IS.2011.11	45.82	FG.2016.03	30.04	IS.2011.15	28.83
FG.2016.16	26.26	FG.2016.03	34.05	FG.2016.03	35.69	IS.2011.04	26.72	FG.2017.13	36.35	IS.2011.15	34.36	IS.2011.11	31.36	IS.2011.11	34.47	IS.2011.04	46.42	FG.2016.07	30.34	FG.2017.11	29.26
LA.2011.03	26.77	FG.2016.16	34.47	IS.2011.14	36.04	IS.2011.12	27.54	FG.2017.11	37.28	FG.2017.11	35.07	FG.2017.12	31.44	FG.2016.18	37.60	IS.2011.02	49.57	IS.2011.12	31.07	FG.2016.07	29.34
IS.2011.04	29.43	LA.2011.03	36.01	IS.2011.05	36.10	IS.2011.05	28.20	FG.2017.12	37.45	FG.2016.07	35.27	IS.2011.15	31.88	FG.2016.03	37.75	IS.2011.12	50.74	FG.2016.05	31.36	FG.2017.12	29.99
FG.2016.03	30.17	IS.2011.15	37.10	IS.2011.04	36.11	FG.2016.05	28.33	LA.2011.03	38.09	LA.2011.03	35.32	FG.2016.05	36.04	IS.2011.02	38.49	FG.2016.05	53.49	FG.2017.12	31.37	IS.2011.11	30.26
FG.2016.05	30.37	LA.2011.01	37.80	FG.2016.05	36.56	FG.2016.03	33.42	IS.2011.11	41.60	FG.2017.12	35.56	IS.2011.02	36.24	FG.2016.05	38.72	FG.2017.16	55.28	LA.2011.03	31.42	LA.2011.03	32.46
FG.2016.07	31.63	IS.2011.12	38.27	IS.2011.15	36.93	IS.2011.15	34.96	IS.2011.12	43.93	IS.2011.11	36.83	FG.2016.03	37.07	IS.2011.05	38.82	FG.2017.14	55.53	IS.2011.02	31.66	DE.2011.14	35.65
IS.2011.05	32.09	FG.2016.05	38.53	IS.2011.12	36.95	FG.2017.13	38.04	FG.2017.14	43.99	IS.2011.05	37.83	IS.2011.05	37.37	IS.2011.12	38.83	IS.2011.05	55.74	FG.2017.14	38.43	FG.2013.29	37.04
IS.2011.12	32.18	FG.2016.07	39.11	FG.2016.07	37.37	FG.2017.12	38.21	IS.2011.15	44.50	IS.2011.04	38.30	IS.2011.12	37.53	IS.2011.33	41.05	FG.2017.17	56.01	FG.2017.17	40.22	FG.2017.14	38.70
IS.2011.02	32.84	IS.2011.05	40.56	IS.2011.11	41.90	FG.2017.11	38.53	FG.2017.16	44.53	IS.2011.14	38.30	FG.2017.14	40.93	FG.2017.14	42.75	FG.2013.29	57.24	FG.2017.16	40.66	FG.2017.17	39.44
LA.2011.01	32.93	IS.2011.04	40.65	DE.2011.14	44.87	IS.2011.11	39.30	FG.2017.17	45.19	FG.2016.05	38.50	FG.2017.17	42.42	FG.2017.16	43.71	DE.2011.14	60.57	FG.2013.29	41.74	IS.2011.12	40.45
IS.2011.14	33.00	FG.2013.29	45.41	FG.2013.29	47.13	FG.2016.07	40.18	IS.2011.05	45.21	IS.2011.02	39.49	FG.2017.16	44.07	FG.2017.17	43.80	IS.2011.32	NA	DE.2011.14	41.98	FG.2017.16	40.70
IS.2011.15	36.00	DE.2011.14	48.78	FG.2016.16	54.12	LA.2011.03	42.26	FG.2016.07	45.38	FG.2016.03	40.18	FG.2013.29	44.24	FG.2013.29	44.97	IS.2011.14	NA	IS.2011.33	NA	FG.2016.18	NA
DE.2011.14	39.16	IS.2011.11	60.84	LA.2011.01	NA	IS.2011.14	44.82	FG.2013.29	46.10	IS.2011.12	40.36	DE.2011.14	45.73	DE.2011.14	49.39	FG.2016.18	NA	FG.2016.18	NA	IS.2011.33	NA
IS.2011.11	50.28	IS.2011.34	NA	IS.2011.34	NA	IS.2011.02	45.08	IS.2011.04	46.10	FG.2017.16	46.04	IS.2011.29	NA	FG.2013.01	NA	FG.2013.01	NA	FG.2013.01	NA	FG.2013.01	NA
FG.2017.09	NA	FG.2017.09	NA	FG.2017.09	NA	FG.2017.17	47.06	FG.2016.05	46.33	FG.2017.17	46.57	FG.2016.13	NA	FG.2016.17	NA	FG.2016.17	NA	FG.2016.17	NA	FG.2016.17	NA
FG.2017.13	NA	FG.2017.13	NA	FG.2017.13	NA	FG.2017.14	47.16	DE.2011.14	47.39	FG.2017.14	46.76	FG.2016.12	NA	IS.2011.29	NA	IS.2011.29	NA	IS.2011.29	NA	IS.2011.29	NA
FG.2017.11	NA	FG.2017.11	NA	FG.2017.11	NA	FG.2017.16	49.08	FG.2016.03	47.88	FG.2013.29	48.58	FG.2016.15	NA	FG.2016.13	NA	FG.2016.13	NA	FG.2016.13	NA	FG.2016.13	NA
FG.2017.12	NA	FG.2017.12	NA	FG.2017.12	NA	DE.2011.14	50.31	IS.2011.02	48.75	IS.2011.32	48.85	IS.2011.14	NA	FG.2016.12	NA	FG.2016.12	NA	FG.2016.12	NA	FG.2016.12	NA
FG.2017.17	NA	FG.2017.17	NA	FG.2017.17	NA	FG.2013.29	52.88	IS.2011.14	49.17	DE.2011.14	50.98	IS.2011.32	NA	FG.2016.15	NA	FG.2016.15	NA	FG.2016.15	NA	FG.2016.15	NA
FG.2017.14	NA	FG.2017.14	NA	FG.2017.14	NA	LA.2011.01	NA	LA.2011.01	NA	LA.2011.01	NA	LA.2011.01	NA	LA.2011.01	NA	LA.2011.01	NA	LA.2011.01	NA	LA.2011.01	NA
FG.2017.16	NA	FG.2017.16	NA	FG.2017.16	NA	IS.2011.34	NA	IS.2011.34	NA	IS.2011.34	NA	IS.2011.34	NA	IS.2011.34	NA	IS.2011.34	NA	IS.2011.34	NA	IS.2011.34	NA

Figure 95: Distance/chronology, individual IS.2016.14 closest companion from IS.2011.33, from orange group FG

The animal that suffers the death/out event in the orange group moves away from IS.2016.14, even when this one was at one time its closest companion.

- ## 5.8.3 Biggest (green) group FG observation

The following table is made to observe the behavior of the largest group in the FG area over time, the 3 years are observed in separate time periods of 3 months.

However, this table has to be calculated with respect to only 1 animal, so the animal that is considered the most important within the group structure was taken. For this, the accumulated times of the matrix of times shared between animals were added. from FG, and the animal that accumulated the most time with its green companions in total was selected, which is the case of FG.2016.03.

Chronology of each quarter of year of the distance between the animal ID FG.2016.03 and the rest of animals

Distance average to other animals in meters in descendant order

Animal ID	2017-(1-3)	Animal ID	2017-(4-6)	Animal ID	2017-(7-9)	Animal ID	2017-(10-12)
FG.2016.05	11.22	IS.2011.02	10.23	IS.2011.14	12.19	IS.2011.02	13.01
IS.2011.02	13.92	IS.2011.14	10.93	IS.2011.02	12.62	IS.2011.14	14.39
IS.2011.15	13.98	FG.2016.07	21.31	FG.2016.07	20.17	FG.2016.07	14.53
FG.2016.07	13.99	FG.2016.16	21.52	FG.2016.05	21.83	IS.2011.15	15.26
IS.2011.05	14.18	FG.2016.05	21.59	IS.2011.15	22.94	FG.2016.05	15.71
IS.2011.14	14.29	IS.2011.15	23.21	IS.2011.12	24.07	IS.2011.05	16.15
IS.2011.12	14.39	IS.2011.12	23.85	IS.2011.04	25.02	IS.2011.12	16.27
IS.2011.04	20.16	IS.2011.05	26.00	IS.2011.05	25.59	IS.2011.11	17.70
FG.2016.16	22.53	IS.2011.04	26.47	FG.2016.16	33.69	IS.2011.04	20.03
FG.2016.18	27.42	FG.2016.15	31.31	FG.2016.15	33.88	IS.2011.33	33.38
FG.2016.15	28.62	FG.2016.12	31.40	FG.2013.01	34.61	FG.2016.14	33.42
IS.2011.11	28.69	FG.2016.13	32.71	LA.2011.03	34.96	FG.2017.13	34.86
FG.2016.14	30.17	FG.2016.18	33.43	FG.2016.14	35.69	FG.2017.11	35.53
FG.2016.17	30.40	LA.2011.03	33.53	FG.2016.12	36.36	FG.2017.12	36.23
LA.2011.03	32.19	LA.2011.01	33.76	FG.2013.29	37.01	FG.2017.09	36.70
FG.2016.12	32.31	FG.2016.14	34.05	DE.2011.14	37.84	LA.2011.03	39.84
DE.2011.14	32.83	IS.2011.33	34.67	FG.2016.13	38.00	FG.2017.17	40.99
FG.2016.13	33.30	IS.2011.29	35.09	FG.2016.18	38.23	FG.2017.14	41.32
IS.2011.32	34.45	FG.2016.17	35.30	IS.2011.11	38.27	FG.2017.16	43.50
FG.2013.29	34.86	IS.2011.32	37.21	IS.2011.32	39.15	FG.2016.15	44.08
FG.2013.01	35.97	FG.2013.01	39.94	IS.2011.33	39.29	DE.2011.14	44.62
LA.2011.01	36.76	FG.2013.29	43.79	FG.2016.17	39.30	FG.2016.13	44.75
IS.2011.33	37.48	DE.2011.14	45.97	IS.2011.29	39.35	FG.2016.16	45.51
IS.2011.34	37.62	IS.2011.11	53.96	LA.2011.01	NA	FG.2016.12	45.88
IS.2011.29	37.77	IS.2011.34	NA	IS.2011.34	NA	FG.2016.18	45.96
FG.2017.09	NA	FG.2017.09	NA	FG.2017.09	NA	FG.2013.01	46.19
FG.2017.13	NA	FG.2017.13	NA	FG.2017.13	NA	FG.2016.17	47.30
FG.2017.11	NA	FG.2017.11	NA	FG.2017.11	NA	IS.2011.32	47.77
FG.2017.12	NA	FG.2017.12	NA	FG.2017.12	NA	IS.2011.29	48.85
FG.2017.17	NA	FG.2017.17	NA	FG.2017.17	NA	FG.2013.29	52.93
FG.2017.14	NA	FG.2017.14	NA	FG.2017.14	NA	LA.2011.01	NA
FG.2017.16	NA	FG.2017.16	NA	FG.2017.16	NA	IS.2011.34	NA

Animal ID	2018-(1-3)	Animal ID	2018-(4-6)	Animal ID	2018-(7-9)	Animal ID	2018-(10-12)
IS.2011.02	15.99	IS.2011.02	13.06	IS.2011.02	12.01	IS.2011.02	11.88
IS.2011.14	16.74	IS.2011.14	16.16	FG.2016.05	12.37	FG.2016.05	12.59
FG.2016.05	18.58	IS.2011.05	16.19	IS.2011.12	13.23	IS.2011.05	12.53
FG.2016.07	18.74	FG.2016.05	16.79	IS.2011.05	14.12	FG.2016.07	12.75
IS.2011.12	19.22	IS.2011.12	17.49	IS.2011.15	21.11	IS.2011.12	13.89
IS.2011.15	19.52	IS.2011.15	27.43	FG.2016.07	22.64	IS.2011.04	15.09
IS.2011.05	19.72	FG.2016.07	27.45	IS.2011.04	23.21	IS.2011.11	18.34
IS.2011.11	23.33	IS.2011.04	31.67	IS.2011.11	23.58	IS.2011.14	11.94
IS.2011.04	29.29	IS.2011.11	31.95	FG.2013.01	34.00	IS.2011.15	20.85
FG.2017.17	37.10	FG.2016.13	34.78	FG.2017.11	34.03	FG.2017.14	27.25
FG.2017.13	37.39	FG.2017.09	37.47	FG.2017.12	35.03	FG.2017.17	27.92
FG.2017.14	38.12	FG.2016.12	38.16	FG.2016.17	35.32	FG.2017.16	28.76
FG.2017.12	38.81	FG.2017.11	38.32	FG.2017.13	35.55	IS.2011.32	32.25
FG.2017.11	39.69	FG.2017.12	38.87	FG.2016.14	37.07	FG.2013.29	30.48
DE.2011.14	40.37	FG.2016.16	38.93	FG.2016.18	37.55	IS.2011.33	31.78
LA.2011.03	40.79	FG.2017.13	38.96	FG.2016.16	37.70	DE.2011.14	31.51
FG.2017.16	40.96	FG.2013.01	39.11	FG.2017.09	37.83	FG.2016.18	42.36
FG.2016.12	41.62	FG.2016.18	39.46	LA.2011.03	38.10	FG.2017.11	39.20
FG.2016.16	43.16	FG.2016.14	40.18	IS.2011.33	39.71	FG.2017.13	38.42
FG.2017.09	44.72	FG.2017.17	40.59	FG.2017.17	40.56	FG.2017.12	39.90
FG.2016.17	45.45	FG.2017.14	41.06	FG.2017.14	41.25	FG.2017.09	34.17
FG.2016.15	45.65	LA.2011.03	41.30	FG.2017.16	43.74	FG.2016.14	37.75
FG.2013.01	45.87	FG.2016.17	41.65	DE.2011.14	44.86	LA.2011.03	43.00
IS.2011.32	45.89	IS.2011.33	41.73	FG.2013.29	45.55	FG.2016.16	36.55
FG.2016.18	46.25	FG.2016.15	42.42	IS.2011.14	NA	FG.2013.01	NA
FG.2016.14	47.88	FG.2017.16	43.05	FG.2016.13	NA	FG.2016.17	NA
FG.2016.13	48.68	IS.2011.29	43.24	FG.2016.12	NA	FG.2016.13	NA
IS.2011.29	49.31	IS.2011.32	44.07	FG.2016.15	NA	FG.2016.12	NA
FG.2013.29	49.85	FG.2013.29	45.46	IS.2011.29	NA	FG.2016.15	NA
IS.2011.33	50.85	DE.2011.14	46.15	IS.2011.32	NA	IS.2011.29	NA
LA.2011.01	NA	LA.2011.01	NA	LA.2011.01	NA	LA.2011.01	NA
IS.2011.34	NA	IS.2011.34	NA	IS.2011.34	NA	IS.2011.34	NA

Animal ID	2019-(1-3)	Animal ID	2019-(4-6)	Animal ID	2019-(7-9)	Animal ID	2019-(10-12)
IS.2011.02	10.56	IS.2011.14	12.30	IS.2011.14	10.68	IS.2011.02	12.93
IS.2011.14	10.99	IS.2011.02	12.59	IS.2011.02	10.78	IS.2011.14	14.66
FG.2016.05	11.18	IS.2011.05	13.56	IS.2011.05	12.10	IS.2011.05	15.17
IS.2011.05	11.77	IS.2011.15	19.01	IS.2011.15	23.98	FG.2016.07	17.74
FG.2016.07	15.10	FG.2016.07	19.87	FG.2016.07	26.18	FG.2016.05	19.27
IS.2011.15	15.64	FG.2016.05	21.24	FG.2016.05	26.42	IS.2011.04	22.84
IS.2011.04	18.64	IS.2011.04	25.05	IS.2011.11	30.04	IS.2011.11	26.91
IS.2011.11	23.30	IS.2011.11	31.27	IS.2011.04	31.52	IS.2011.32	35.54
DE.2011.14	25.87	FG.2016.16	34.95	DE.2011.14	34.52	FG.2013.29	36.04
IS.2011.12	26.23	IS.2011.32	39.13	FG.2016.16	37.23	FG.2016.16	37.07
FG.2017.14	27.44	FG.2017.12	39.64	IS.2011.32	40.27	FG.2017.13	40.25
FG.2017.17	27.59	FG.2017.11	40.05	FG.2017.17	40.85	LA.2011.03	41.00
FG.2016.14	27.61	FG.2017.09	40.49	FG.2017.11	43.25	FG.2017.16	41.28
FG.2016.16	28.55	FG.2017.13	40.80	FG.2017.14	43.25	FG.2017.17	41.49
FG.2013.29	29.11	LA.2011.03	42.93	FG.2013.29	44.14	FG.2017.14	41.85
FG.2017.09	29.77	DE.2011.14	43.41	FG.2017.13	44.36	FG.2017.11	45.11
FG.2017.16	30.02	FG.2013.29	44.18	FG.2017.12	45.21	[illegible]	[illegible]
IS.2011.32	30.20	FG.2017.17	45.82	LA.2011.03	48.29	IS.2011.12	[illegible]
FG.2017.13	34.62	FG.2017.14	46.64	[illegible]	[illegible]	[illegible]	NA
FG.2017.11	35.62	[illegible]	[illegible]	IS.2011.12	61.72	DE.2011.14	NA
FG.2017.12	[illegible]	IS.2011.12	64.86	[illegible]	[illegible]	FG.2017.09	NA
LA.2011.03	37.79	[illegible]	NA	FG.2016.14	NA	FG.2016.14	NA
IS.2011.33	NA	IS.2011.33	NA	IS.2011.33	NA	IS.2011.33	NA
FG.2016.18	NA	FG.2016.18	NA	FG.2016.18	NA	FG.2016.18	NA
FG.2013.01	NA	FG.2013.01	NA	FG.2013.01	NA	FG.2013.01	NA
FG.2016.17	NA	FG.2016.17	NA	FG.2016.17	NA	FG.2016.17	NA
FG.2016.13	NA	FG.2016.13	NA	FG.2016.13	NA	FG.2016.13	NA
FG.2016.12	NA	FG.2016.12	NA	FG.2016.12	NA	FG.2016.12	NA
FG.2016.15	NA	FG.2016.15	NA	FG.2016.15	NA	FG.2016.15	NA
IS.2011.29	NA	IS.2011.29	NA	IS.2011.29	NA	IS.2011.29	NA
LA.2011.01	NA	LA.2011.01	NA	LA.2011.01	NA	LA.2011.01	NA
IS.2011.34	NA	IS.2011.34	NA	IS.2011.34	NA	IS.2011.34	NA

Figure 96: Distance/chronology, Biggest (green) group FG observation

The stability of the group seen around the most relevant member is surprising, throughout the 3 years the group remains practically the same, with only a few small changes.

The green group, in addition to being the most numerous, is the one with the best quality data in the FG area, as can be seen in the table, it has values in all time sections. In the case of this table, the small data gaps do not affect much, as long as there is some data in the time segments, since with a few data the average distance can be calculated anyway.

Animal ID FG.2016.16 from the orange group was initially part of the green group, then ended up joining the orange group. Animal ID IS.2011.11 seemed to wander through different groups at first, until it eventually joined the green group.

A regular member of the green group (IS.2011.12) begins to move away in 2019 until it is no longer with the group at all.

Possible further research questions:

- who was the leader of the groups and how can it be determined by a quantitative method using the data and results as presented in this work?
- Why did the animal ID IS.2011.12 leave the green group?

6 Analysis and results (Acceleration perspective)

The acceleration perspective was initially intended to observe the magnitude of movement (but not distance) of the animals. For this, the sensors on the animals recorded the changes in the animal's movement speed, in a feature that is called acceleration, belonging to the acceleration dataset, which is the largest dataset of the work. **Note: only the absolute acceleration was analyzed, not the acceleration by each axis.**

The challenge was interesting and complicated from the beginning, unlike the position dataset and the climate data, with this set it was not known what type of results could be expected, but it seemed promising to explore it.

The most difficult part was processing the dataset to a size manageable by the computer of the author of this work. At the beginning there was a total of more than 500 million rows (in separate files). As already explained, in the processing an attempt was made to reduce an order of 10 times the size, but the reduction was greater in this set (due to the amount of data every 10 minutes there was), but still containing all the valuable information.

Although the processing of the dataset to have it ready for analysis was complicated and very time-consuming, unfortunately not many valuable results have been obtained from the data. It is certainly not the perspective of this work with the best results.

7 Discussion

After carrying out and analyzing 3 different perspectives, we can say that 2 of them have given many satisfactory results and with very valuable information on wild boars, and sadly 1 of them (the acceleration one) has not been very useful for a general overview, but this learning is also valuable for future works.

The 3 perspectives: The perspectives have developed thanks to the implementation of 4 visualization tools; the time-sharing matrices, the position heatmaps, the KM distance heatmaps and the chronologies of average distances between animals. All these tools working together allow us to generate an excellent overview of the animals' behavior by temporality, climate, specific conditions, and data quality.

Identification of groups: The technique implemented for group identification had excellent results, the trends observed in the heatmaps repeatedly reaffirm that group identification using a spatial approach (animals nearby) on a discretized map works very well.

Research that continues this could focus on comparing the results of such a technique, comparing it with the results of a clustering algorithm that finds clusters without the need to have a discrete map. Which would imply that the algorithm, to be more precise, would have to make calculations every moment of time, for each of the animals, and this over 3 years. It requires high computing power, but it is possible. It would be interesting to know the advantages and disadvantages of using these 2 techniques, although honestly, in any case, even if some research is carried out with a clustering technique that does not use a discrete map, I would always recommend having the map discreetly, since it is an alternative way that can help verify results from a different technique and provides extra information, such as exact zone locations on a map, without the complication of continuous coordinates.

Groups sizes: The results of a study of commercial pig farm show that even in environments with a high population density, which is not natural and is for commercial use (semi-natural conditions), the pigs' behavior of maintaining differentiated groups of animals is consistent (Kaufholz, 2021).

It was expected to find groups of sizes between 11 and 20 individuals (Sebastian G. Vetter, 2016), however the groups observed in the time matrices and distance heatmaps are smaller. In Vetter's work it is mentioned that a larger number of animals usually causes the creation of more groups of animals and not larger groups. However, in this study, the groups of animals found are smaller. These observed group sizes could be due to the limited space that the enclosure has, which is not such a "large" area and could also be due to the technique used for group identification, which may differ with techniques used in other studies, where it may be that even though some animals spend less time together, they are still considered part of a group (due to limited number of observations or different criterion), which would result in larger groups.

The significant changes in the group formation of wild boars seem to be affected mainly by factors external to the group of animals, such as human caused mortality (Iacolina, 2009). It is possible that the formation of groups is affected in its size or structure by the presence of imminent dangers, such as wild animals (wolves) (Iacolina, 2009). This is one of the big differences to take into account if we intend to compare the results of this analysis with the behavior of these animals in free nature.

Disease spreading: The study of disease spreading of wild animals requires studies like this one, since valuable information can be obtained that guides specialists in the subject in the right direction for the development of more functional or accurate models. It is known that information related to contact rates in wildlife populations can be used as a basis for the development of epidemiological models (Craft, 2011), (Bansal, 2007).

Contact between individuals of an animal species is a key factor in the dynamics of diseases that are directly transmissible (Podgórski, 2018). In most animal populations in a wild habitat, contact between individuals of species depends on the social and spatial structure of the animals of the species. These characteristics can affect the probability, size, persistence and severity of diseases spread throughout a group of animals (Lloyd-Smith, 2005).

Hunting effect: A focus is made on a specific individual case that emulate hunting in open nature. As terminology, the expression death/out event, refers to a case where one of the members of the group was removed. But in addition to that, it has been observed that there is 1 member of the group who normally moves much more than the others, so it is suggested that the hunting effect may be different in them than in the other members of the group, however it is not known yet. If so, identifying this main member (by quantifying its movement) can be a great tool for handling these animals, since this is easily quantifiable. The difference in distances traveled in 1 year is easily observable.

The data quality and recommendations: Data quality has proven to be an extremely important factor to carry out analysis of this type, because although from some "angles" it may not have a major problem, when zooming in it, some themes, seasons or animals specifically, cannot be properly analyzed without good data quality.

In general, this work refers to low data quality as a lack of data in time periods, especially time periods of days, weeks or months (significantly amount of time). In other aspects, the data was excellent, there were no outliers or other kind of problems. It is then suggested for future work to implement a strict system to control the data collection, to ensure that there are no weeks or months in which the data is stopped being collected. Also, some more in detail (on site) data collection is strongly recommended to gain exactitude in a positional analysis.

The most common problem for the data collection is that the tags (sensors) ran out of battery, and then it is difficult to capture the animal to perform a battery replacement. As has been seen, this can have an impact on the final analysis.

8 Conclusions

The possible observations (case by case) in this work are numerous, but the objective of this analysis was only to give an overview of the behavior of these animals, to describe in a quantitative way generalities observable with big data analysis.

The main behavioral trends can be summarized in the following:

- The months of greatest activity or displacement in KM are months 4-6, although activity can be at high levels from month 7 to 10.
- In general, in the winter, or from month 10 onwards, activity levels drop noticeably, but there are some exceptions. There are animals that present high levels of activity (for winter) in the 11th and 12th month, and this could be related to the humidity levels of the environment, although no conclusive conclusions could be obtained in this work.
- The first 3 months of the year are uniformly months of low activity (displacement in KM).
- The groups that the animals formed, do show patterns of group behavior observable in the heatmaps of distance traveled KM, however, it was observed that by individualizing the values (scale by row) the observations of the trends are much clearer and more evident, so it is suggested to use this technique for future research, removing the factor of the "character" of the animal.
- The temperature of the environment and solar radiation have a direct influence on the high levels of behavior of animals.
- The groups seem to have 1 main leader, or a member who moves considerably more than the other members of the group. It may be possible to identify the most important member of the group by counting their KM of travel and comparing them with those of the other members.

9 Repository of nodes used in Knime

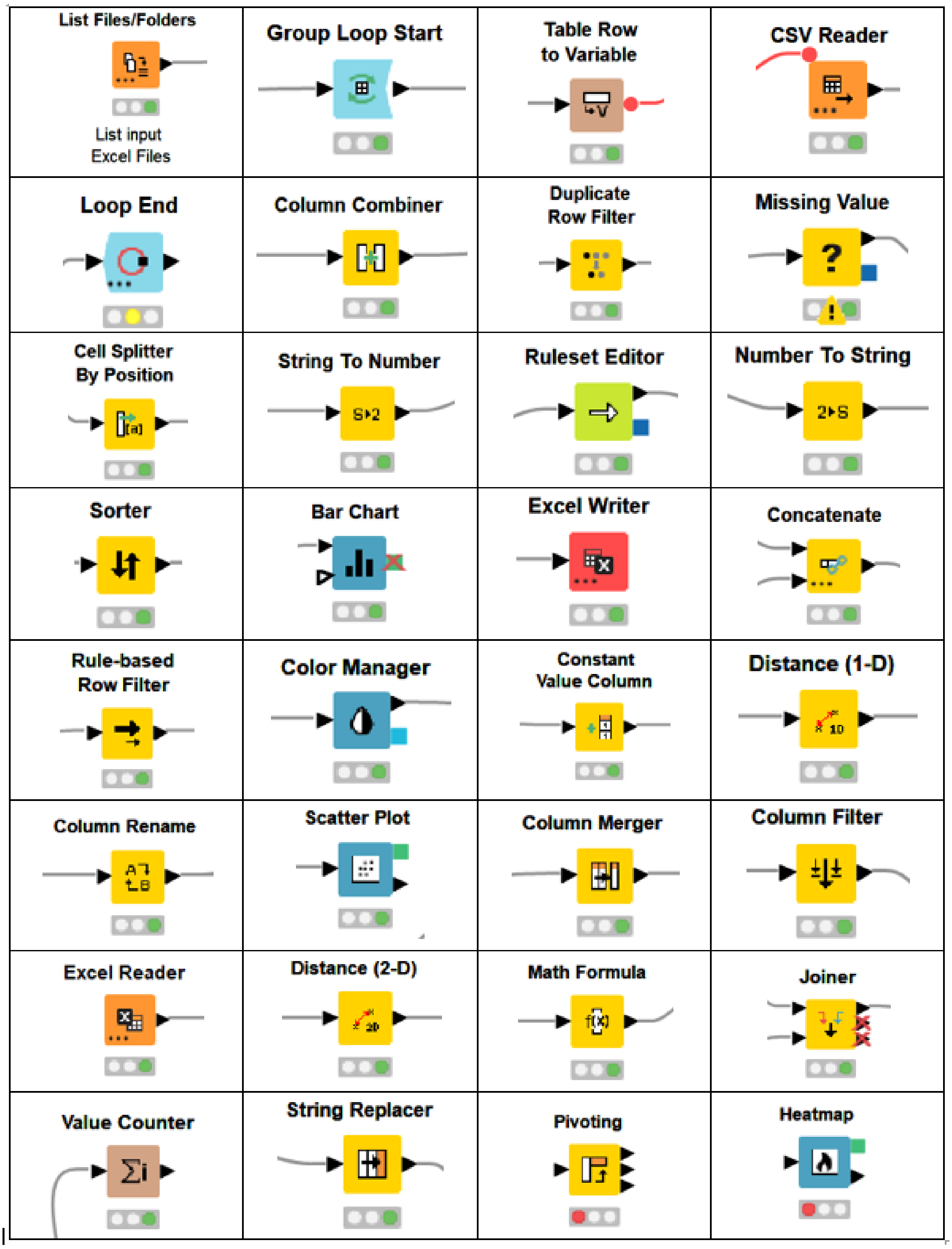


Figure 97 Used nodes in Knime

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