REPORT ON MONITORING WORKPLAN IMPLEMENTATION

D.T2.4.3 – Biosphere Reserve Southeast-Rügen (PP06)

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1. Introduction

As part of the INTERREG project CEETO (CE926), the Biosphere Reserve Office South-East Rügen carried out a visitor monitoring in the nature reserve "Zicker Berge" in the period from July 11th 2018 to October 7th 2019. The Zicker Mountains are located in the south of the biosphere reserve on the Mönchgut peninsula in the municipality of the same name. The administration of the area is done by the office Mönchgut-Granitz. The towns of Gross Zicker and Gager are not part of the examination area. This respectively begins at the exits of the two villages. At both entrances to the Zicker mountains there are information boards for visitors, which inform about local peculiarities as well as rules of behavior in the nature reserve.

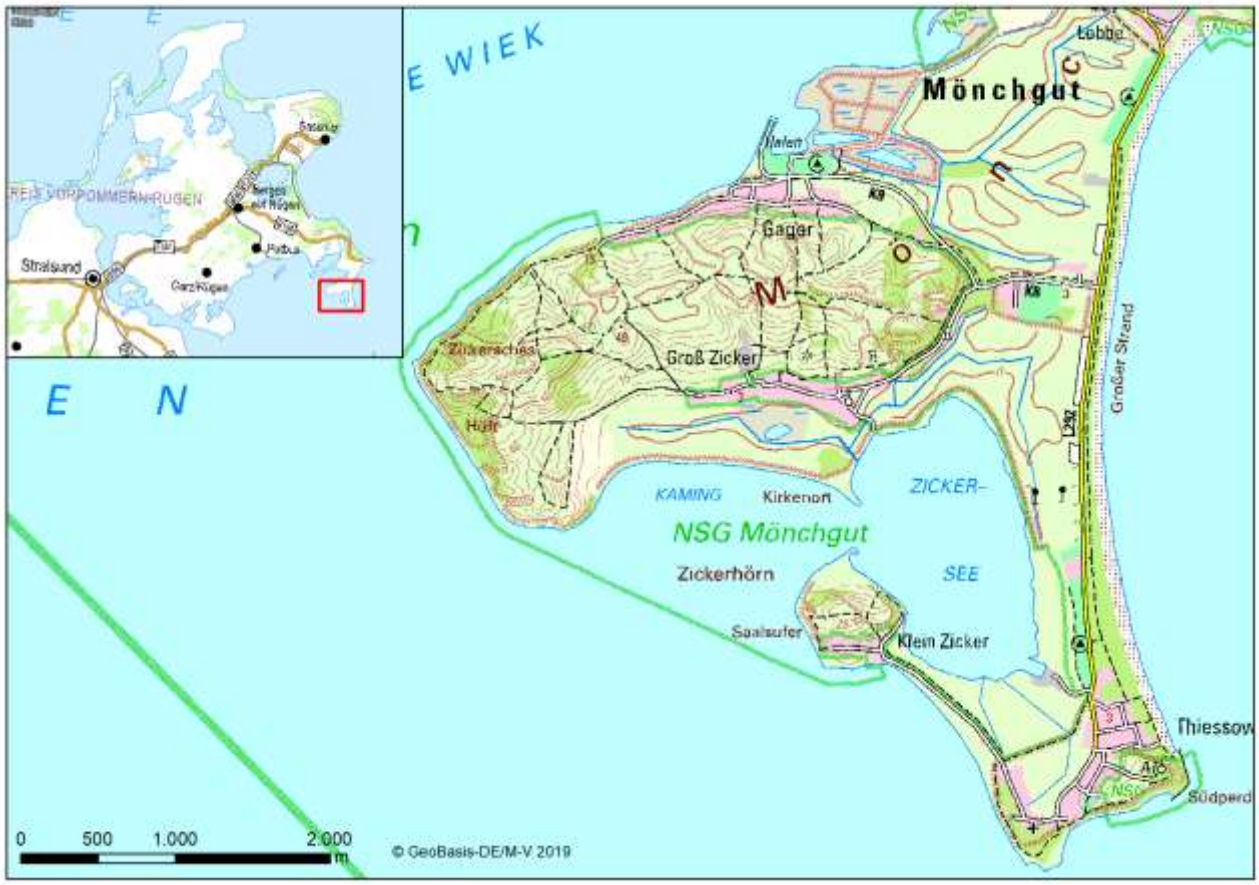


Figure 1: Location of the examination area

The project "CEETO-Central Europe Eco-Tourism: tools for nature protection" is an interregional cooperation project in which protected areas, non-governmental organizations and representatives of state institutions from Italy, Croatia, Hungary, Slovenia, Austria and Germany work together to develop a strategy for sustainable tourism in protected areas. (Biosphere Reserve Southeast Rügen: The CEETO Project Biosphere Reserve Southeast Rügen.)

In the Zicker Mountains, violations of the protected area regulations have repeatedly been noted in the past. In order to be able to analyze and classify the visitor behavior as well as to avoid rule violations in the future even better, different pilot actions have been implemented and the visitor monitoring was launched. Reasons to start the pilot actions have been:

1. Limited knowledge of the visitor profile in terms of number, origin, behavior, mobility preferences, awareness of being in a protected area and knowledge of the specific code of conduct.

2. Inappropriate behavior of visitors and poor respect for the place, due to insufficient knowledge of natural values of the area.

This report focuses on the evaluation of data collected during the monitoring.

2. Pilot Action Implementation

A first evaluation for the period July to October 2018 was carried out as part of a master's thesis of a student of the University of Greifswald in the field of regional development and tourism. This evaluation of the initial state of affairs was used to find out the degree of touristic pressure, and subsequently to be able to decide on visitor management activities to be implemented in the area.

The first results showed that touristic pressure in this area seems to be acceptable. The pressure point has not been reached as long as visitors behave correctly according to the access rules to the protected area.

The results were then discussed at a participatory workshop, where further visitor management activities were decided (the implementation of an audio guide, setting up garbage cans, improving signage, implementation of rescue routes). Existing monitoring tools were improved, especially manual surveys, by adding further questions concerning new actions, and continuous data collection to find out if there is a change of behavior of visitors during the year.

In the second phase, after the implementation of visitor management activities and adjustment of monitoring tools, newly obtained data are used to compare visitors behavior before and after the implementation of visitor management activities and to evaluate the effectiveness of those activities.

3. Monitoring design and setup

3.1. Monitoring Activities

The visitor monitoring was carried out under the direction of the Biosphere Reserve Office in the period from July 11th 2018 to October 7th 2019. Two electronic counting devices installed in the area recorded the absolute number of visitors, the frequency of visitors (hourly, daily, spread over the year) and the visitors going in and out of the area. In addition, manual counts and visitor surveys were conducted at regular intervals using a questionnaire at two specific locations in the area.

For the period 2018-2019 an evaluation of the collected data as well as a comparison of these should be carried out as part of the pilot action. Of particular interest is the level of visitor traffic in the area dependent on holidays and bridgehead constellations, certain days of the week, tourist events and weather conditions.

Furthermore, the evaluation of the quantitative use of the route network should provide information about the amount of visitors on individual sections of the route. In the qualitative evaluation of the use of trails, the focus is on the extent to which the reception of natural features such as the view into the coastal landscape, dry grassland and wetlands, forest or coastal zone / Bodden waters is crucial for individual route selection.

In the summer of 2019, a new offer for visitor guidance was implemented. This is an audio guide of the provider izi.Travel. The offered audio tour "Biosphere Reserve Southeast Rügen - Hike Zicker Berge" includes a tour suggestion and audio information for a total of 11 sub-points of the route. Visitor monitoring should clarify how many visitors took advantage of the offer from July 10th to October 7th 2019 and set the visitor statistics of the izi.Travel website in relation to the absolute number of visitors measured by the electronic counters.

The analysis of the irregular behavior of visitors is carried out by conducting short interviews with different regional actors.

3.2. Monitoring Equipment

When conducting visitor monitoring, a mix of different survey methods was used to obtain the data. These include:

- Automatic visitor counting through two counting stations in fixed locations
- Manual counts and flash interviews with questions regarding the origin and type of transport of the visitors as well as compliance with the regulations regarding the use of bicycles and the keeping of dogs if relevant
- Long interviews on fixed dates with standardized detailed surveys on demographic parameters, knowledge of the region and natural features, perception of the biosphere reserve, rule awareness, etc.

The long interviews turn out as the most comprehensive element of visitor monitoring. In detail the questionnaire consisted of six different sections:

1. General data (date, time, interviewer, location, weather)
2. Motivation of the visitors, knowledge of the biosphere reserve, the protection status and associated behavioral regulations
3. Questions about the subjective satisfaction with the stay and the landscape experience
4. Assessment of visitor numbers in the Zicker mountains and influence on own behavior
5. Graphical representation of path sections in the area
6. Statistical data on arrival, age, education and occupation

In July 2019, two questions on the newly implemented audio tour regarding knowledge of the app and its use were added.

The flash interviews took place at the same time as the manual counts. Inquiries were made about the origin of the visitors in the categories of locals, day guests or overnight guests. Also the home postcodes were requested. In addition, it was recorded whether the visitors were hikers, hikers with a dog (leashed or not leashed), cyclists (pushing or driving) or runners. The purpose of the manual counts was to document and quantify rule violations.

3.3. Monitoring Systems Setup

At the beginning of the monitoring phase, two automatic counting devices were installed at the two main accesses to the nature reserve Groß Zicker. Start of the counting was on 26.07.2018.

Figure 2: Entrance to the nature reserve and automatic counting device in Groß Zicker

The data were transmitted online to the eco-visio portal, from where they can be retrieved with the appropriate authorization exact to the hour. Thanks to their wooden design the two automatic counting devices fit into the environment very well and are rarely noticed by visitors. This has a positive effect on the absence of manipulation attempts. Inaccuracies can still arise when vehicles or animals pass through the counting devices. Also larger groups of people or people standing still may distort the data. Furthermore, it is possible for visitors to enter the area on other routes or past the counter. The automatic counting devices can thus represent a trend for the distribution of the visitor flows, but do not completely map them.

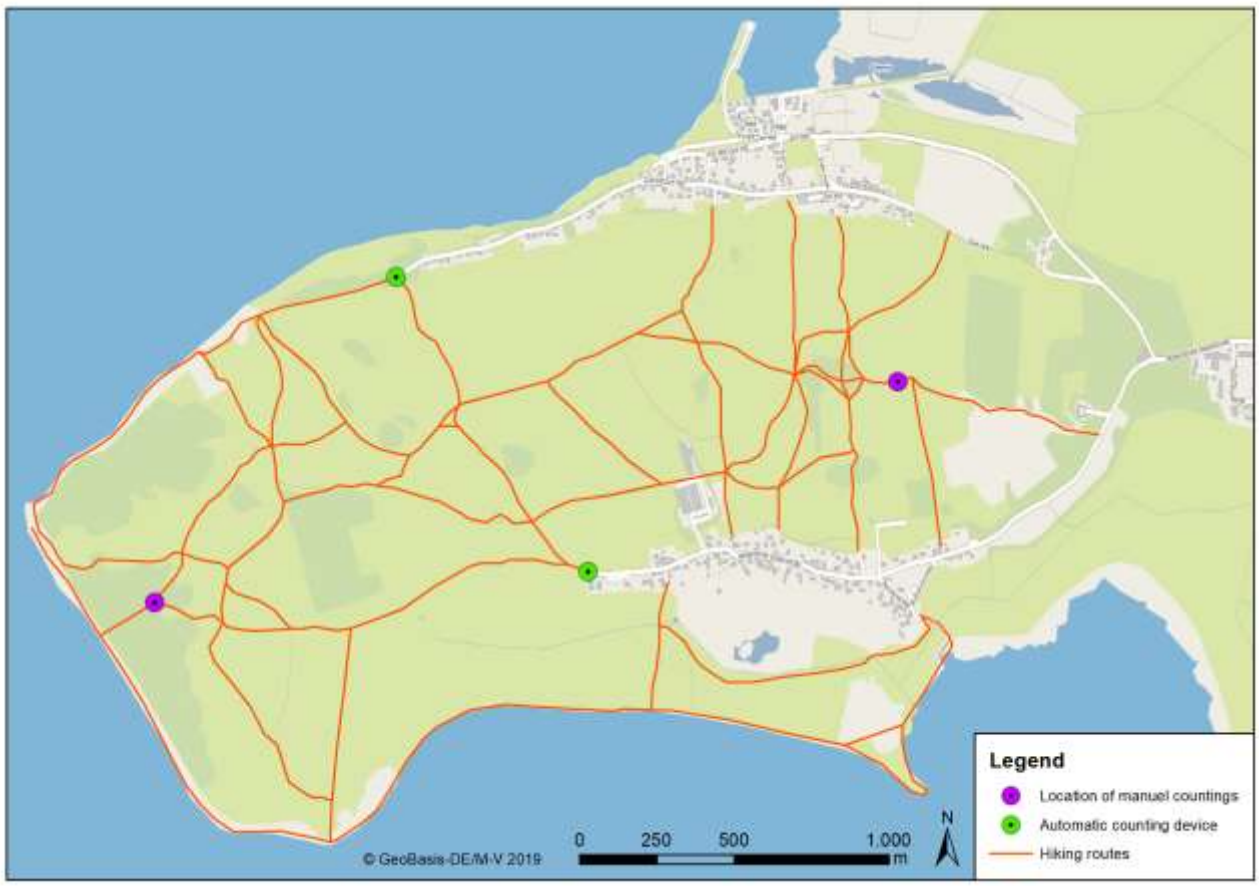


Figure 3: Location of visitor counts and visitor surveys

In 2018 there was another counting point, which turned out to be impractical in the course of the monitoring and was therefore not used in the second half of the monitoring and is not shown here.

3.4. Implemented managerial activities

Discussions with communities and property owners were necessary. Direct agreements were reached and the permits were obtained. Significant management actions have not been necessary.

3.5. Education on the use of equipment

There was no significant training necessary. There was only an explanation about the use of the electronic counters via phone.

3.6. Monitoring system tourist information campaign

CEETO Logo was present and the brand has been mentioned in every possible publication, e. g. the audio guide promotional post cards, press releases and on the garbage cans.

3.7. Expected results

1. To acquire a better knowledge of characteristics, choices, and the degree of awareness of Zicker Berge visitors regarding the natural characteristics of the Biosphere Reserve Southeast Rügen.
2. To improve the visitor behaviour by conveying knowledge about peculiarities of the area called “Zicker Berge”, informing about paths and safety, correct rules of conduct and adequate behaviour within the Biosphere Reserve.

3.8. Use of Collected data

The collected data will be analyzed once. But to find out if there is a change in the behavior of the visitors over time, data must be collected and compared again in 3 to 5 years if possible, because such changes may happen slowly. The results will be presented to the stakeholders and will be used to decide on possible further future actions.

Table 1: final timing of monitoring related activities, specifying actions by row and times by column

3.9. Monitoring Workplan Final Version (TimeLine)

4. Data Collection and Analysis

The data collection phase has been successfully completed. The collected data will now be evaluated by means of various parameters to form the basis for further measures of visitor guidance and future developments.

4.1. Short interviews

In order to generate an opinion on the subject of misdemeanors and waste in the Zicker Mountains, a series of short interviews with regional actors were conducted. These were named by the Biosphere Reserve Southeast Rügen. Interviews were conducted with the following persons:

- René Geyer independent nature guide and certified partner of the Biosphere Reserve Southeast
- Katharina Schulz, employee of the local tourist authority Mönchgut
- Thomas Papke, Ranger at the Biosphere Reserve Southeast Rügen
- Frank Rusch, Ranger at the Biosphere Reserve Southeast Rügen

All interviewees were asked the same questions, slightly varied depending on the field of action and the answers were recorded in writing. The questions were primarily related to the amount of waste in the area Zicker Berge:

- Is there an acute problem with the amount of waste in the eyes of the actors?
- Has there been a noticeable change since the trash cans were set up?
- Are voluntary waste collection campaigns planned or necessary in the eyes of the actors?
- Where is the focus of the waste in the area?
- What measures are useful for further avoiding waste in the area?

Further questions were concerned with the perception of offences such as cycling in the area or other measures of visitor guidance.

With regard to the questions about the amount of waste, all participants agreed that there were only isolated problems, but no massive waste arising in the Zicker mountains. Mainly discarded paper handkerchiefs and dog waste bag, isolated candy wrapper and cigarette butts close to existing seating options can be viewed. In general, the largest collection of garbage occurs close to the resting areas. Setting up the new garbage bins has so far produced no noticeable behavioural changes. However, it should be noted that the new bin had not been in their place for a long time at the time of conducting the interviews and that there already used to be normal garbage cans in the entrance areas before. As part of the "Coastal Cleaning" campaign, voluntary waste collection campaigns take place in the outskirts of the nature reserve in May and June, with the participation of local schools. This action can be continued, especially in the context of sensitizing children and young people to the topic, but further concerted waste collection campaigns are not necessary from the actors' point of view. In general, especially the rangers of the biosphere reserve are pleading for further education of the visitors. Clear instructions in the entrance areas should ensure that visitors are sensitized to take back any form of garbage and generally avoid waste. The local tourist authority would like to address a more explicit presentation of the topic in cooperation with the biosphere reserve, but it must not create a "sign forest".

Overall, however, the impression of regional actors is optimistic. Only a small percentage of visitors violate the rules. Cyclists are be observed from time to time, especially with the increase in e-bikes, but there is no serious problem. It remains to be seen how the new prohibition signs at the entrances will affect the medium and long term. The local tourist authority encouraged a better signage of parking in the local situation, but primarily saw this as a community task. The rangers do not consider further measures of visitor guidance to be expedient; instead, the primary task should be to educate and inform the visitors in order to gain insight. Along with this, a larger area presence of the rangers

would be desirable. Due to the very rare case of a serious offences, which would then have to be noticed directly in person, disciplinary fines are imposed as absolute exceptions.

4.2. Visitor guidance measures

4.2.1. Audio Guide

In July 2019, the implementation of an audio guide for a hiking route through the nature reserve Zicker Berge took place. With the help of a smartphone, additional information about animal and plant species as well as the settlement history and current land use of the region can be retrieved along the designated hiking trails at a total of 14 stations. (Table 1) For this you need the app of the provider izi-Travel, which is available free of charge for Android and IOS. The audio guide was developed by the Administration of the Biosphere Reserve Southeast Rügen in cooperation with the local tourist authority Mönchgut and various other actors and is to be regarded as a measure of visitor guidance.

Figure 4: QR code for the start of the audio tour at the entrance Gross Zicker

Table 2: Stations of the audio tour and number of plays per month and total

Location/topic	June 2019	July 2019	August 2019	September 2019	October 2019	Plays
History of Groß Zicker	0	49	36	33	22	140
Pfarrwitwenhaus Groß Zicker	1	20	15	13	7	56
Entrance Nature Reserve	3	16	18	16	12	65
Biodiversity birds	1	8	16	17	10	52
Sheep grazing	0	12	13	10	5	40
Nonnenloch	2	17	21	23	9	72
Lookout	3	5	10	16	7	41
Biodiversity insects	0	9	17	9	9	44
Biodiversity vegetation	0	4	10	9	5	28
Entrance Nature Reserve 2	0	6	10	5	5	26
Lookout Bakenberg	1	13	19	14	14	61
Total	**11**	**159**	**185**	**165**	**105**	

The table shows that the use of the app was strongest in the months of July and August. In June, the audio tour went online and thus only could reach a small amount of users that shortly after its launch.

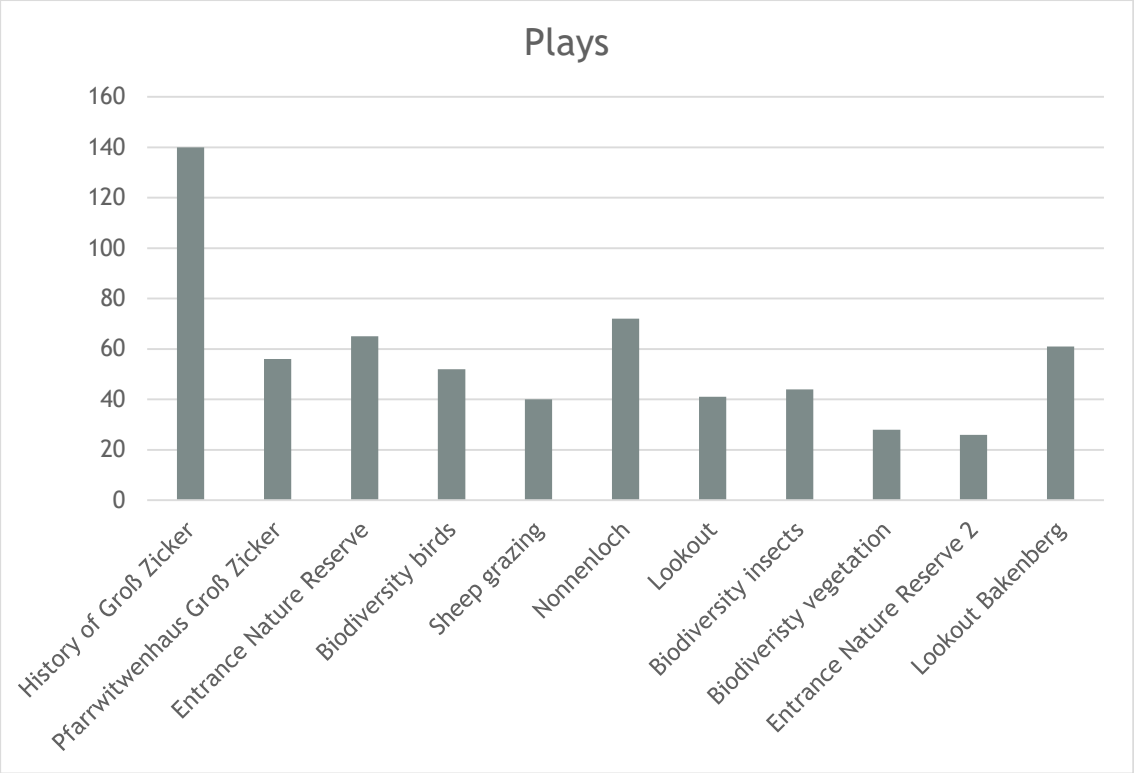


Figure 5: Distribution of the played audio files

Figure 5 shows how often the audio tracks were played at the individual stations as well as the distribution of the tracks in terms of frequency. Most often the first track dealing with the history of the place Groß Zicker was played. This suggests that users have only tested the audio tour or that there may have been network coverage issues outside the location.

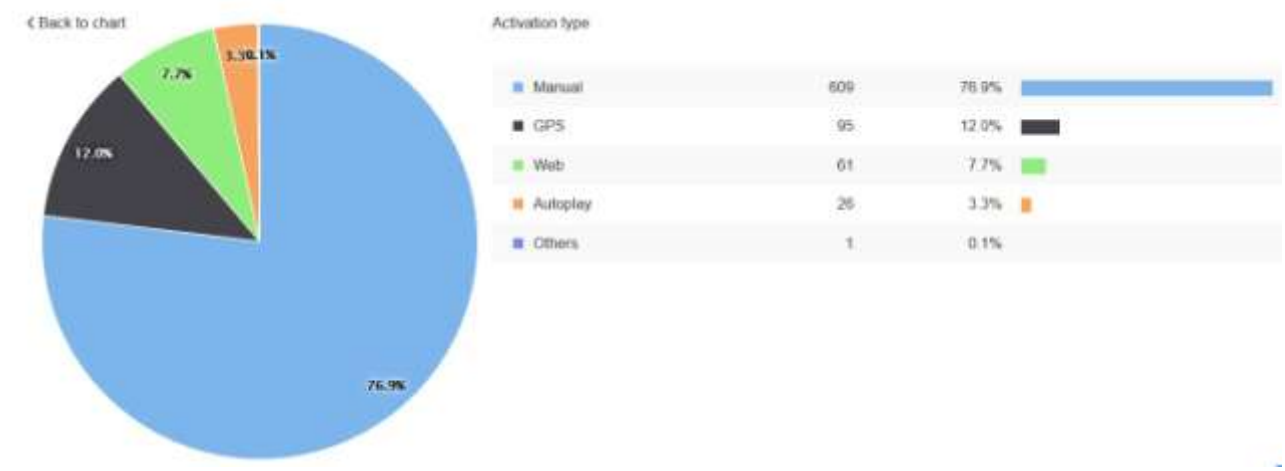


Figure 6: Distribution of activation type for starting an audio track

Figure 6 is taken from the statistics tool of the izi.Travel App and shows in percentage terms how the playback of the audio tracks was activated. About three quarters of the games were manually activated by the smartphone, 12% via the GPS function. This recognizes where the user of the app is located (with correspondingly set GPS location on the terminal) and plays the right track depending on the location. Almost 8% of the tracks were directly played from the izi.Travel website, probably not through a mobile device. The rest is negligible.

However, considering the values from Figure 7, which states that almost half of all the audio tracks have been activated in Berlin, it is reasonable to assume that the usage statistics of the app also includes many test runs and the frequency of use for the actual purpose is still distorted. This is certainly due to the relatively short observation period of app usage. Also, Figure 8 shows a similar picture: here it becomes clear that so far only just over a quarter of all played tracks were actually heard to the end. These figures together suggest that correct use by the actual target group has so far taken place only on a very small scale. The izi.Travel website has so far only one comment that praises the content, but complains about technical problems during offline use. Mentions in social networks have not at all taken place yet.

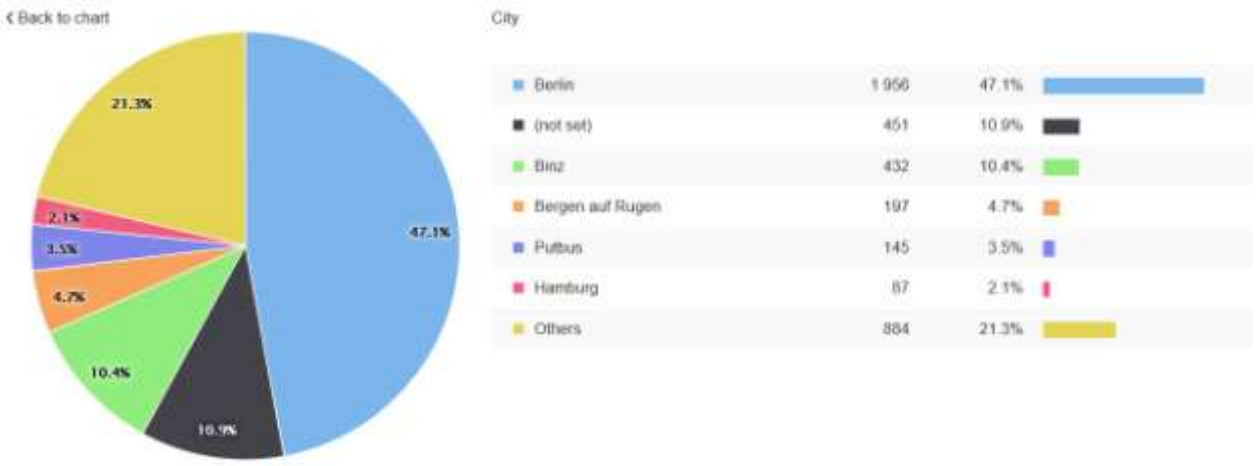


Figure 7: Geographical location of the use of audio tracks by cities

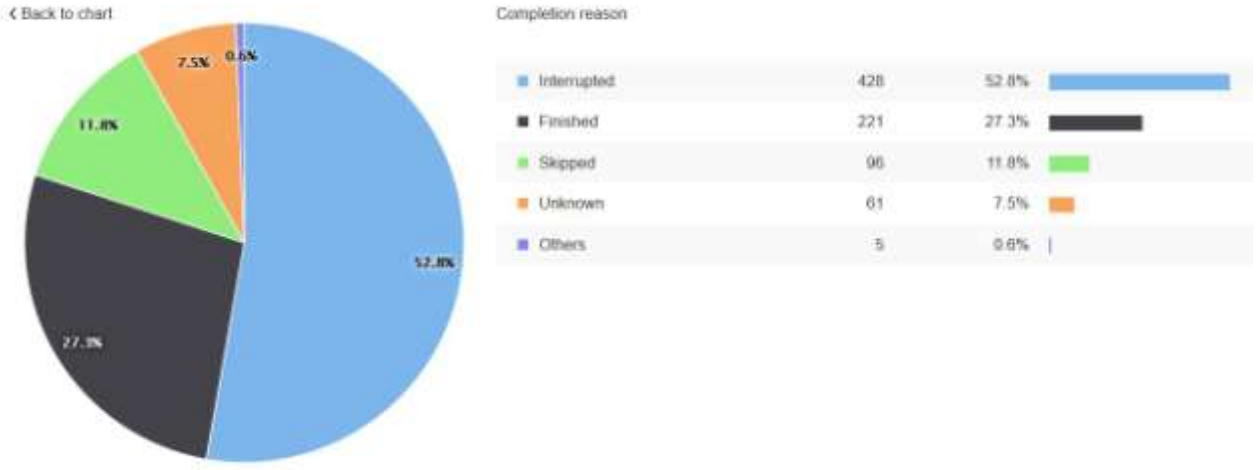


Figure 8: Proportion of fully played audio tracks

4.2.2. Information signs and signposts

Another measure of visitor guidance is the revision and renewal of mandatory and prohibition signs. Since especially the use of bicycles in the nature seems to have increased recently, the references to the bicycle driving ban in the entrance area Groß Zicker were again strengthened. An evaluation of the counted offenses with regard to cycling in the nature reserve can be found in chapter 4.4.3.

Figure 9: Cycling prohibition signs in the entrance area Groß Zicker

4.2.3. Garbage Containers

As part of the project, new garbage containers were set up in the examination area. These were artistically decorated and also provided with the CEETO logo. The inscription: "Last bin before the Zicker mountains" should point out to visitors that there is no possibility of waste disposal directly in the nature reserve. The rubbish bins can help to raise the awareness of the visitors to dispose already accumulated rubbish before their walk into the Zicker mountains or to pack up any waste that accumulates during the visit of the nature reserve and to dispose it in the garbage containers. The containers are emptied twice a week by employees of the local tourism authority.

Figure 10: New garbage container at the Groß Zicker entrance

4.3. Manual surveys

The following table shows the number of questionnaires collected (detailed surveys) as well as the number of persons recorded by the questionnaires on the given dates. A total of 670 questionnaires were filled in and evaluated as part of the monitoring. These represent 1,856 visitors. Extensive surveys took place on 59 days during the monitoring period. The average age of visitors is 45.3 years, the median age is 50 years.

Table 3: Number of questionnaires collected distributed on survey dates

Date	Number of questionnaires	Recorded number of persons
11.07.2018	9	28
13.07.2018	19	51
14.07.2018	28	72
15.07.2018	20	47
16.07.2018	1	3
17.07.2018	25	86
22.07.2018	21	58
30.07.2018	6	21
02.08.2018	20	46
08.08.2018	16	39
14.08.2018	12	30
19.08.2018	12	26
25.08.2018	26	58
27.08.2018	7	17
31.08.2018	11	37
05.09.2018	8	17
11.09.2018	8	15
20.09.2018	8	16
30.09.2018	5	10
01.10.2018	9	34
02.10.2018	10	20
03.10.2018	21	50
05.10.2018	5	14
07.10.2018	14	34
09.10.2018	6	15
14.10.2018	6	15
21.10.2018	4	11
03.04.2019	9	52
09.04.2019	2	7
15.04.2019	3	12
20.04.2019	17	46

Date	Number of questionnaires	Recorded number of persons
28.04.2019	10	20
03.05.2019	12	21
06.05.2019	3	8
25.05.2019	2	8
31.05.2019	15	32
09.06.2019	14	73
11.06.2019	2	5
20.06.2019	7	29
04.07.2019	11	28
06.07.2019	2	25
10.07.2019	12	40
16.07.2019	24	80
21.07.2019	14	44
26.07.2019	10	20
29.07.2019	7	20
01.08.2019	15	53
07.08.2019	17	37
13.08.2019	18	46
18.08.2019	28	77
24.08.2019	7	25
26.08.2019	2	12
30.08.2019	9	17
04.09.2019	17	49
10.09.2019	2	2
19.09.2019	8	15
29.09.2019	2	4
04.10.2019	21	62
07.10.2019	11	17
Summe	**670**	**1856**

In the course of the project, a total of 6401 persons were recorded by the manual counting. 3218 in the year 2018 and 3183 in the year 2019.

4.4. Data Analysis

The analysis of the frequency is mainly based on the two automatic counting devices at the two nature reserve entrances in Groß Zicker and Gager. In order to be able to make statements about the number of visitors depending on different factors, a size had to be determined from the overall data, which makes it possible to draw conclusions about the total visitor volume in the area. The two counters respectively record the number of entrances and exits of persons as well as the sum of both. Since

double counting is to be avoided, a value was taken as the minimum number of visitors in the area. The value of the maximum of either entries or exits per day on the Groß Zicker counter was determined as the minimum number of area visitors per day for further evaluation. The restriction on the counter in Gross Zicker has several reasons.

At the counter in Groß Zicker significantly more people were counted on average than in Gager. The master's thesis conducted by Oliver Hack already described both counting locations in terms of their suitability (Hack 2019, p. 28 ff.). It was also emphasized that the counter in Gager can easily be circumvented by an alternative routing. In addition, it was evident from the evaluation of the questionnaires that the Groß Zicker entry was much more frequented by the visitors to the area. In the error analysis, more errors or failures were noticed at the counter in Gager, especially towards the end of the observation period.

A restriction to only one counter appears to be a reasonable assumption against considering the clear correlation of the two counter values. The course of the respective maxima from entrances or exits at the two counting locations is shown in Figure 11.

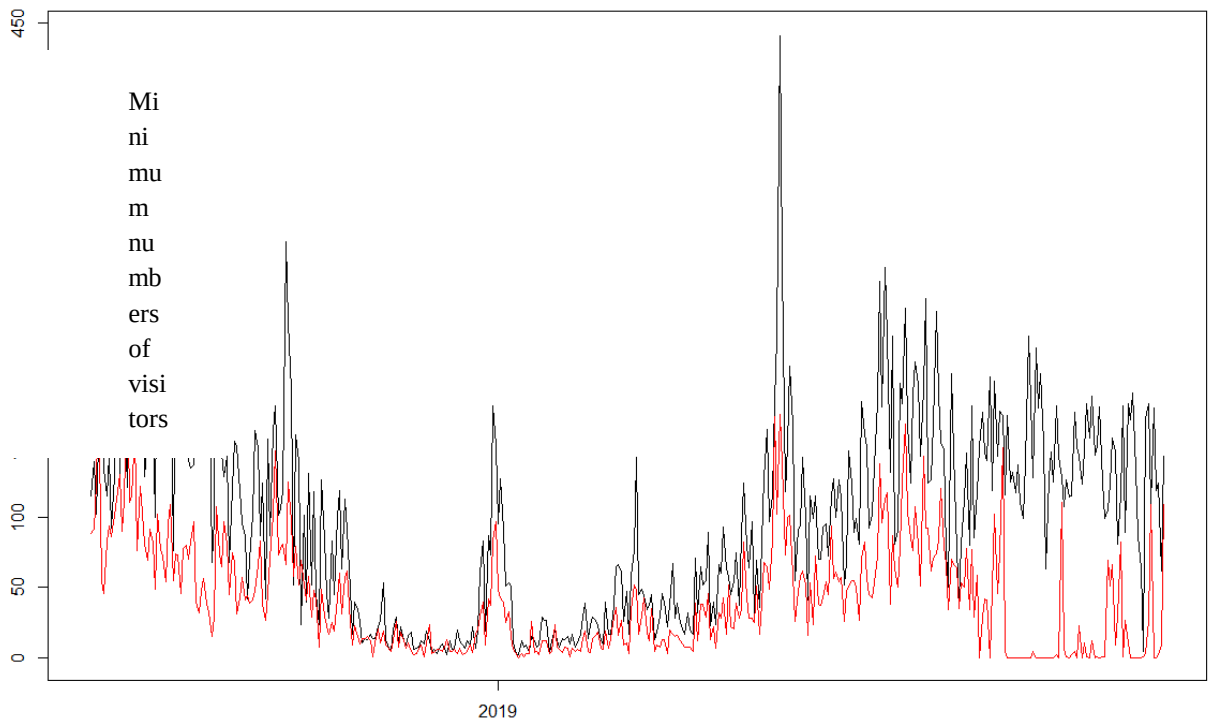


Figure 11: Raw data of the counters Groß Zicker and Gager each maximum entry or exit (black = Groß Zicker, red = Gager), counting period 26.07.2018-18.09.2019

Before further use of the data these were adjusted for outliers. For this purpose, each data pair was defined as an outlier, in which a double deviation of one of the two values occurred. This pair of data was replaced by the value of the same weekday in the previous week for further data analysis.

4.4.1. Frequentation of the area

As explained in section 3.2, the maximum frequency of entry or exit of persons at the Groß Zicker counter is used as a measure of the visitor frequentation analysis. This value can be considered as a minimum number of site visitors per day. Based on the analysis of the visitor routes, it is also possible to estimate a correction factor that allows a conclusion to be drawn on the actual daily number of visitors in the area. An overview of the visitor frequentation over the course of the year as weekly and monthly sum is shown in figure 12 and figure 13.

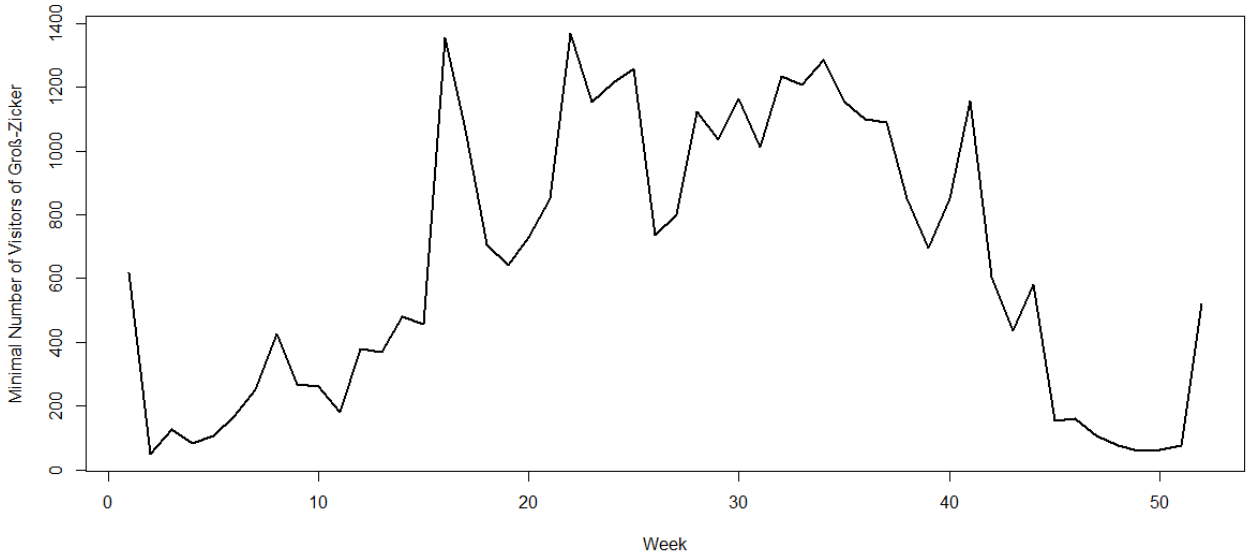


Figure 12: Yearly progression of visitor frequency according to calendar week (viewing period 18.07.2018-17.07.2019)

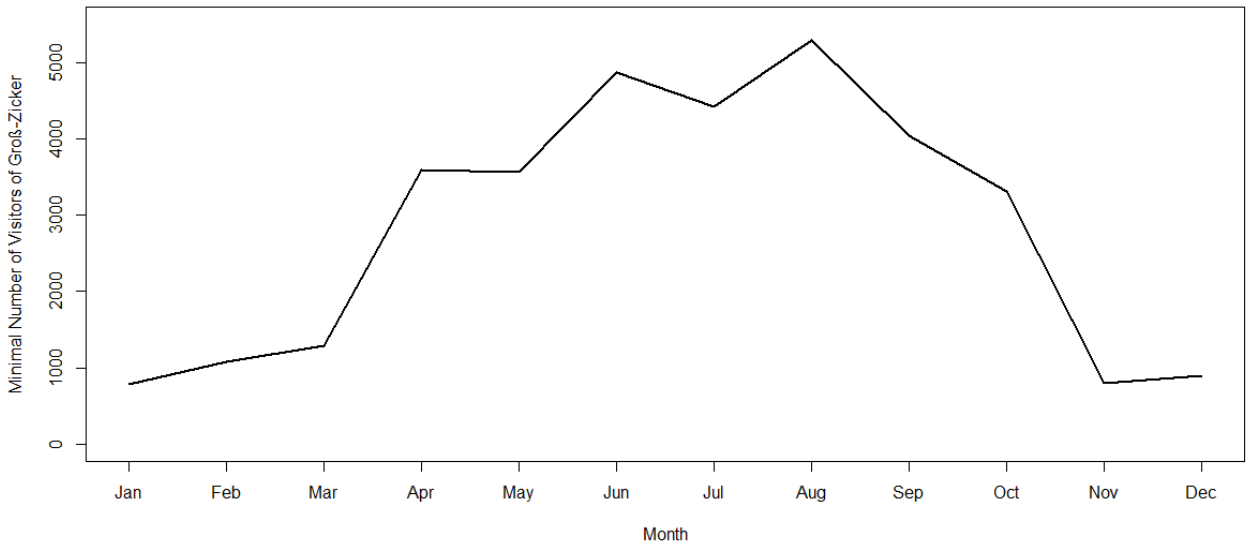


Figure 13: Yearly progression of visitor frequency by month (viewing period 18.07.2018-17.07.2019)

In the following, the dependencies of the number of day visitors are determined by different influencing factors.

4.4.1.1. School holidays and holidays in the federal states

Since the Zicker Mountains are a destination of particular tourist interest, a connection between the number of day visitors and the school holidays in the individual federal states is assumed. For the analysis, for each day a sum of the inhabitants of those federal states, in which school holidays or holidays took place were compared to the total number of visitors of the day.

Figure 14 shows that there is a relationship between the two quantities. The more people are on holiday in Germany, the greater the number of visitors in the area. However, the additional visitor volume due to school holidays / holidays is relatively low, as shown by the relatively flat slope of the regression line in the graph. In addition, the coefficient of determination of the correlation with a value of R2 = 0.21 is not particularly high.

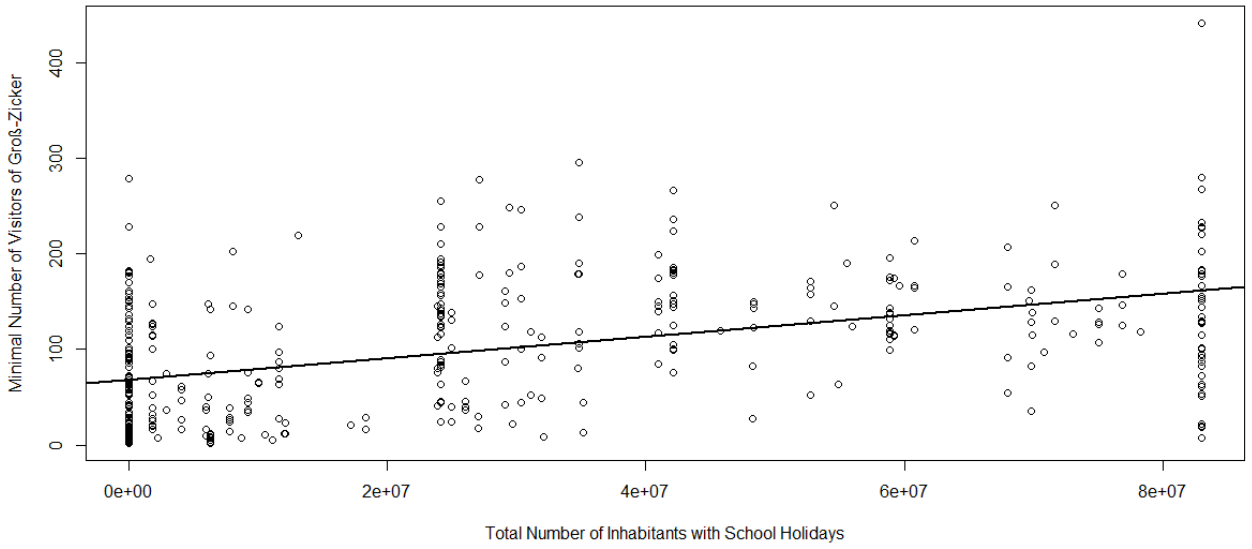


Figure 14: Correlation between total number of visitors to the Zicker Mountains and the sum of inhabitants with school holidays or public holidays

Because of this correlation, it can be seen that a large proportion of visitors visit the area, regardless of school holidays or public holidays. In addition, it can not be completely clarified whether the influence on the area traffic is not rather determined by other factors such as season or weather conditions.

4.4.1.2. Weekdays

For many tourist destinations a differentiation of the visitor frequency according to different days of the week can be assumed. Figure 15 shows the averages of the day visitors according to the respective days of the week.

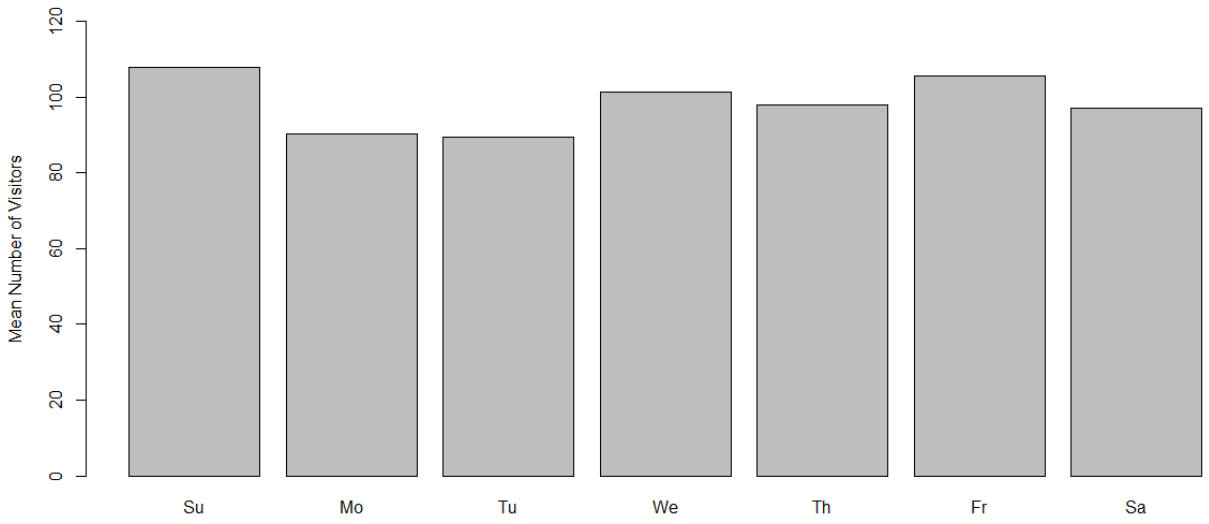


Figure 15: Average number of visitors in relation to individual days of the week

Due to the nearly equal distribution of visitors on the individual days of the week, it can not be proven in the case of the Zicker Berge Nature Reserve that certain days of the week are preferred for a visit.

4.4.1.3. Long weekends

Destinations with a high degree of attractiveness for short breaks and day visitors should have a higher visitor frequency, especially on bridge days and long weekends. For this purpose, selected holidays and the associated bridging days were compared with the weekday average of the respective month. The corresponding percentage deviation of the individual days is shown in Figure 16. It is easy to see that a positive impact on the number of visitors does not apply to all the days studied, but distribution is uneven.

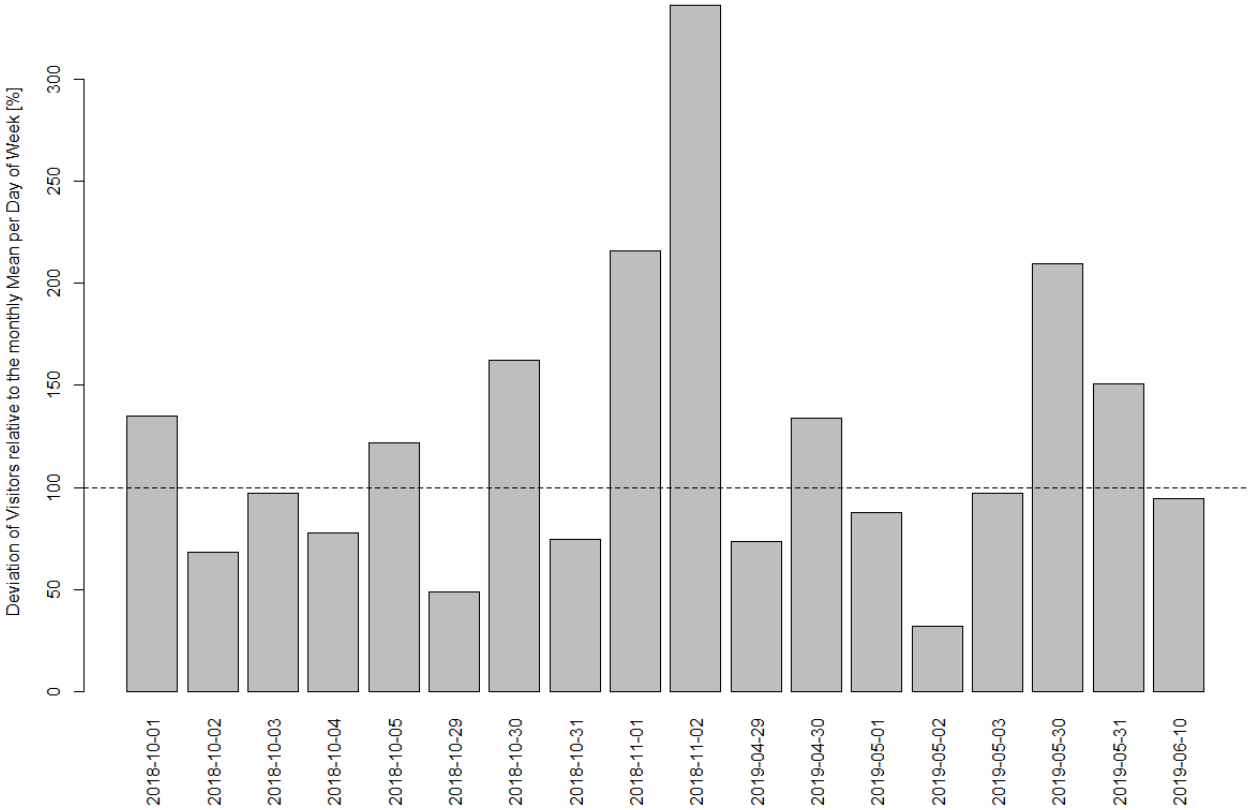


Figure 16: Percentage deviation of the number of visitors from the weekday mean of the month on bridge days and public holidays during the investigation period

This data also suggests that other factors have a higher impact on the decision to visit the area than long weekends and holiday constellations.

4.4.1.4. Tourist Events

The Tourist Board of the island of Ruegen has created two season-extending measures called “Hiking Spring” and “Active Autumn”. These include a number of free guided hikes leading to special natural and cultural highlights of the island. Both tourist events and their diverse offers are actively advertised with the help of a specific program booklet. During the examination period the “Active Autumn” (15.09. - 28.10. 2018 and the “Hiking Spring” (05.-14. April 2019) took place once each. The study area was represented in the program booklet each with a late summer evening hike on the heights near Gager as well as a spring evening hike in the sunset.

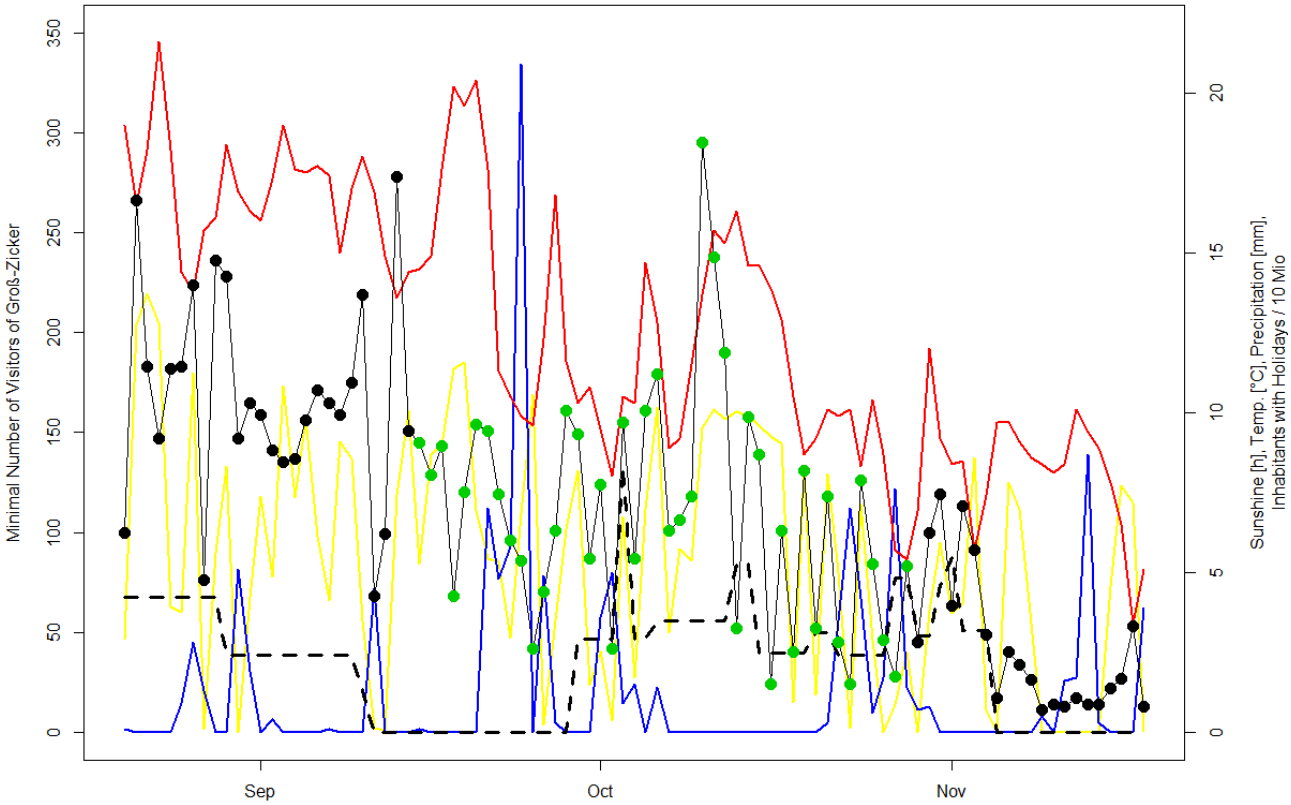


Figure 17: Daily number of visitors during the Active Autumn (green points) and before and after (black points); Comparison with influencing factors for the visit decision: Sunshine duration (yellow), temperature (red), precipitation (blue)

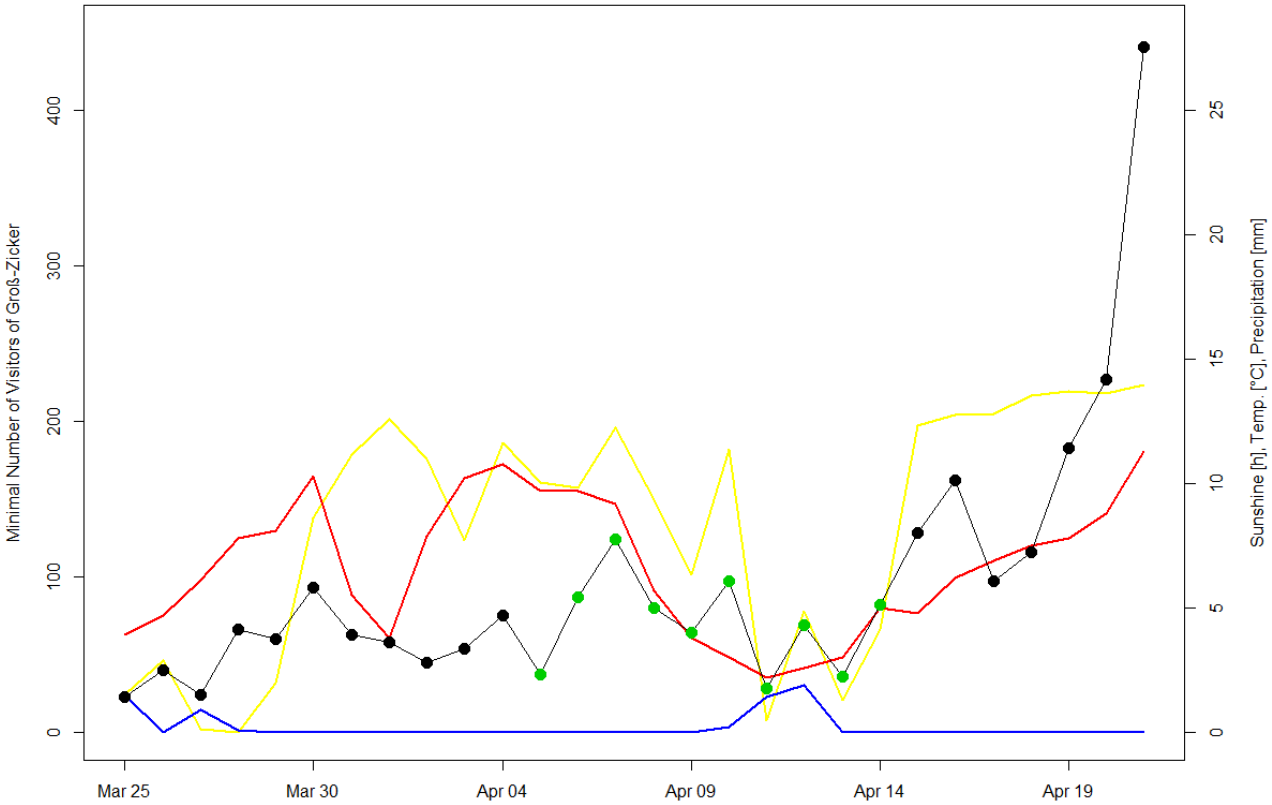


Figure 18: Daily number of visitors during the Hiking Spring (green dots) and before and after (black dots); Comparison with influencing factors for the visit decision: Sunshine duration (yellow), temperature (red), precipitation (blue)

Figure 17 und Figure 18 show that the number of visitors is not particularly influenced by the mentioned tourist events. The number of visitors is instead significantly influenced by the weather conditions (see next chapter).

4.4.1.5. Weather

To be able to show a relationship between the number of visitors and the influencing factors of the weather daily values of the station Putbus (DWD 19.09.2019) for the daily mean temperature (TMK in C °), the daily total of precipitation (RSK in mm) and the sunshine duration (SDK in h) were examined according to seasons. This was done using a Pearson correlation.

Frühling	Sommer	Herbst	Winter	Jahr

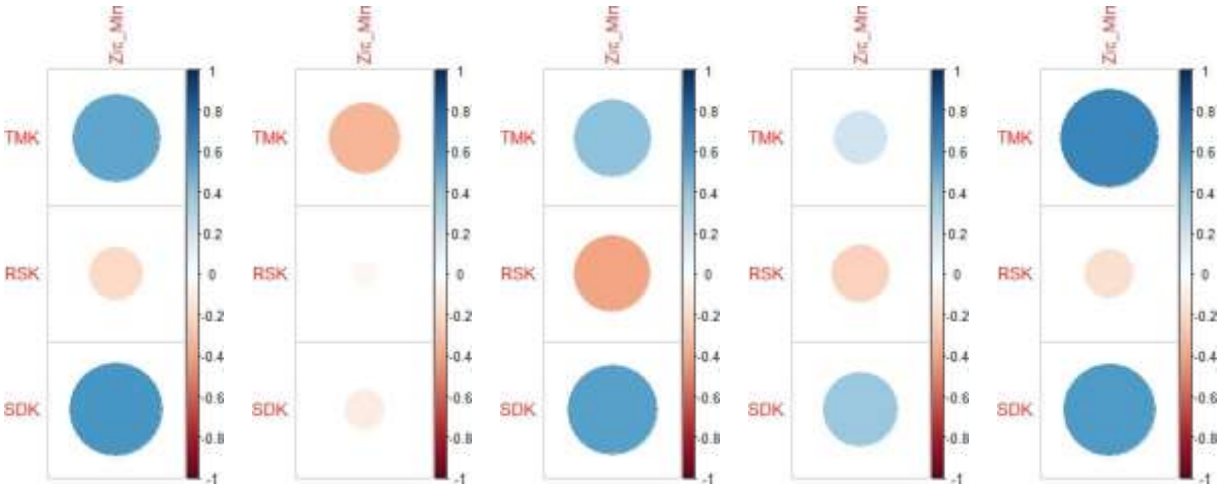


Figure 19: Strength of correlation (Pearson) of weather factors (TMK = temperature, RSK = precipitation, SDK = hours of sunshine) and number of visitors (Zic_Min) for each season and year.

Depending on the diagram, Figure 19 displays the relationships between the influencing factors of the weather and the number of visitors. The size of the circle symbolizes the strength of the correlation between the individual factor (temperature, precipitation and sunshine duration) and the number of visitors of one day. The color indicates whether the correlation is positive (blue) or negative (red). Thus, the blue circles in the Spring column mean that more guests visit the area as the temperature and sunshine increase. As expected, there is a positive correlation over the year as a whole between higher temperatures and longer hours of sunshine and the number of visitors. On the other hand, there is a negative correlation between the precipitation totals of the days and the number of visitors. It is noteworthy, however, that in the summer months this effect tends to reverse, especially with regard to temperature and sunshine duration. Here is to assume that on particularly warm and sunny days potential visitors might prefer the beach as day destination. This correlation is also made clear in Figure 20 und Figure 21.

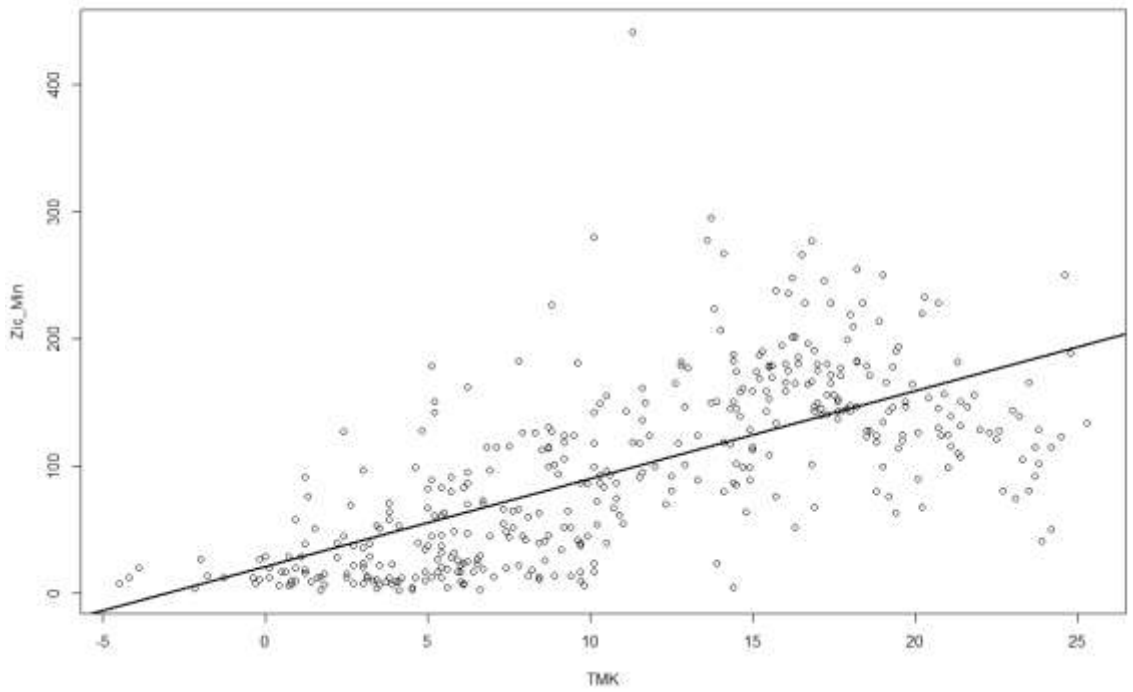


Figure 20: Relation between number of visitors (Zic_Min) and daily mean temperature (TMK). Period of observation 1 year.

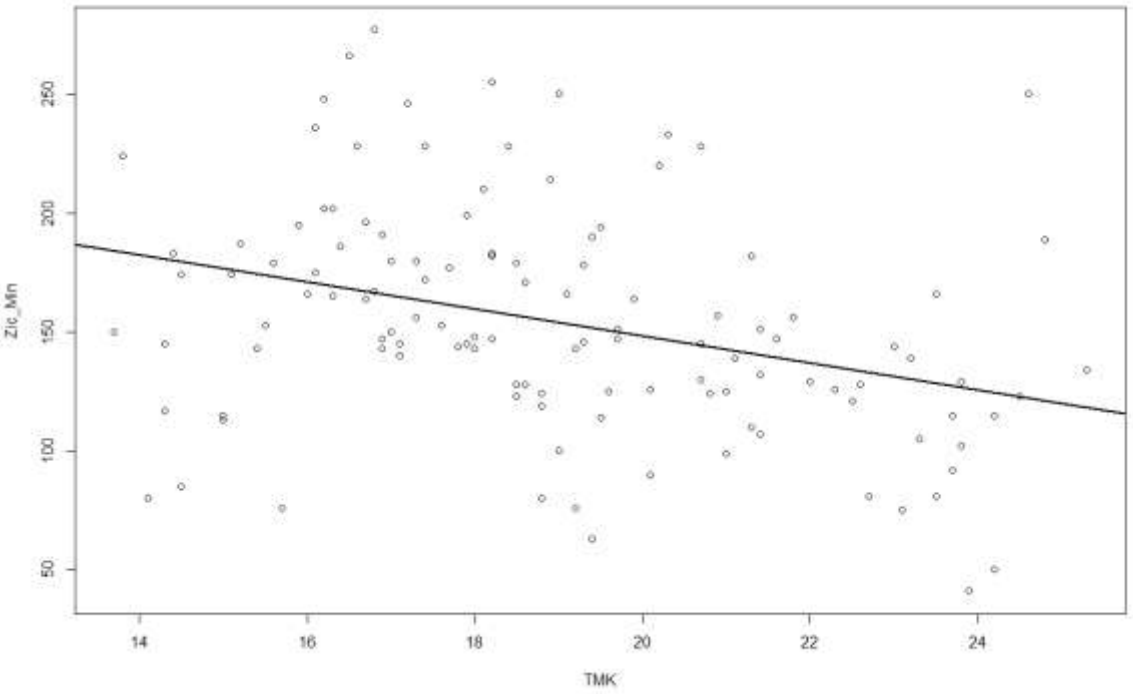


Figure 21: Relation between number of visitors (Zic_Min) and daily mean temperature (TMK). Period of observation June, July, August.

4.4.2. Use of hiking routes

The routes indicated in the questionnaires were divided into individual sections using a GIS. Each route section of the questionnaire was assigned the number of persons noted on the respective sheet. In this way, the relative proportion of the use of routes in different line width can be displayed. Figure 22 shows that especially the Groß Zicker entrance as well as the way to the Nonnenloch and the high route to the Bakenberg are particularly frequented.

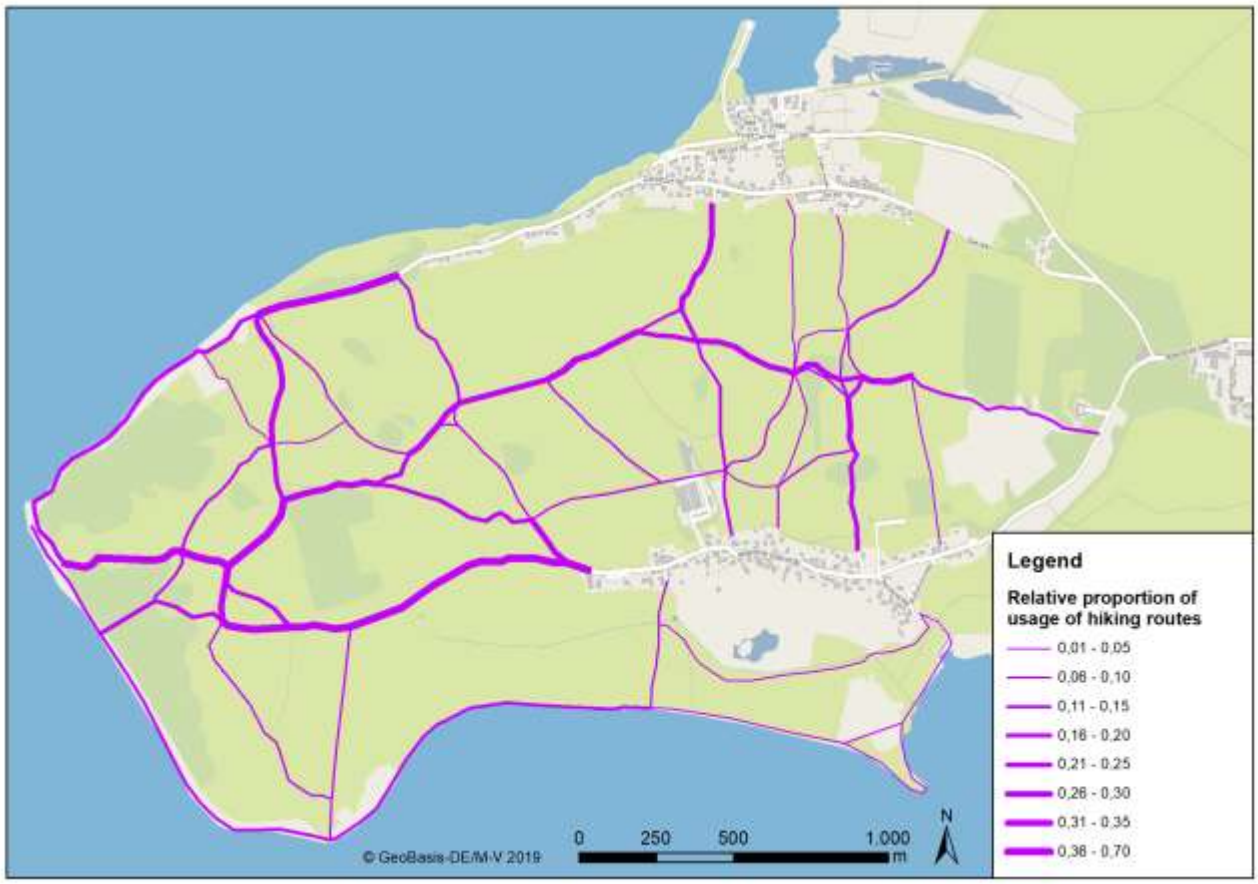


Figure 22: Relative proportion of the hiking routes in the study area

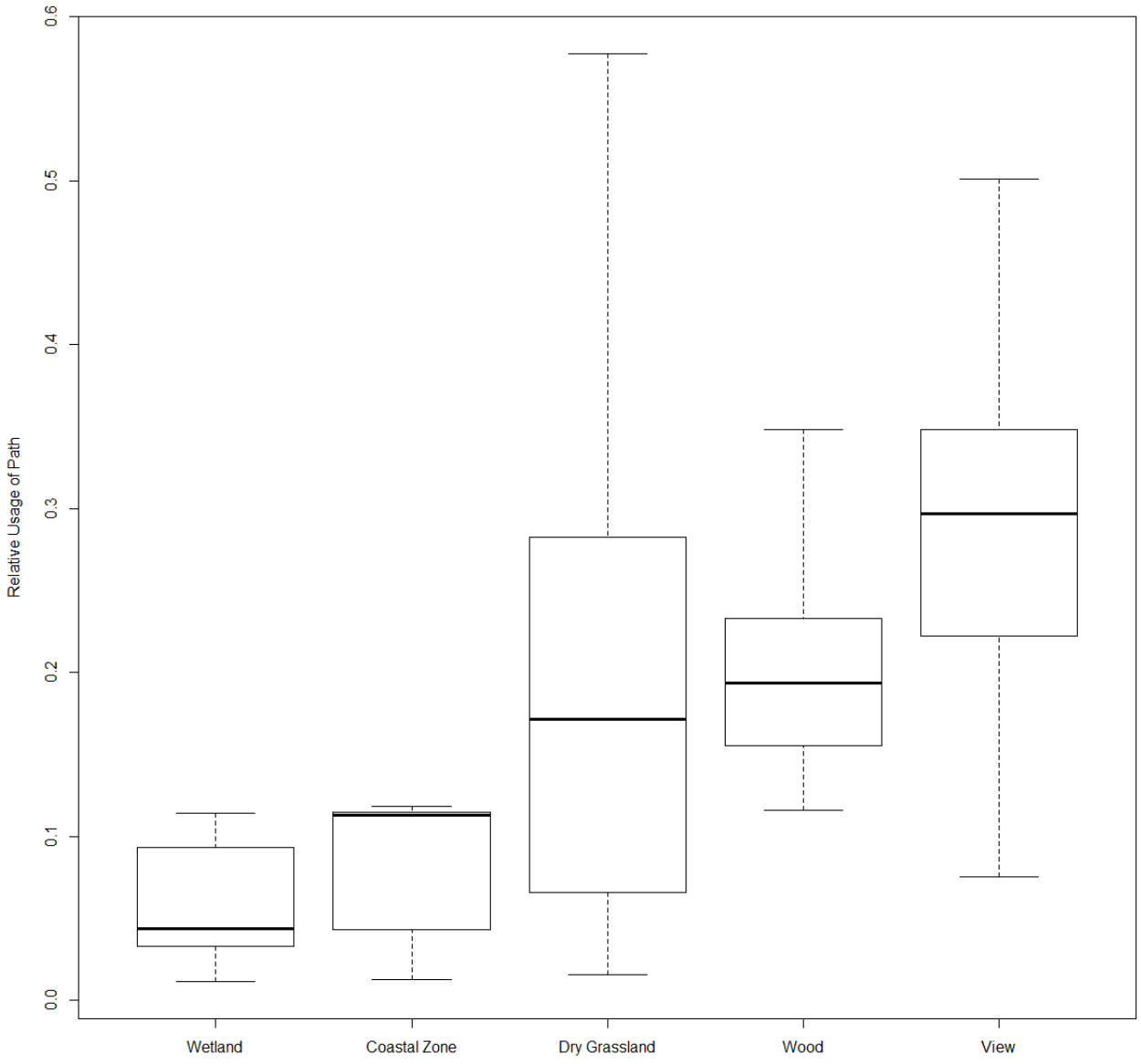


Figure 23: Relative share of the use of routes depending on landscape features

Each route section has been assigned one or more properties related to the natural features. The division was made in:

- Wetlands
- Küstenzone/Boddengewässer
- Coastal Zone / Bodden
- Forst
- View into the differentiated coastal landscape

Figure 24 shows the hiked kilometers of the surveyed visitors in percent according to the natural features along their routes.

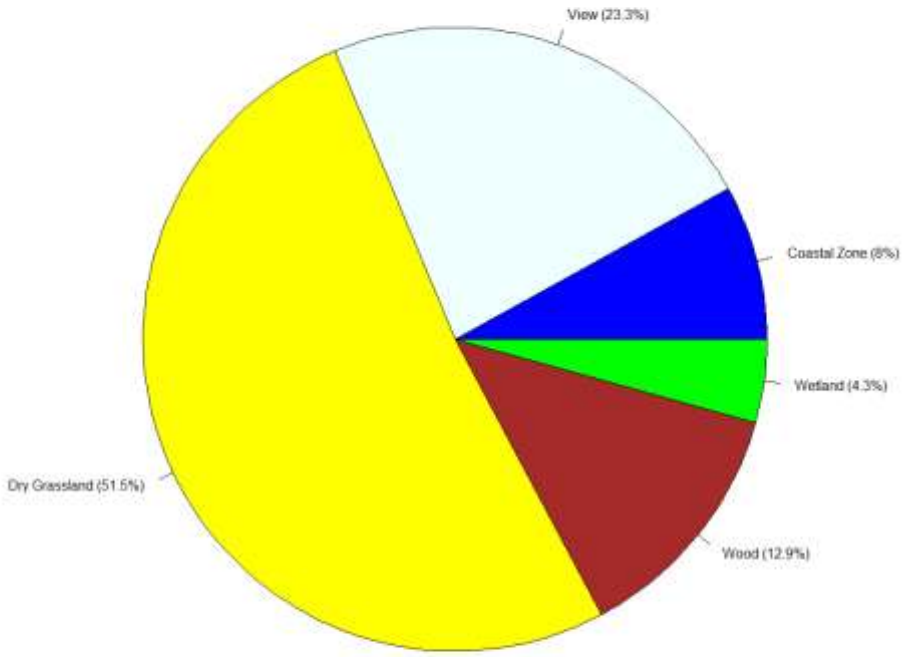


Figure 24: Hiked kilometers of the surveyed visitors in percent according to natural features.

4.4.3. Offences

In the context of manual counts, irregular behavior of the area visitors was also recorded. For this purpose, the visitors were divided into six categories:

- Hikers
- Hikers with a dog (leashed)
- Hikers with a dog (not leashed)
- Runners

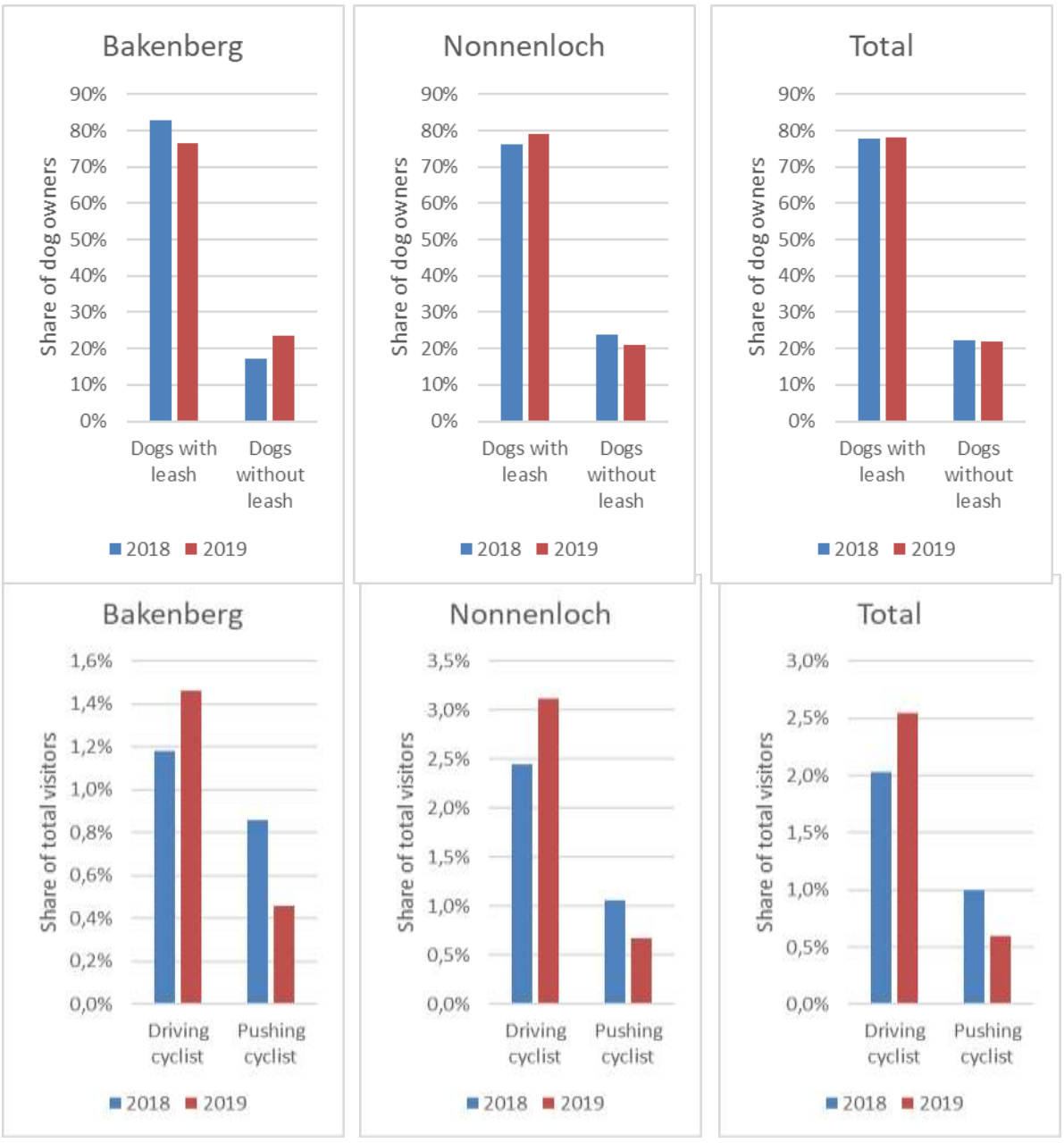
- Cyclists (pushing bike)
- Cyclists (driving bike)

Dogs that are not leashed as well as cyclists driving their bikes are considered as offences.

The counting results were evaluated separately for the years 2018 and 2019 in order to examine the effect of visitor guidance measures on the disorderly behavior.

Figure 26: Distribution of leashed and free-running dogs 2018 and 2019

Figure 25: Distribution of cyclists pushing and driving their bikes 2018 and 2019



To determine whether the observed changes between 2018 and 2019 are actual changes in behavior rather than random observations, a binomial test was performed. This makes possible to check the probability with which the respective distributions of the observed values from the years 2018 and 2019 differ from each other. The resulting p-value is shown in Figure . Values below 0.05 represent a significant change.

Looking at the p-value for the observation of the bicycle traffic it can be said with more than 95% probability, that an actual, albeit small increase of the driving bicycle traffic has taken place. A change in the frequency of unleashed dogs, however, is not significantly detectable.

	Dogs without leash	Driving cyclists

Bakenberg	0,060	0,397
Nonnenloch	0,286	0,055
Total area	0,904	0,044

Figure 26: p-values of observed events at the site Bakenberg, Nonnenloch and total

4.4.4. Audio Guide Usage

Starting on 10.07.2019 also the awareness and usage of the audio guide among the visitors of the area was queried with the help of the questionnaires. For that purpose, two questions 7a and 7b were included:

- 7a) Did you hear about the audio guide via the izi.Travel app in the Zicker Mountains (yes / no)
- 7b) Did you use the audio guide from the izi.Travel app for your today's hike through the Zicker Mountains. (yes / no / no, I could imagine on my next visit / no, generally no interest)

Figure shows that the awareness of the audio guide is relatively low. However, the separate consideration of the second half of the publication period shows a clear increase in awareness in recent months.

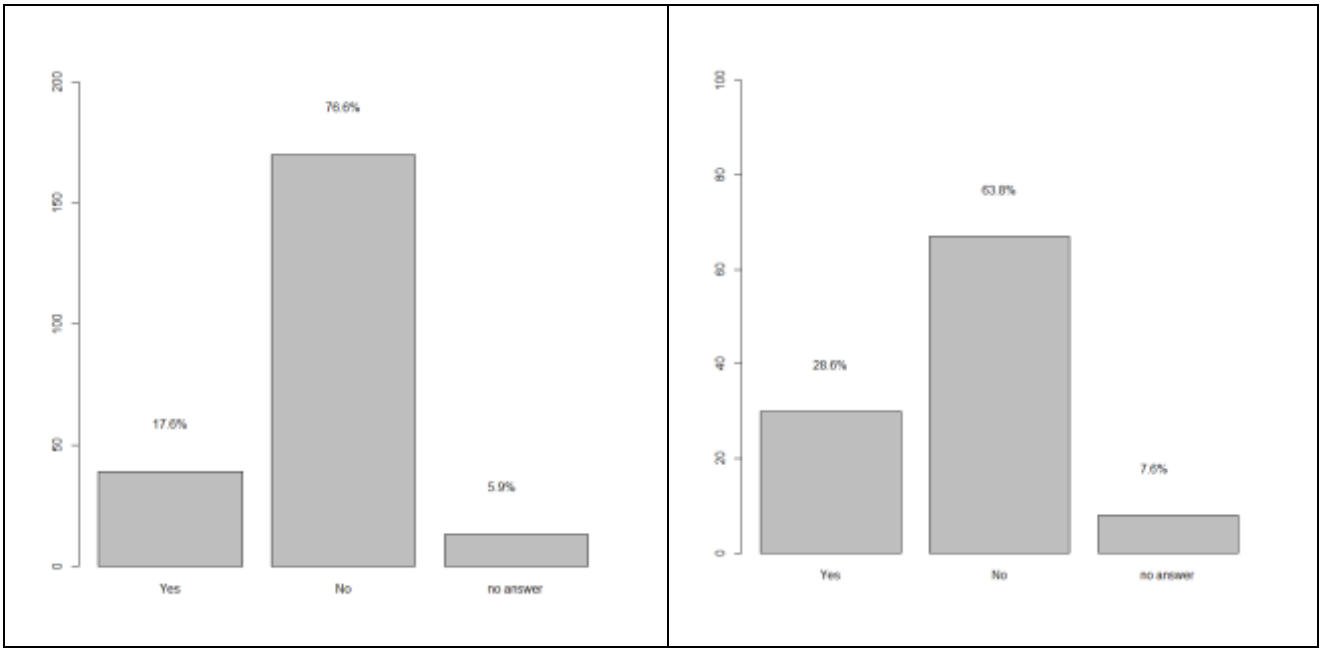


Figure 7: Answers to question 7a (left from 10.7.2019, right from 18.08.2019)

The given answers concerning the usage in Figure show that so far only a few visitors use the audio guide. However, if one adds those respondents who can imagine using it in a later visit, the offer is attractive for about a quarter of the visitors. A differentiation of the acceptance depending on the age can not be determined (see Figure 27).

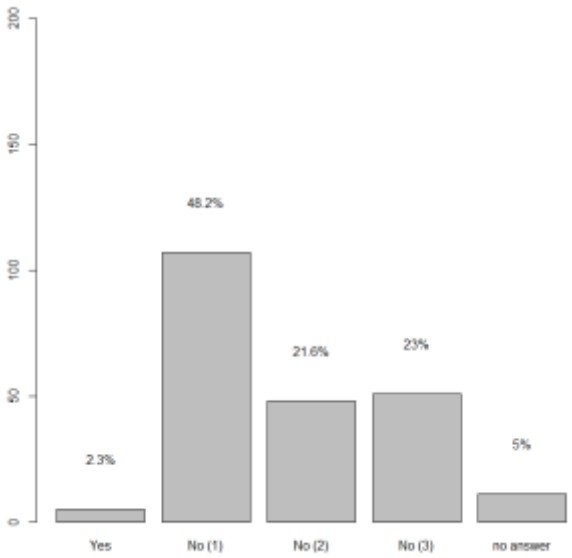


Figure 28: Answers to question 7b[1]

[1] No(1) = No, No(2) = No, I could imagine on my next visit, No(3) = No, generally no interest

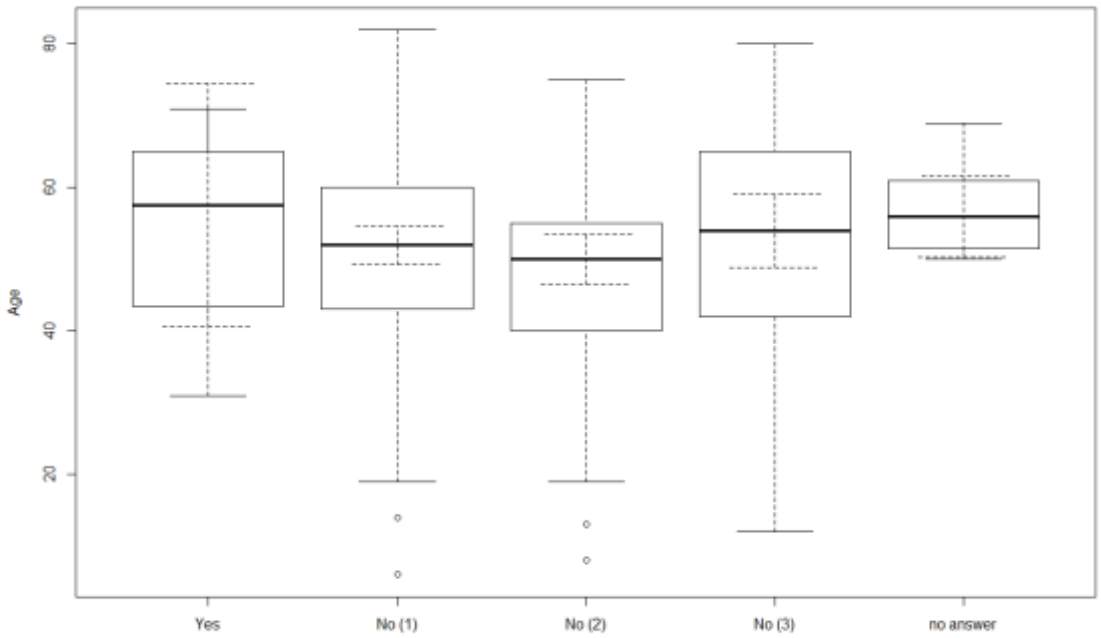


Figure 27: Attitudes towards the usage of the audioguide depending on the age of the respondent

In conclusion, it should be noted that the existing database is still too small to make reliable statements on the use of the app and its function as a visitor guidance measure. Nevertheless, one can already say that a more extensive application of the content-rich offer as well as a more prominent placement of the references to the offer at the entrance situations to the nature reserve would be advantageous.

5. Use of monitoring data analysis

5.1. Use of the data in the Pilot Action(s)

→ Mentioned monitoring tools have been developed together with the University in Greifswald. The initial evaluation has been performed in the form of a master thesis, by a Univesity student, and data were collected continuously up to the 07.10.19. The first results of the master thesis show that touristic pressure in this area seems to be acceptable. The pressure point has not been reached as long as visitors behave correctly according to the access rules to the protected area. But Further data is needed.

Those first results were discussed at a participatory workshop, where further pilot action activities were decided (for example, the implementation of an audio guide, setting up garbage cans, improving signage, etc.). Existing monitoring tools were improved, especially the manual surveys, by adding further questions concerning new actions and continuous data collection to find out if there is a change of behaviour of the visitors during the year.

5.2. Use of the data in the Action Plan Implementation

The collected data provide a large amount of information about the visitors' target group and their preferences. In the future, further steering measures as well as information offers can be better adapted to the visitors. Regarding offences by visitors there is little need for action. Only compliance with the bicycle driving ban should be better monitored. A further survey in the following years could clarify whether there is actually an increase in bicycle traffic.

The usage data of the audio guide should be further evaluated in the coming season. For this the statistics of the app are available. If the offer is better known, the audio guide should be a good supplement to the information offered about the area. Should the offer be used more extensively in the future, adding additional information could further enhance the attractiveness of the audio guide. In particular, the visitor preferences from the questionnaires can be used to supplement the offer.

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