Research

The benefits of counting butterflies: recommendations for a successful citizen science project

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ABSTRACT. Citizen science (CS) projects, being popular across many fields of science, have recently also become a popular tool to collect biodiversity data. Although the benefits of such projects for science and policy making are well understood, relatively little is known about the benefits participants get from these projects as well as their personal backgrounds and motivations. Furthermore, very little is known about their expectations. We here examine these aspects, with the citizen science project "German Butterfly Monitoring" as an example. A questionnaire was sent to all participants of the project and the responses to the questionnaire indicated the following:

• Most transect walkers do not have a professional background in this field, though they do have a high educational level, and are close to retirement, with a high number of females;
• An important motivation to join the project is to preserve the natural environment and to contribute to scientific knowledge;
• Participants benefit by enhancing their knowledge about butterflies and especially their ability to identify different species (taxonomic knowledge);
• Participants do not have specific expectations regarding the project beyond proper management and coordination, but have an intrinsic sense of working for a greater good. The willingness to join a project is higher if the project contributes to the solution of a problem discussed in the media (here, insect decline).

Based on our findings from the analysis of the questionnaire we can derive a set of recommendations for establishing a successful CS project. These include the importance of good communication, e.g., by explaining what the (scientific) purpose of the project is and what problems are to be solved with the help of the data collected in the project. The motivation to join a CS project is mostly intrinsic and CS is a good tool to engage people during difficult times such as the COVID-19 pandemic, giving participants the feeling of doing something useful.

Key Words: *COVID-19 pandemic; gender gap; insect decline; intrinsic motivation; monitoring*

INTRODUCTION

As early as the 17th century, a fascinating woman became famous for her love for nature and her detailed drawings. Maria Sibylla Merian was one of the first female entomologists adding substantial knowledge to science with her paintings of plants, butterflies, caterpillars, and chrysalises (Kutschera 2017). Like many other entomologists during that time and in the following centuries, she was an amateur expert, i.e., a researcher that was neither trained nor paid as a scientist (Vetter 2011). It was only in the late 19th century that science was professionalized. Before that, almost all scientific research was conducted by amateurs (Miller-Rushing et al. 2012). Recently, this branch of science has become popular under the name citizen science (CS), and numerous projects have been established across many disciplines (Conrad and Hilchey 2011, Kullenberg and Kasperowski 2016, Hecker et al. 2018). Historically, CS covers a wide range of areas, such as astronomy, public health, environmental monitoring and assessment, biology, and biodiversity monitoring (Hecker et al. 2018). Well-known examples currently are projects such as Galaxy Zoo, an online astronomy project that invites people to help classify galaxies (https://www.zooniverse.org/projects/zookeeper/galaxy-zoo/), or Foldit, an experimental computer game that helps scientists optimizing (i.e., folding) proteins (http://fold.it/). A large number of CS projects to date are also dealing with biodiversity monitoring in different ways.

Because the loss of biodiversity has become a major societal issue (Thomas et al. 2004, Barnosky et al. 2011), the need for biodiversity data with high spatial and temporal resolution has also increased, in order to analyze the consequences of global change; to monitor conservation success; and to inform policy. However, obtaining these data is limited by the availability of professional staff and financial resources. Therefore, many biodiversity monitoring programs have been established based on volunteer participation. Best known in Germany are the Monitoring of Common Birds (*Monitoring häufiger Brutvögel*, https://www.dda-web.de/#), Butterfly Monitoring Germany (*Tagfalter-Monitoring Deutschland*, https://www.ufz.de/tagfalter-monitoring/, hereafter called TMD), or the Midge Atlas (*Mückenatlas*, https://mueckenatlas.com/), along with many

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other more local or regional initiatives (see https://www.buergerschaffenwissen.de/).

The benefits of such projects for science are obvious: numerous important findings and also scientific publications would have been impossible without the work and support of volunteers. A prominent example is the ongoing discussion about the decline of insects. Important publications on this topic are based on data collected by citizen scientists (Thomas et al. 2004, Filz et al. 2013, Habel et al. 2016a, 2016b, Hallmann et al. 2017, Rada et al. 2018, Van Swaay et al. 2019). In contrast, little is known about the background (Füchslin et al. 2019) and motivation (Domroese and Johnson 2017, Ganzevoort and van den Born 2020) of volunteers. Also, little is known about incentives and benefits for participants (Dickinson et al. 2010, Wehn and Almomani 2019, Kühl et al. 2020) and whether projects meet their expectations (Golumbic et al. 2020). However, such knowledge is crucial to keep CS projects alive in the long run. Only if we understand why people participate in CS projects, will we be able to design projects that benefit both scientists and citizens, thus guaranteeing their long-term existence.

Therefore, it is desirable to analyze successful CS projects in order to unravel the reasons for their success. Citizen Science as such has different approaches and projects can be roughly divided into contributory projects, collaborative projects, and co-created projects (Tweddle et al. 2012). Contributory projects are designed by scientists, collaborative projects are designed by scientists with involvement of participants, and co-created projects are designed jointly by scientists and participants (Tweddle et al. 2012). Biodiversity projects that generate long-term research data are mainly contributory projects with sometimes collaborative aspects, for example, when participants do not only collect data, but also quality check and analyze them. Here we focus on the project TMD (*Tagfalter-Monitoring Deutschland*), which is successful because people often participate over long periods of time (32% of participants take part in the project for 10 or more years), during long stretches of their own personal leisure time and they collect highly reliable and hence scientifically valuable data (Kühn et al. 2008, Rada et al. 2018, Pellissier et al. 2020). Even beginners can participate in the project, because the butterfly species found on a transect (a defined route along which the counts are carried out) can be learned within one season. In order to examine the factors that make this project particularly successful, we conducted a survey among the participants in which we addressed the following aspects:

- Who participates in the project? (Background)

- Why do people participate in the project? What is their motivation to participate over a long time? (Motivation)

- What are the personal advantages for people to participate in the project? (Benefits)

- What do people expect from the project and the project coordination? (Expectations)

In addition, we realized during the COVID-19 pandemic year 2020 that more people were interested in counting butterflies than in previous years. We quantified this as an indicator of the motivation of volunteers, because obviously their motivation to participate was higher when they had more free time.

METHODS

Background
TMD is a CS project that started in 2005 (Kühn et al. 2008). Volunteers count butterflies along defined lines (i.e., transects), if possible once a week from April through September and over many years. Each transect consists of 1–20 sections, each 50 meters in length. Along a transect, all butterflies are counted by individual species in an imaginary box, i.e., 2.5 m to each side and 5 m in front and above (Kühn et al. 2014). There is a temporal target for the count, i.e., you should take 5 minutes to walk a section of 50 meters.

Since 2005, a total of 1301 transects have been established all over Germany, consisting of 9850 sections. Over the duration of the project, many new transects were set up every year, but many others were also abandoned. In 2019, butterflies were counted along 544 transects (representing 4246 sections). A total of 243 of these transects have been delivering data for 10 or more years, with 67 transects walked constantly since 2005/2006. The results are published in annual reports (e.g. Kühn et al. 2018, 2019).

Two groups can be distinguished among the participants of the TMD. The largest group is the transect walkers, who count butterflies along defined transects. These are in some cases absolute beginners, but most of them have good knowledge in identifying butterflies. The other group are regional coordinators who support project participants in their region by helping them to identify butterflies and by checking the data. These are butterfly experts and taxonomists, who often also walk a transect.

Participants of the CS project TMD are not paid for their contribution, but count butterflies and enter their data online in their leisure time. At the start and the end of the butterfly season (beginning of April and end of September), information is sent to all participants via e-mail and via mail for those who do not have e-mail (only 4%). At the end of each year, an extensive annual report of the previous year is sent to all participants, published as an issue of the journal *Oedippus* (ISSN: 1436-5804 [print] ISSN: 1314-2682 [online]). In the first part, this report comprises the general results of the project, such as an overview on the butterflies counted, their total numbers (abundance), and numbers per species, together with trends for selected species since 2005. It further provides an overview on relevant publications. In the second part of the report, participants can introduce their transects or related projects, and books covering related topics are presented. In some years, a special incentive is sent out together with the annual report, for example, butterfly calendars, cotton bags with a butterfly print, a poster with all butterflies of Germany, and identification charts for difficult butterfly groups such as Hairstreaks (Theclini and Eumaeini) or Fritillaries (Melitaeini). All in all, the personal benefit in the form of material items is very low compared to the time and effort participants invest in the project.

Survey
In the context of this project, a survey was developed consisting of 42 questions (full questionnaire in Appendices 2 [English] and 3 [German]). The survey was created with the website SoSci Survey (Leiner 2019) (https://www.soscisurvey.de/) and consists of 12 multiple choice questions, 8 closed-ended (i.e., yes or no) questions, 14 Likert-scale or rating-scale questions, 4 open-ended

Table 1. Questions analyzed for the manuscript and topics they refer to (background, motivation, benefits, or expectations).

Question No.	Reference to...	Question
Q2	Background	In which years did you participate in butterfly monitoring?
Q3	Background	Can you estimate how much time (hours) per year you spend on butterfly monitoring in total?
Q4	Background	Have you already observed butterflies before participating in butterfly monitoring? (no/yes)
Q5	Motivation	What is your motivation to participate in butterfly monitoring? (6 choices)
Q8	Background	Are you or have you been professionally involved with butterfly monitoring? (5 choices)
Q11	Benefits	Please estimate: How many butterfly species did you know before you participated in the butterfly monitoring? (9 choices in steps of fives: 1–5, 6–10, etc.)
Q12	Benefits	Please estimate: How many butterfly species do you know today? (9 choices in steps of fives: 1–5, 6–10, etc.)
Q13	Motivation	Do you intend to (continue to) participate in butterfly monitoring? (5 choices)
Q14	Motivation	Reasons, if you do not intend to participate (free text)
Q22	Motivation	Do you exchange with other transect walkers? (yes/no)
Q36	Expectations	What do you wish from the coordination of butterfly monitoring? (7 choices, 1 free text, multiple answers possible)
Q37	Expectations	In which way would you like to receive more information / exchange on the project? (6 choices, 1 free text, multiple answers possible)
Q39	Background	Please enter your year of birth
Q41	Background	What is your highest professional qualification (7 choices)?
Q42	Background	Gender

questions, and 4 questions related to demographic issues. Here we analyze the answers to 15 of these questions; these are the answers particularly relevant for the content of this paper as they deal with the background of the participants, their motivation, their (educational) benefits, their expectations, and the feedback on the project (see Table 1 for full questions).

The survey was conducted among former and current transect walkers and people associated in other ways with the TMD project (including, for example, regional coordinators, who supervise transect walkers but do not walk a transect themselves). A total of 1314 surveys were sent out to all participants on 19 July 2019, and the recipients were asked to answer the survey by 15 September 2019.

Questionnaires were already sent to project participants in 2005 and 2014. These questionnaires were much shorter than the one analyzed here and focused on demographic data. For the comparison of age classes of participants, we used data from all three questionnaires.

Analyses of the annual number of registrations were limited to those since 2009. The reason is that in the early years of a project many more people than usual register (because there is a higher proportion of those interested but not involved yet). This levels off after the initial pool of volunteers is more or less involved. Therefore, after the initiation of TMD it took a few years (2006–2008) until this level was reached. To test whether there was a difference between number of registrations 2009–2017 (publication of Hallmann et al. 2017) and 2018–2020, annual numbers of new participants in two periods were tested using a two-sample randomization test for location *EnvStats:: twoSamplePermutationTestLocation( )* (Millard and Neerchal 2001), with "median" as location parameter. This is a non-parametric version of the two sample *t*-Test (Manly 1991). Differences among age class distributions were tested using Kruskal-Wallis *H* test and Mann-Whitney *U* test for post-hoc comparisons. To test for the increase in the knowledge of species numbers, we used Fisher's paired comparison design test (Manly 1991), a non-parametric version of the paired *t*-Test. We also tested whether the mean number of registrations in the years

2009–2019 were lower than that of 2020 (COVID-19 restrictions in Germany). Here we used a non-parametric analogue to the one sample t-test, namely Fisher's paired comparison design test, but instead of calculating the difference between pairs, one calculates the difference between the observed number and the expected number (here number of registrations in 2020), using a one-sided hypothesis.

Cross-question associations were analyzed as follows: relationships between duration of participation (Q2), age (Q39), and motivation (Qs 5.1–5.6.) using Kendall's correlation. For reasons of scientific transparency and to learn about the correlation structure, we calculated all correlations (Table A1). Most of them though are trivial, e.g., the longer the participation, the older the participant. We therefore do not present them in the results. Responses to questions 5.1–5.6 are on Likert scale. We therefore used the function *ordinal*::*clm( )* (Christensen 2019), including the questions mentioned above as predictor in the model, i.e., exchange with other transect walkers (Q22) and gender (Q42). Similarly, to relate expectations (Qs 36.1–36.7.) to duration of participation (Q2), age (Q39), and gender (Q42), we used binomial models, i.e., generalized linear models with family=" binomial." To be able to include the results of Q2 ("In which years did you participate in butterfly monitoring? In the years ...") in the correlation, we counted the number of given years. Because question 5 consists of 6 sub-questions and question 36 consists of 7 sub-questions analyzed, this resulted in multiple testing. To avoid corresponding type I errors, we corrected for multiple testing, using the approach of Holm (1979), and see also Rice (1989). All analyses were conducted using the statistics software R Version 4.0.3. (R Core Team 2020).

For some results and discussion points, the source cited is "personal communication with participants." This refers to information provided in the course of personal contacts between project coordination and participants. Part of the project coordination of the TMD is a high amount of email exchange and telephone calls in the context of the support of transect walkers.
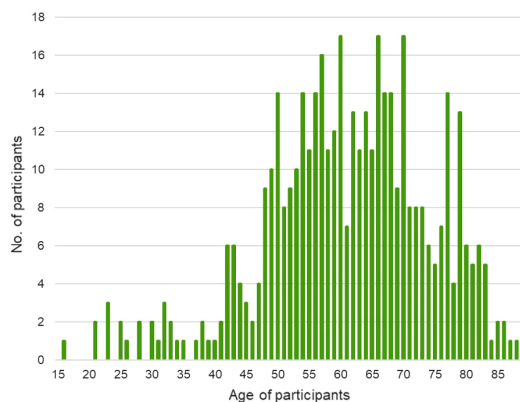
RESULTS

In total, 496 completed surveys were returned (response rate 38%). Four hundred and forty-eight surveys were filled in via the SoSci Survey website, and 48 surveys were sent back via regular mail. The participants returning surveys can be split into four groups: active transect walkers (326), former transect walkers (163), regional coordinators who advise transect walkers (29), and people who do not participate in the project actively, but are interested in it and support it (68).

Who takes part in the project? (Background)
Age and gender

The median age of the respondents was 62 years (the oldest was 88, the youngest 16, i.e., ranging across 72 years; Fig. 1). Although the majority of completed surveys came from male individuals, the gender imbalance was not very pronounced (41.9% females, 57.7% males, 0.5% diverse). The median age of female participants (64) was significantly higher (U test, p = 0.001) than that of male participants (59; Fig. A1.2).

Fig. 1. Age of participants answering a survey for the citizen science project *Tagfalter-Monitoring Deutschland*.


A comparison with the results of two shorter questionnaires sent out to TMD participants in 2005 and 2014 showed that there are significant differences in age class distribution (p < 0.001); in particular between 2005 (median 50–59 years) and 2014 (median 60–69 years; p < 0.0001), as well as between 2005 and 2019 (median 60–69 years; p < 0.0001; Fig. 2). There is no significant difference in age classes between 2014 und 2019 (p = 0.94).

Fig. 2. Age class distribution of participants in citizen science project *Tagfalter-Monitoring Deutschland* (Kruskal-Wallis test, X^2 = 54.97, df = 2, p < 0.0001).
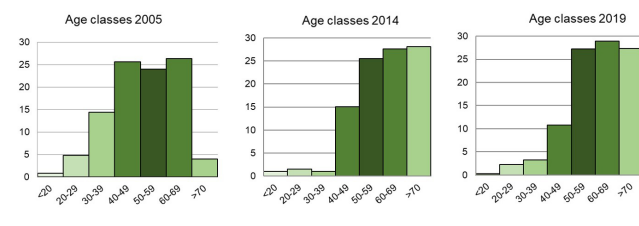
The willingness to join the project over a long period of time and to spend time on butterfly monitoring was high. Many participants had joined the project several years ago, and the median number of years a participant had contributed to the project since its establishment was 7 years (Fig. 3). The median number of hours per year spent for the project (field work and data entry) was 39 hours.

Fig. 3. Time of participation (years) per participant answering a survey for the citizen science project *Tagfalter-Monitoring Deutschland*.
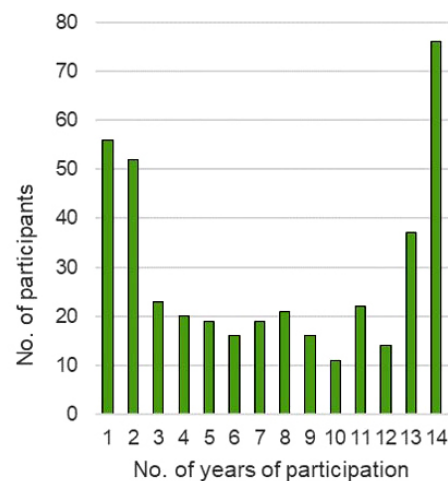
Educational and professional background

Most of the participants were interested in butterflies before joining TMD (60%), but the majority of participants (77%) was not professionally working in entomology or related fields. The professional qualification of participants was relatively high: 47.9% held a university degree (Fig. 4).

Fig. 4. Professional education of participants answering a survey for the citizen science project *Tagfalter-Monitoring Deutschland*.
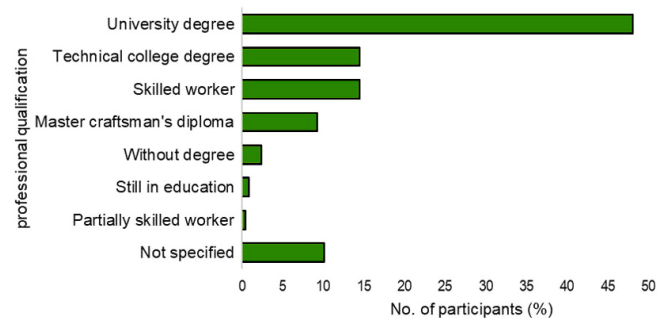

Why do people participate in the project? (Motivation)
Regarding respondents' motivation to participate in TMD, an overwhelming majority stated a general interest in preserving the natural environment. Participants' desire to halt the loss of

butterflies and biodiversity in general was also pronounced. Also, the wish to collect scientific data on butterflies was very high (Fig. 5).

Fig. 5. Motivation to participate in butterfly monitoring among participants of the citizen science project *Tagfalter-Monitoring Deutschland*.
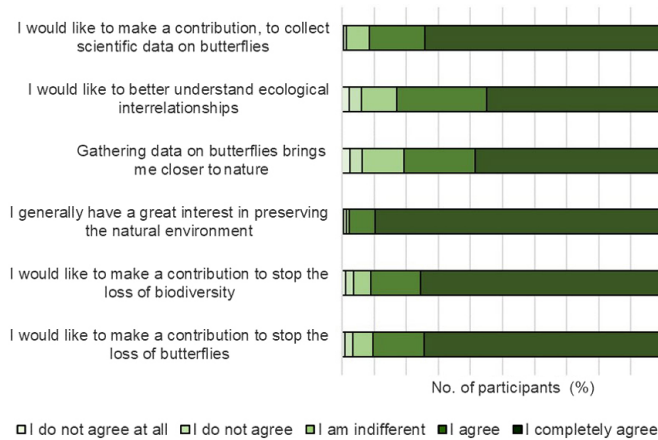
For participants having exchanges with other participants (Q22), it was more important to understand the ecological interrelationships (Fig. 6) and to contribute to scientific data (Fig. 7) than it was for participants without exchanges with other participants. No significant differences in motivation were obtained with relation to age or gender of the participants as well as the duration of participation. When asked whether they intended to (continue to) contribute to TMD, most people answered that they plan to continue their monitoring activities (Figure 8).

Fig. 6. Answers to Question 5.5: "I would like to better understand ecological interrelationships." The answers were split into two fractions corresponding to the answer on Q22 (i.e., Exchange with other walkers yes/no), p < 0.001 of a cumulative link model with Q22 and Q42 (n.s.) as joint predictors. For full results see Figure A1.1 and Table A1.1.
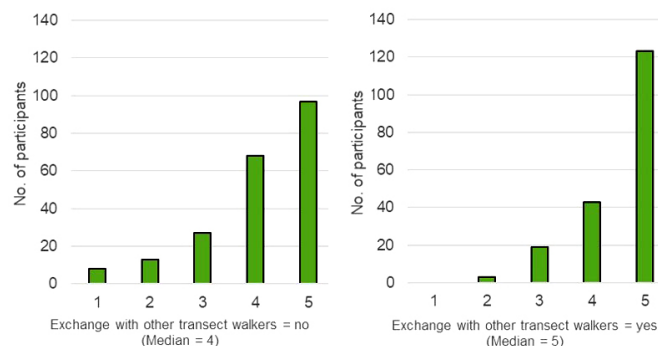
In a free text box, participants had the opportunity to write down the reasons for not participating (anymore). The reasons given (89

comments in total, some with more than one reason) were very diverse, but can be aggregated into five groups:

· Lack of time (39)

· Old age and/or health reasons (25)

· Transect changed/was destroyed, frustration due to low butterfly numbers (23)

· Relocation (7)

· Data entry too complicated (4)

Fig. 7. Answers to Question 5.6: "I would like to contribute to scientific data." The answers were split into two fractions corresponding to the answer on Q22 (i.e., Exchange with other walkers yes/no) p = 0.004 of a cumulative link model with Q22 and Q42 (n.s.) as joint predictors. For full results see Figure A1.1 and Table A1.1.
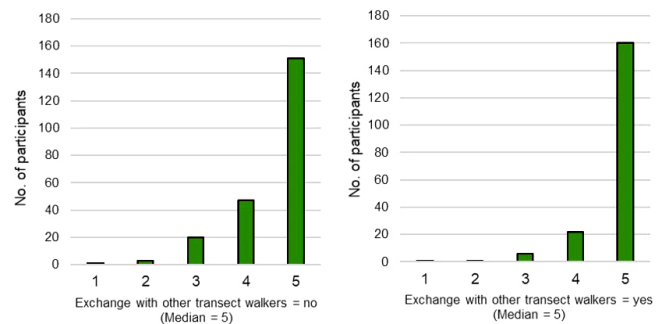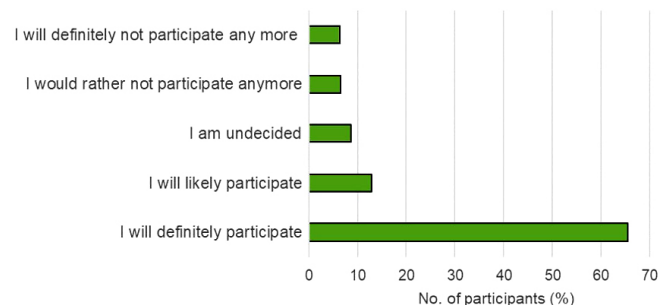

Fig. 8. Number of participants asked whether they intend to (continue to) contribute to citizen science project *Tagfalter-Monitoring Deutschland*.

All reasons given were personal and none of the comments gave negative feedback to the project coordination or the project in general.

Over the last three years (2018–2020), we had a particularly high number of new registrations (Fig. 9). The annual number of new participants 2018–2020 is on median (74) significantly larger than for 2009–2017 (48; excluding the early years of establishment; two sample randomization test, p = 0.02). With the exception of the years 2005 and 2006, there was no active promotion of the project (reason for excluding data from these years).

Fig. 9. New registrations for the citizen science project *Tagfalter-Monitoring Deutschland* per year since the start of the project.
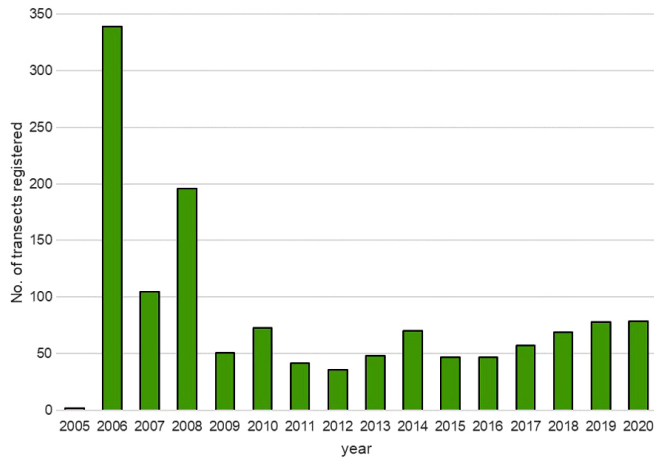
What are the personal advantages for people to take part in the project? (Benefits)

A major non-material benefit was the gain of knowledge the participants experienced during their participation. The general knowledge gain in identifying butterfly species was quantified by asking participants how many butterfly species they knew when they initially joined the project and how many butterfly species they presently can identify (numbers grouped in steps of five). Whereas most participants knew only 6–10 (mode; median = 11–15) different butterfly species when they joined the project, the majority by now knows more than 40 species (mode; median = 35–40), which is a highly significant ($p < 0.0001$, Fisher's paired comparison test) increase in taxonomic knowledge (Fig. 10).

Fig. 10. The participants of the citizen science project *Tagfalter-Monitoring Deutschland* were asked how many butterfly species they knew when they initially joined the project (light green) and how many butterfly species they know today (dark green).
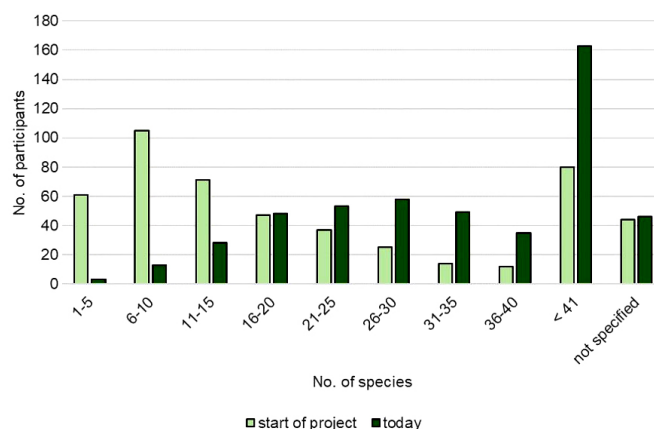
What do people expect from the project and the project coordination? (Expectations)

Being asked what participants wish from the project coordination, 35.3% mentioned more events such as regional meetings, seminars, workshops, or excursions. Approximately 20% answered that they would like more exchanges in general, more training courses, and more notifications by e-mail. More notifications via mail or social media or better reachability in general were of minor interest (Fig. 11a).

Fig. 11. Expectations toward the project coordination (a) and preferred way to receive project information (b) of participants answering a survey for the citizen science project *Tagfalter-Monitoring Deutschland*.
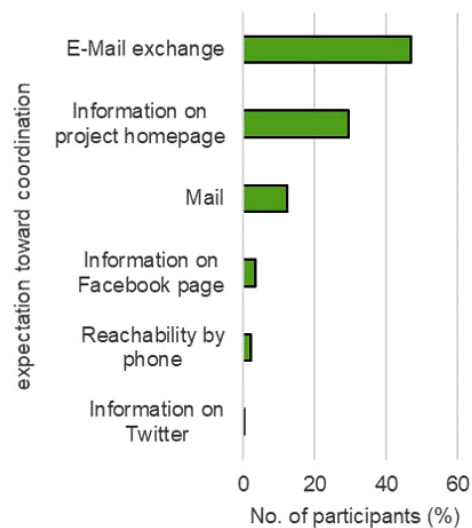
Almost 47% of the participants wanted to receive more information by email and 29.6% wanted more up-to-date information on the project homepage. Only 12.3% wished to receive information by mail; obtaining information on Facebook or reachability of project coordination by phone was of minor importance. Information on Twitter was only of interest for one person (Fig. 11). In a free text, participants could add more wishes and 38% indicated that they were satisfied with the coordination. Fourteen percent wished for more information in general and 7% wished for more regional meetings and excursions. For older participants, better reachability was less important (*U*-test, $p = 0.009$) and they preferred notifications by mail rather than email ($p = 0.04$) if compared to younger participants (Fig. A1.3). Training courses ($p = 0.006$) as well as events in general ($p = 0.001$) were more important for younger participants. All other relationships between expectations and gender, age, or duration of participation were statistically not significant.

COVID-19 participation vs. normal years

Usually, the butterfly counts for TMD started every year 1 April. In 2020, because of the COVID-19 pandemic, we were not sure whether the project could start as usual. Several restrictions were issued 22 March, including regulations for social distancing and the prohibition on leaving the house if not for a special reason (going to work, to the doctor, or for shopping were among most

essential reasons). Nevertheless, during the whole time of strong restrictions, people were allowed to go outside for sports as well as walking the dog or other "good reasons" as long as you were alone, with one other person, or with people in your household. After a short time of confusion, it became clear that going out to assist CS projects, such as counting butterflies, was considered a "good reason." During this time, we noticed an increase in new registrations (Fig. 9). The year 2020 was exceptional because there were more new registrations (95) than between 2009 and 2019 (mean = 55.5). Using Fisher's paired comparison design test with 5000 permutations, not a single observation was higher, hence the average number of new registrations between 2009 and 2019 was significantly lower than 2020 (p = 0.0002).

DISCUSSION
Long-term ecological research is extremely important because it is the only way to detect trends over a long period and to estimate the impact of different variables on ecosystems (Müller et al. 2010, Haase et al. 2018). Citizen Science projects provide an opportunity to collect standardized observation data with high spatial, temporal, and taxonomic resolution, hence providing robust data for the analysis of biodiversity changes. For some taxonomic groups such as birds or butterflies, CS has proved to be a good tool for collecting such data (Pellissier et al. 2020). The longer a CS project runs the more valuable the collected data becomes for science. Therefore, one of the priority objectives when planning a CS project is a long duration. This can be achieved by better exploring the reasons for long-term participation of volunteers. This includes very basic knowledge of who participates in such projects (background), what motivates them to participate, what benefits they get from participating, and what expectations they have of the project.

Who takes part in the project? (Background)
Summarizing the results, the typical participant of the TMD is close to retirement or already retired, male, does not work professionally in entomology, and holds a university degree. This result is quite in line with the results of other studies on similar projects (Walker 2018, Füchslin et al. 2019, Thelwall et al. 2019). Most participants are settled, do not move anymore, and do not have to take care of children (anymore). These circumstances give them enough free time to join a CS project such as the TMD, which requires a rather high time investment. To be able to spend enough time for a relatively time-consuming project seems to be an important factor for joining the project. Because most participants already observed butterflies before they joined the project, the project is a good addition to their hobby. The fact that female participants in average are older than male participants might be because the life expectancy of women is generally higher than that of men, i.e., women stay healthy for a longer time than men and can therefore participate for longer.

Contrary to other entomological fields (Walker 2018), the gender imbalance among volunteers interested in butterflies is not pronounced. Compared to entomological societies where most members are male, the number of women taking part in TMD is relatively high. Many women appreciate that they do not have to be a "member" of a society, but can just join the project without any commitments (personal communication with participants). For TMD, butterflies only have to be counted and not caught and

killed, which also seems to be an important aspect, especially for women, but also for younger participants (personal communication with participants). Furthermore, butterflies in general are very popular because they are beautiful and one can count them on a sunny day in a nice surrounding. In this context it should be noted that butterflies are also popular among fashion, decoration, and ornamental accessories.

There is the frequently expressed fear of over-ageing (Hopkins and Freckleton 2002, Orr et al. 2020), i.e., that taxonomic experts and volunteers get older and no younger people follow up. In TMD this is true compared to 2005, i.e., the full cohort of volunteers aged jointly. Between 2014 and 2019, the age distribution did not change. On the one hand, this might be the case because the resolution of our age data (10 years) is coarser than the temporal difference (5 years). On the other hand, this can also indicate that indeed the community did not "over-age." Of course, older people skipped their participation. But because anyone interested can join at any time and increase their level of expertise, there is an influx of people, especially once the children leave the house or they retire and have more time. This results in new people in their "best age" joining the project. Consequently, TMD age structure might be a "moving window" reflecting human population dynamics.

When starting a CS project like TMD, it is important to know the background of the people who might join the project. Knowing that the majority of participants are pensioners or close to being pensioners helps to specifically target this group, for example, with special workshops or training days. It is also important to keep in mind that participation by older persons has been shown to pose problems. For example, it has been shown that volunteer birdwatchers have poorer hearing with age and thus detect fewer birds by song (Kayser 2017). The same might apply to butterfly observations, when older people see less well or are slower in reaction, observing a fast flying butterfly. On the other hand, there might be a bias in our questionnaire, if we assume that older participants are likelier to take the time to respond to surveys. Unfortunately, on the basis of the questionnaire we have no possibility to test this assumption.

Knowing that the majority of participants at the moment are of relatively older age makes it necessary to discuss possibilities to get younger people interested in the project. This might be achieved by using new technologies like identification and/or recording apps for counting and determining butterflies in the field or by involving young people in different parts of the project such as data evaluation or (regional) project coordination.

Why do people take part in the project? (Motivation)
Why do we do the things we do? Psychologists propose two different ways of thinking about motivation, including looking at whether motivation arises from outside (extrinsic) or inside (intrinsic) an individual (Ryan and Deci 2000). Finkelstien (2009) has looked at the special intrinsic and extrinsic motivation of volunteers and found that intrinsic motivation is a motive that is satisfied by the volunteer activity itself whereas extrinsic motivation is mostly driven by "external" motives such as career aspirations.

In CS, the motivation of professional scientists and volunteers to start and join a project is often fundamentally different. Scientists

hope to get access to large-scale data sets, whereas citizen scientists join in search of opportunities to broaden their horizons and allow them to engage in an enjoyable activity (Golumbic et al. 2020). Their motives are mainly intrinsic. The review by Schuttler et al. (2018) showed that participating in CS projects can increase emotional and cognitive connections to nature.

Therefore, it is logical that the wish to preserve the natural environment and to contribute to stop the loss of butterflies and biodiversity in general are the main reasons why people take part in TMD. However, to contribute to science is an important factor, too, as also shown by West and Pateman (2016) and Ganzevoort et al. (2017). This also applies to other CS projects, such as the Water Quality Monitoring (Alender 2016) or the Great Pollinator Project (Domroese and Johnson 2017), both in the U.S. The fact that 47.9% of TMD participants hold a university degree indicates that the participants have a closer connection to science in general than the average population. In Germany, 17.6% of the population holds a university degree (Destatis 2020).

The structure of TMD with personal responsibility of the participants for their own transect promotes personal ties to that transect and to the butterfly species alongside. By going there many times per year and over a long period of time, people get to know their transect very well. After a short time, they know all butterfly species that occur and they start to compare the results from different weeks and different years (personal communication with participants). They want to know, how their butterflies are doing and are willing to continue the counts over many years. Consequently, a place-based project has many advantages for the participants, and they might connect their participation to a sense of stewardship (e.g., Haywood et al. 2016). The personal bonding to a transect seems to be an important characteristic for butterfly monitoring schemes. In the Netherlands where butterfly monitoring has been performed since 1990, many transects are also walked over many years, some even for 30 years (personal communication with Chris van Swaay and https://twitter.com/chrisvanswaay/status/1323723739058626564? s=20).

In the last three years (i.e., 2018–2020), the number of new registrations for the TMD has increased significantly. We assume that the most important impact in attracting new participants probably has been the publication on insect decline in German nature reserves by Hallmann et al. (2017), which provoked a great echo in the media. The so-called Krefeld study has achieved what no renowned publication at the national or international level or elaborate campaign in nature conservation had ever achieved before: making the threat to insects the subject of news reports and editorials, making their rescue the subject of debates in the German parliament, and even resulting in draft laws. We argue that the increased registration numbers for TMD result from the media coverage of this topic. Consequently, people are really concerned and want to know how they can get involved. They understand that long-term data is essential to assess the situation of biodiversity and they want to contribute to scientific analyses by collecting the data necessary for this. These wishes are even more pronounced if the transect walkers are in contact with other transect walkers. They probably exchange their views and discuss solutions of the problems.

What are the personal advantages for people to take part in the project? (Benefits)

People who join TMD do not have a direct benefit from counting butterflies. They do not get payed and they do not get any regular incentives. Nevertheless, an indirect benefit of joining TMD is a remarkable knowledge gain over time. The close contact to experts and the possibility to ask for help in identifying butterfly species are important factors to improve personal knowledge. Going out to count butterflies almost every week is very good training, too. People who join the project knew significantly more butterfly species after a few years of participation than when they started their commitment. In times where on the one hand the loss of taxonomists is deplored (Frobel and Schlumprecht 2016) and on the other hand a strong connection between knowing species and the connectedness to nature is shown (Cox and Gaston 2015), the knowledge gain in species must not be underestimated. In line with this, Bonney et al. (2015) showed that participating in CS projects enhances the participants' knowledge about science, increases their awareness for scientific research, and provides a deeper meaning to their hobby.

What do people expect from the project and the project coordination? (Expectations)

Good communication is essential for CS projects and is often valued higher than recognition or rewards (Alender 2016). Participants want to be informed about the impact their data have (Ganzevoort et al. 2017) and often strongly relate to their project (Tiago et al. 2017). Also, a trusting relationship with the project team is an important driver to participate.

In our questionnaire, many participants indicated that they would like to have more events such as regional meetings, seminars, workshops, or excursions. Also, the wish for more exchange in general, more training courses, and more information by e-mail was expressed. These wishes were more pronounced in younger participants. However, whenever we organized regional meetings or excursions only a few people took part and even some events had to be canceled because of the low number of registrations. Most participants also join other citizen science projects and are engaged in nature conservation. So, even if they are interested in further events, they do not have the time to participate in the end.

Although there is some turn-over of people in TMD, a relatively high number of people remain in the project for a long time. This also was shown in an analysis of the social network of TMD (Richter et al. 2018). However, we do not have information about the people leaving the project who do not inform us and we therefore do not know their reasons for doing so. Participants leaving the project because of older age, health issues, etc., tell us their reasons, but it might be that participants who quit because of dissatisfaction with the project and its coordination do not give any feedback instead of negative comments.

COVID-19 participation vs. normal years

In 2020, our everyday lives changed radically within a few weeks. Because of severe restrictions, many people had more leisure time; consequently, many of them decided to start activities they did not have time for before. In April 2020, the TMD project had the highest registration numbers ever, most probably for these reasons. People contacted us either via email or phone and asked

if they could join the project and also many former transect walkers, who had given up their transect walks for different reasons (mostly lack of time), rejoined the project and reactivated their former activities. Of course, having more free time was an important aspect for people to (re)join the project, quite independent from the corona virus pandemic. But this was not the only motivation and reasons to participate are more complex. Many participants stated that TMD is a fruitful activity that can be done while respecting physical distancing; it was also often said that TMD participation helped participants in passing this difficult time. This was summarized very accurately in the statement of one participant who said on the phone, "In these difficult times, counting butterflies is good for my soul."

The same effect was observed in Ireland and the UK, where the National Biodiversity Data Centre in Ireland registered a higher level of activities in several counties in spring 2020 compared to the previous year (https://www.biodiversityireland.ie/people-engaged-more-with-biodiversity-during-covid-19-lockdown/) and the National Moth Recording Scheme in the UK showed a rise in numbers of people submitting sightings of moth species in 2020 (https://www.bbc.com/news/science-environment-57742701). They summarized their findings in the headlines "People engaged more with biodiversity during Covid-19 lockdown" and "Backyard moth spotting rises during lockdown."

Of course, CS is also a good tool to directly participate in research on Corona-relevant topics. The German CS platform "Citizens create knowledge" (https://www.buergerschaffenwissen.de/) gives an overview on CS projects in Germany and just recently published a new webpage called "Together against the virus: research in times of Corona," where different Corona-related projects are presented.

Here it becomes clear that CS is also very well suited for researching current problems in society. If the projects address topics that are currently occupying people's minds, then the motivation for people to participate is very high. It is therefore worthwhile for scientists to address current issues with the help of CS.

Butterfly Monitoring in a European context
What makes the TMD so special and distinguishes it from other CS projects in Germany is the fact that it is embedded in a European network of butterfly monitoring projects, all applying (almost) the same methodology. Bringing projects of different countries together is a big challenge to generate knowledge on the distribution and trends of species across borders and to derive protective measures for conservation. This network is organized by Butterfly Conservation Europe, a partnership organization focused on halting and reversing the decline of butterflies, moths, and their habitats throughout Europe (https://www.vlinderstichting.nl/butterfly-conservation-europe). In the years 2019 to 2020, the EU-funded project ABLE aimed, among other things, at expanding butterfly monitoring in Europe (https://butterfly-monitoring.net/able). To the best of our knowledge, this is the first time within this entire network that the reasons why people participate in this project and what motivates them to take part over a long time have been analyzed in detail. Long-time participation is an important factor for the success of CS projects dealing with biodiversity data; consequently, the question how to achieve continuity has also been addressed before (Everett and Geoghegan 2016, Cunha et al. 2017, Richter et al. 2018).

In TMD, the long-term involvement of participants and the high quality of the data collected are outstanding. Therefore, the results of our analysis presented here can be used as a guideline to develop similar projects or to establish the same project structure (Kühn et al. 2008) in other European countries. The same type of project can easily be applied to other taxonomical groups and can help to significantly increase data sampling for biodiversity and to perpetuate such projects. However, the taxonomic group of butterflies has the advantage that it is particularly beautiful and therefore charismatic and there are not too many species that most people encounter.

Outlook
Although TMD is very successful in terms of long-term participation (as shown in this manuscript) and data quality (Rada et al. 2018, Pellissier et al. 2020), some aspects still could be improved. For example, the wish for more events and a better flow of information can be met by using modern technologies. The experiences made during the Corona pandemic might help to develop new forms of events, such as video conferences or online tutorials. In any case, the technological development has to be considered in the future, and we already started to develop new tools for data collection in the field such as an application for smartphones. In other countries similar tools are already used (for example, https://butterfly-monitoring.net/ebms-app). Another important cornerstone might be the development of an app for automatic butterfly species identification. Participants of the TMD can use this app to check their identification of species and the results might help to check the quality and to improve the data.

Because nature conservation is very important for the participants of the TMD, another future goal is to strengthen the connection between the scientific output of TMD and nature conservation in practice. In 2020, the TMD scheme was adapted to count butterflies on National Natural Heritage sites. These sites are usually former military sites that were given to nature conservation after the reunification of Germany. They are of high conservation interest and under management of different nature conservation agencies. We developed a simplified method to count butterflies, following a common protocol. Data collected on these sites with endangered and rare habitats will help to cover different, so far underrepresented habitats. Using occupancy models (Bried and Pellet 2012, Fleishman et al. 2017), rarefaction techniques (Simonson et al. 2001), meta-analytical time series (Pilotto et al. 2020), and scaling the finer to the coarser data easily allows for the comparison of data and even to jointly analyze it. The comparison of results from different (endangered and common) habitats will help to understand the development of biodiversity on a larger scale.

CONCLUSION
Based on the experience of TMD and our findings from the analysis of the questionnaire, we derive a set of recommendations for the establishment of a CS project with a high potential of being successful.

- It is important to know the (demographic) background of the participants, because this is what most of them have in common. This knowledge helps to specifically target this group and to improve the project structure to make it also attractive to other groups such as younger people or families.

- To increase the motivation of people to participate in a CS project, it is important to explain the scientific background of the project. People want to contribute to scientific research and they want to know how their data is used to improve the knowledge about biodiversity.

- A personal relationship to a special site (i.e., butterfly transects) helps to motivate participants to take part for a long period of time (feeling of stewardship for that site).

- The motivations of citizen scientists to join a project are mostly intrinsic. More important than special rewards for participation like giveaways or travel refund is information that enhances the emotional connection to nature.

- Good communication with regular reporting about the results of the CS project is crucial. Workshops or excursions are appreciated.

Responses to this article can be read online at:
https://www.ecologyandsociety.org/issues/responses.
php/12861

Data Availability:

The data/code that support the findings of this study are openly available in Zenodo at https://zenodo.org/badge/DOI/10.5281/zenodo.4486775.svg https://zenodo.org/badge/DOI/10.5281/zenodo.4486775.svg.

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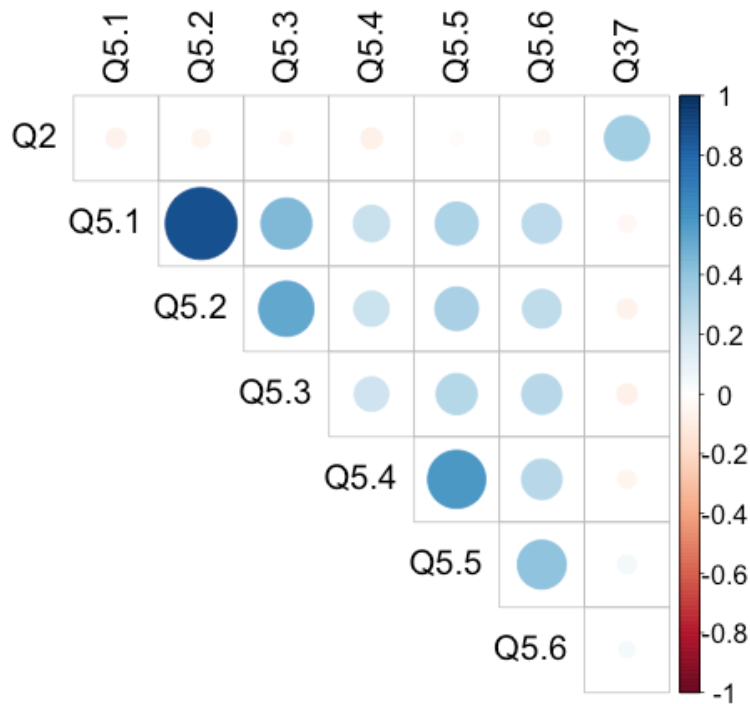
APPENDIX 1

Fig. A1.1: Correlation plot (Kendall's τ) between "duration of participation" (Q2), Questions 5 and age of the participants (Q39). Size of the circles as well as color palette represents the magnitude of τ

Table A1.1: Error probabilities (p) of the multinomial models relating Questions 5.1-5.6 to Question 22 and 42 using Cumulative Link Models (ordinal::clm). Error probabilities are corrected for multiple testing to avoid type I errors, using the approach of Holm (1979)

	Q22	Q42
Q5.1	0.739	0.787
Q5.2	0.739	0.907
Q5.3	0.600	0.195
Q5.4	0.578	1.000
Q5.5	<0.001	1.000
Q5.6	0.004	1.000

p.adj = 0.006

G

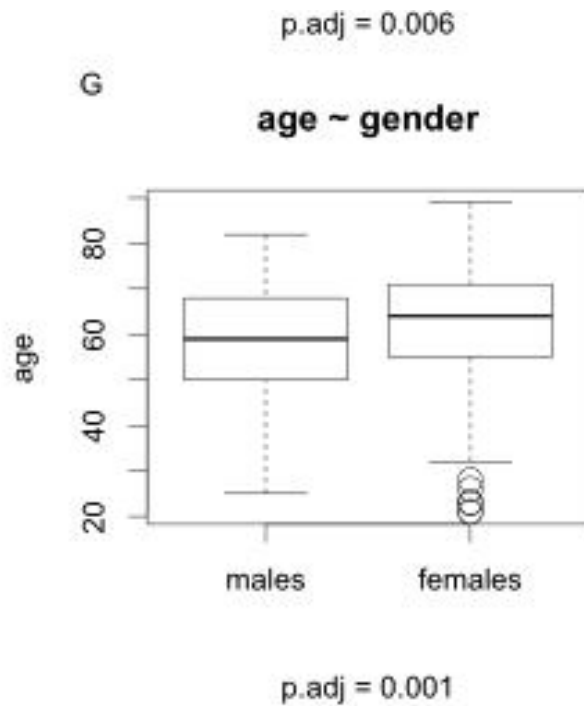**age ~ gender**

p.adj = 0.001

Fig. A1.2: Age distribution of participants vs gender (Mann-Whitney *U* test)

Table A1.2: Error probabilities (p) of the binomial models relating Questions 36.1-36.7 to Question 2, 39 and 42. Error probabilities are corrected for multiple testing to avoid type I errors, using the approach of Holm (1979)

	Q2	Q39	Q42
Q36.1	1.000	1.000	1.000
Q36.2	1.000	0.020	1.000
Q36.3	1.000	1.000	0.290
Q36.4	0.128	0.171	1.000
Q36.5	1.000	1.000	1.000
Q36.6	0.697	0.348	1.000
Q36.7	1.000	0.038	1.000
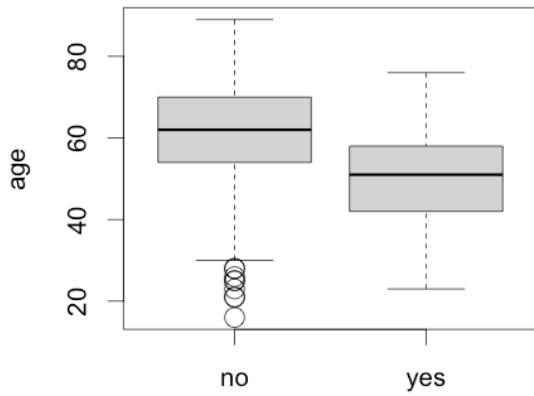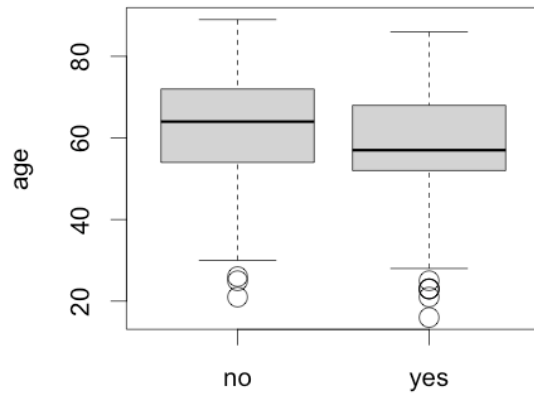
Fig. A1.3: Age of the participants vs. their expectations.
A: Better reachability; B: More events, e.g. regional meetings, excursions, seminars
(Error probability calculated from binomial model, including Questions 2, 39 and 42 as predictors; for full overview please see table A2)

Questionnaire
for all participants and supporters of Butterfly Monitoring Germany (BMG)

Helmholtz-Centre for Environmental Research GmbH – UFZ
Department Community Ecology and
Department Urban and Environmental Sociology
Halle / Leipzig

Contact: Elisabeth Kühn, Helmholtz-Centre for Environmental Research – UFZ, Butterfly-Monitoring Germany, Theodor-Lieser-Str. 4, 06120 Halle (Saale), elisabeth.kuehn@ufz.de, Tel.: 0345 558 5263

Dear butterfly lovers,

The project "Butterfly Monitoring Germany" has now been in existence for 14 years. In the starting year 2005 we had about 200 active participants and this number increased rapidly to over 500 participants per year nationwide. This high number of participants has been maintained over the years and in the last exceptional summer of 2018, another 50 new participants were added. We are very happy about this constantly high participation and it is an important part of the success of our project.

Butterfly monitoring has become one of the most successful Citizen Science projects in Germany and we are often asked what makes a good Citizen Science project and how we manage to get so many people involved in our project over such a long period of time.

Of course, we already have ideas what this could be due to, but we don't know exactly. Deshalb haben wir heute eine große Bitte an Sie: Helfen Sie uns herauszufinden, welche Personen sich eigentlich an einem Projekt wie dem Tagfalter-Monitoring beteiligen und warum sie sich beteiligen. Was ist Ihre Motivation, was sind Ihre Erwartungen und Wünsche und was können wir noch besser machen?

In cooperation with the Department of Urban and Environmental Sociology at the UFZ in Leipzig we have developed a questionnaire. We kindly ask you to fill in this questionnaire and thereby help us to answer the above mentioned questions.

All information is anonymous and no personal data is collected. Today we are sending you the link to the questionnaire with the request to fill it out online. If you wish, we can also send you a printed version of the questionnaire by post and you can return it completed. Just send us a short message.

https://www.soscisurvey.de/TMDsurvey/

Please decide for one of the two variants!

Do you still have questions? Then you are welcome to contact us at the given address by mail, phone or post.

Kind regards, Elisabeth Kühn and Josef Settele on behalf of the BMG team and Christian Kuhlicke (Department of Urban and Environmental Sociology)

Many thanks for your support!

1. **In what form do you participate in the BMG? (multiple answers possible)**

   o   I am currently counting butterflies on one (or more) transect route(s)
   o   I have counted butterflies on one (or more) transect route(s) in the past.
   o   I supervise and advise transect counters as country or regional coordinator and also participate myself as a transect walker (please continue with question 2)
   o   I supervise and advise transect walkers as country or regional coordinator, but do not count myself (please continue with question 12)
   o   I am not participating in the project (please continue with question 12)
   o   Other form of participation, namely: …………………………………………. (please continue with question 12)

2. **In which years did you participate in butterfly monitoring?**

   In the years ………………………………………………………………………..........

3. **Can you estimate how much time per year you spend on butterfly monitoring in total?**

   Hours: …………

4. **Have you already observed butterflies before participating in butterfly monitoring? If so, since when?**

   o   No
   o   Yes, since: ………. (year)

5. **What is your motivation to participate in butterfly monitoring?**

I agree with this statement …					
	… not at all				…comple-tely
I would like to make a contribution, to stop the loss of butterflies	o	o	o	o	o
I would like to make a contribution, to stop the loss of biodiversity	o	o	o	o	o
I generally have a great interest in preserving the natural environment.	o	o	o	o	o
Gathering data on butterflies brings me closer to nature.	o	o	o	o	o
I would like to better understand ecological interrelationships.	o	o	o	o	o
I would like to make a contribution, to collect scientific data on butterflies.	o	o	o	o	o
Others: ………………………………………………………………….	o	o	o	o	o

6. How well did you know about butterflies in your region <u>before</u> participating in butterfly monitoring?

I didn't know anything about it.				I knew a lot about it.
O	O	O	O	O

7. How well do you know about butterflies in your region <u>today</u>?

I don't know anything about it				I know a lot about it.
O	O	O	O	O

8. Are you or have you been professionally involved with butterfly monitoring? (multiple answers possible)

- o No, not at all
- o Yes, as an employeein nature conservation
- o Yes, as an employee in a specialist authority
- o Yes, as a scientist
- o Yes, namely …………………………………………..

9. How do you determine the butterflies in your transect? (multiple answers possible)

- o By looking at them without aids
- o By looking at them with aids (e.g. small binoculars)
- o I catch questionable species with a net for subsequent determination on site.
- o I photograph the butterflies.
- o I catch questionable species and sometimes take a specimen copy home for further analysis.
- o Others: ………

10. How do you ensure the identification of butterflies? (multiple answers possible)

- o With field guides
- o With further specialist literature
- o Through research in specialist Internet portals
- o By direct inquiry with experts
- o Others: ………………………………………….

11.   Please estimate: How many butterfly species did you know before you participated in the butterfly monitoring? (Please mark with a cross)

1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41+
O	O	O	O	O	O	O	O	O

12.   Please estimate: How many butterfly species do you know today? (Please mark with a cross)

1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41+
O	O	O	O	O	O	O	O	O

13.   Do you intend to (continue to) participate in butterfly monitoring?

- o   No, I will definitely not participate any more (please explain briefly under point 14)
- o   I will rather not participate anymore.
- o   I am undecided.
- o   I will rather participate.
- o   Yes, I will definitely participate.

14.   Reasons, if you do not intend to participate:

_____

_____

_____

15.   In your opinion, how threatened are butterflies in Germany or in your region?

	Not threatened at all				Highly threatened
In Germany	O	O	O	O	O
In my region	O	O	O	O	O

16.   Please give an assessment: Has your transect route or routes changed structurally (e.g. vegetation, construction measures) during the time you count butterflies?

Transect route 1:
- o   Yes, it has changed completely, as follows: ……………………………………………………………………….
- o   Yes, individual sections have changed completely: ………………………………………………………………………
- o   There were slight changes: …………………………………………………………………………………………
- o   There were no changes: …………………………………………………………………………………………

Transect route 2:

- o   Yes, it has changed completely, as follows: …………………………………………………………………………..
- o   Yes, individual sections have changed completely: …………………………………………………………………………………
- o   There were slight changes: ………………………………………………………………………………………………………
- o   There were no changes: …………………………………………………………………………………………………..

Transect route 3:

- o   Yes, it has changed completely, as follows: …………………………………………………………………………..
- o   Yes, individual sections have changed completely: …………………………………………………………………………………
- o   There were slight changes: ………………………………………………………………………………………………………
- o   There were no changes: …………………………………………………………………………………………………..

Transect route 4:

- o   Yes, it has changed completely, as follows: …………………………………………………………………………
- o   Yes, individual sections have changed completely: …………………………………………………………………………………
- o   There were slight changes: ………………………………………………………………………………………………………
- o   There were no changes: ………………………………………………………………………………………………………

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17.   Please give, without much thought, an estimate of how the number of butterflies on your transect route has changed over the years?

	Has declined sharply				Has increased sharply
Total change in number (number of individuals)	O	O	O	O	O
Change in the number of species	O	O	O	O	O
Noticeable change in individual species					
Name of species:	O	O	O	O	O
Name of species:	O	O	O	O	O
Name of species:	O	O	O	O	O
Name of species:	O	O	O	O	O
Name of species:	O	O	O	O	O

18. **If you could sense any change: What do you think are the main reasons for the change in the number of butterflies on your transect?**

_____

_____

_____

_____

_____

19. **What role do butterflies and, in general, nature and species conservation play in your life?**

I agree with this statement …					
	… not at all				… comple-tely
I pay close attention to butterflies.	O	O	O	O	O
I cultivate my garden in a butterfly-friendly way.	O	O	O	O	O
I assign other people the importance of butterflies.	O	O	O	O	O
I give advice to other people for a butterfly-friendly garden design.	O	O	O	O	O
Whenever possible, I am committed to the protection of butterflies.	O	O	O	O	O
I support nature conservation passively (e.g. through donations).	O	O	O	O	O
I actively support nature conservation (e.g. as a member).	O	O	O	O	O
I stand up politically for the interests of nature (e.g. demonstrations, petitions).	O	O	O	O	O

20. **Now we have some questions about your personal attitude to environmental problems.**

I agree with this statement …					
	… not at all				… comple-tely
Being environmentally responsible is an important part of me.	O	O	O	O	O
I am someone who cares about environmental issues.	O	O	O	O	O
If I could not act in an environmentally responsible manner, I would care a lot.	O	O	O	O	O

21.

How well do you think you can prevent the loss of biodiversity by your own actions?

I agree with this statement …					
	… not at all				… comple-tely
I can help prevent the decline of butterflies	O	O	O	O	O

22. Do you exchange with other transect walkers?

o Yes
o No (continue with 25)

23. How regularly do you exchange information with other transect walkers? (please tick only one answer)

Every week	Every month	Every 2-3 months	Every 4-5 months	Every 6-7 months	Every 8-9 months	Every 10-11 months	Once a year	Less than once a year
O	O	O	O	O	O	O	O	O

24. are the majority of the people with whom you exchange in … (please tick only one answer)

o My immediate neighbourhood
o My town/my city
o My county
o My province
o Germany
o Somewhere else, namely in: ………………………………………..

25. Which of the following groups do you feel you belong to? (multiple answers possible)

o Group of transect walkers
o Group of Conservationists
o Group of Citizen Scientists
o Other groups, namely: …………………………………………………………..

26.   How strongly do you identify with the groups just mentioned?

I identify with…					
	not at all				**comple-tely**
… the group of transect walkers	O	O	O	O	O
… the group of Conservationists	O	O	O	O	O
… the group of Citizen Scientists	O	O	O	O	O
… other groups	O	O	O	O	O

27.   As participants in butterfly monitoring …

I agree with this statement …					
	… not at all				**… comple-tely**
… together we can achieve more in the protection of butterflies than any individual.	O	O	O	O	O
… we can stop the loss of butterflies.	O	O	O	O	O
… we can jointly plan and implement interventions to prevent the loss of butterflies.	O	O	O	O	O

28.   Have you followed the media debate on insect decline in recent years?

- o   Yes
- o   No (please proceed with question 32)

29.   What were or are your main sources of information on insect decline? (multiple answers possible)

- o   conversations with neighbours, relatives, acquaintances
- o   Regional Presses
- o   Nationale Presse
- o   Presse online
- o   Social media like Facebook or Twitter
- o   Local / regional radio
- o   TV
- o   Scientific publications
- o   Information events
- o   Others: ………………………………….

30. **What do you think about the reporting on insect decline in general?**

The problem is played down.				The problem is greatly exaggerated.
O	O	O	O	O

31. **Would you like to write us something more on this subject?**

_____

_____

_____

32. **Butterfly monitoring contributes to the preparation of scientific trend analyses in relation to butterflies, i.e. whether the number of butterflies or their species increases or decreases over time. We would like to ask you a few more questions on this topic.**

I agree with this statement …					
	… not at all				… comple-tely
I make an important contribution to the preparation of trend analyses.	O	O	O	O	O
I would like to know more about what my contribution to trend analysis is.	O	O	O	O	O
I would like to be more involved in the evaluation of the data.	O	O	O	O	O
Trend analyses are important because they are the basis for the protection of butterflies.	O	O	O	O	O

33. **In addition to BMG data, do you have observation data (e.g. "old" data or data from other regions) that you can make available for scientific purposes?**

    o   Yes, namely: ………………………………………………………………………………………………………

          What time period does the data cover? ……………………………

          To which region(s) the data refer? …………………………

    o   No

34. **Have you also dealt or are still dealing with other animal and/or plant groups?**

    o   Yes, namely: ………………………………………………………………………………………………………

          What time period does the data cover? ……………………………

    o   No

35. **Do you participate in other Citizen Science projects besides butterfly monitoring? If so, which ones and since when?**

- o Yes, namely: ………………………………………………………………………… since: ………… (year)
- o No

36. **What do you wish from the coordination of butterfly monitoring? (multiple answers possible)**

- o More exchange
- o Better reachability
- o More notifications by e-mail
- o More notifications by mail
- o More notifications via Social Media (Facebook, Twitter…)
- o More training courses
- o More events, e.g. regional meetings, excursions, seminars
- o Others: …………………………………………………………………………………….

37. **In which way would you like to receive more information / exchange on the project? (multiple answers possible)**

- o Mail
- o Reachability by phone
- o E-Mail exchange
- o Information on the Homepage www.tagfalter-monitoring.de
- o Information on the Facebook page
- o Information on Twitter
- o Others: …………………………………………………………………..

38. **Do you have further wishes or suggestions for improvement for the project coordination?**

We would be pleased if you could answer some more personal questions. These will help us to better understand who is participating in butterfly monitoring.

---

39.   please enter your year of birth.

.... (year of birth)

---

40.   What is your highest educational attainment?

o   Secondary school certificate grade 8/9
o   Secondary school certificate grade 10
o   High school
o   Without degree / left school before 8th grade
o   Still in school

---

41.   What is your highest professional qualification?

o   Part-skilled worker
o   Skilled worker
o   Master craftsman's diploma
o   Technical college degree
o   University degree
o   Without degree
o   Still in education

---

42.   Are you …

o   … male?
o   … female?
o   … diverse?

MANY THANKS FOR YOUR TIME AND COOPERATION!

You have helped us a lot with your answers.

We plan to prepare the evaluation of the survey for a scientific journal, but will definitely present it in the next annual report.

Fragebogen
für alle Teilnehmer*innen und Unterstützer*innen des Tagfalter-Monitoring Deutschland (TMD)

Helmholtz-Zentrum für Umweltforschung GmbH – UFZ
Department Biozönoseforschung und
Department Stadt- und Umweltsoziologie
Halle / Leipzig

Kontakt: Elisabeth Kühn, Helmholtz-Zentrum für Umweltforschung – UFZ, Tagfalter-Monitoring Deutschland, Theodor-Lieser-Str. 4, 06120 Halle (Saale), elisabeth.kuehn@ufz.de, Tel.: 0345 558 5263

Liebe Schmetterlingsfreunde,

das Projekt „Tagfalter-Monitoring Deutschland" gibt es nun seit 14 Jahren.
Im Startjahr 2005 hatten wir rund 200 aktive Teilnehmer*innen und diese Zahl stieg rasch auf jährlich über 500 Teilnehmer*innen bundesweit. Diese hohe Teilnehmer*innenzahl hat sich durchgehend über die Jahre gehalten und im letzten Ausnahmesommer 2018 kamen nochmals ca. 50 neue Zähler*innen hinzu. Über diese konstant hohe Beteiligung freuen wir uns sehr und sie ist ein wichtiger Bestandteil des Erfolges unseres Projektes.

Das Tagfalter-Monitoring hat sich mittlerweile zu einem der erfolgreichsten Citizen Science-Projekte in Deutschland entwickelt und häufig werden wir gefragt, was denn ein gutes Citizen Science-Projekt ausmacht und wie wir es schaffen, dass sich so viele Menschen über einen so langen Zeitraum an unserem Projekt beteiligen.
Wir haben natürlich schon Ideen, woran das liegen könnte, so ganz genau wissen wir es auch nicht.
Deshalb haben wir heute eine große Bitte an Sie: Helfen Sie uns herauszufinden, welche Personen sich eigentlich an einem Projekt wie dem Tagfalter-Monitoring beteiligen und warum sie sich beteiligen. Was ist Ihre Motivation, was sind Ihre Erwartungen und Wünsche und was können wir noch besser machen?

In Zusammenarbeit mit dem Department Stadt- und Umweltsoziologie am UFZ in Leipzig haben wir einen Fragebogen entwickelt. Wir bitten Sie, diesen Fragebogen auszufüllen und uns dadurch zu helfen, die oben genannten Fragen zu beantworten.

Alle Angaben sind anonym und es werden keine personenbezogenen Daten erfasst. Wir senden Ihnen heute den Link zum Fragebogen zu mit der Bitte, diesen online auszufüllen. Falls Sie es wünschen, senden wir Ihnen den Fragebogen auch gerne ausgedruckt mit der Post zu und Sie können ihn ausgefüllt zurücksenden. Schreiben Sie uns einfach eine kurze Nachricht.

https://www.soscisurvey.de/TMDsurvey/

Bitte entscheiden Sie sich für eine der beiden Varianten!
Haben Sie noch Fragen? Dann können Sie uns gerne unter der angegebenen Adresse per Mail, Telefon oder Post kontaktieren.

Herzliche Grüße, Elisabeth Kühn und Josef Settele im Namen des TMD-Teams und Christian Kuhlicke (Department Stadt- und Umweltsoziologie)

Vielen Dank für Ihre Unterstützung!

1.	**In welcher Form beteiligen Sie sich am TMD? (Mehrfachnennungen möglich)**

o	Ich zähle aktuell Tagfalter auf einer (oder mehreren) Transektstrecke(n).
o	Ich habe in der Vergangenheit Tagfalter auf einer (oder mehreren) Transektstrecke(n) gezählt.
o	Ich betreue und berate Transektzähler*innen als Landes- oder Regionalkoordinator*in und nehme auch selber als Transektzähler*in teil (bitte weiter mit Frage 2).
o	Ich betreue und berate Transektzähler*innen als Landes- oder Regionalkoordinator*in, zähle aber selber nicht (bitte weiter mit Frage 12).
o	Ich nehme nicht aktiv am TMD teil, verfolge aber die Entwicklung des Projektes (bitte weiter mit Frage 12).
o	Ich nehme nicht am Projekt teil (bitte weiter mit Frage 12).
o	Andere Form der Teilnahme, nämlich: ………………………………………. (bitte weiter mit Frage 12)

2.	**In welchen Jahren haben Sie am Tagfalter-Monitoring teilgenommen?**

In den Jahren …………………………………………………………………….........

3.	**Können Sie einschätzen, wie viel Zeit Sie pro Jahr für das Tagfalter-Monitoring insgesamt aufwenden?**

Stunden: …………

4.	**Haben Sie bereits vor Ihrer Teilnahme am Tagfalter-Monitoring Tagfalter beobachtet?**
	Wenn ja, seit wann?

o	Nein
o	Ja, seit: ………. (Jahr)

5.	**Was ist Ihre Motivation, am Tagfalter-Monitoring teilzunehmen?**

Ich stimme dieser Aussage …					
	… gar nicht zu				**… völlig zu**
Ich möchte einen Beitrag leisten, um den Verlust von Tagfaltern zu stoppen.	O	O	O	O	O
Ich möchte einen Beitrag leisten, um den Verlust der Artenvielfalt zu stoppen.	O	O	O	O	O
Ich habe generell ein großes Interesse am Erhalt der natürlichen Umwelt.	O	O	O	O	O
Das Sammeln von Daten über Tagfalter bringt mich der Natur näher.	O	O	O	O	O
Ich möchte ökologische Zusammenhänge besser verstehen.	O	O	O	O	O
Ich möchte einen Beitrag leisten, um wissenschaftliche Daten über Tagfalter zu sammeln.	O	O	O	O	O
Sonstiges: ………………………………………………………………………	O	O	O	O	O

6. Wie gut kannten Sie sich <u>vor</u> Ihrer Teilnahme am Tagfalter-Monitoring mit Tagfaltern in Ihrer Region aus?

Ich kannte mich gar nicht aus.				Ich kannte mich sehr gut aus.
O	O	O	O	O

7. Wie gut kennen Sie sich <u>heute</u> mit Tagfaltern in Ihrer Region aus?

Ich kenne mich gar nicht aus.				Ich kenne mich sehr gut aus.
O	O	O	O	O

8. Haben oder hatten Sie beruflich mit dem Thema Tagfalter-Monitoring zu tun? (Mehrfachnennungen möglich)

- o   Nein, gar nicht
- o   Ja, als Mitarbeiter*in im Naturschutz
- o   Ja, als Mitarbeiter*in einer Fachbehörde
- o   Ja, als Wissenschaftler*in
- o   Ja, nämlich ………………………………………….

9. Wie bestimmen Sie die Tagfalter in Ihrem Transekt? (Mehrfachnennungen möglich)

- o   Durch Anschauen ohne Hilfsmittel
- o   Durch Anschauen mit Hilfsmitteln (z.B. ein kleines Fernglas)
- o   Ich fange fragliche Arten mit einem Kescher zur Nachbestimmung vor Ort.
- o   Ich fotografiere die Falter.
- o   Ich fange fragliche Arten und nehme manchmal auch ein Belegexemplar zur Nachbestimmung mit nach Hause.
- o   Sonstiges: ………

10. Wie sichern Sie die Bestimmung der Tagfalter ab? (Mehrfachnennungen möglich)

- o   Mit Bestimmungsbüchern
- o   Mit weiterführender Fachliteratur
- o   Durch Recherche in Internetfachportalen
- o   Durch direkte Nachfrage bei Experten
- o   Sonstiges: …………………………………………..

11. **Bitte schätzen Sie: Wie viele Tagfalter-Arten kannten Sie <u>vor</u> Ihrer Teilnahme am Tagfalter-Monitoring? (Bitte ankreuzen)**

1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41+
O	O	O	O	O	O	O	O	O

12. **Bitte schätzen Sie: Wie viele Tagfalter-Arten kennen Sie <u>heute</u>? (Bitte ankreuzen)**

1–5	6–10	11–15	16–20	21–25	26–30	31–35	36–40	41+
O	O	O	O	O	O	O	O	O

13. **Haben Sie vor, (auch weiterhin) am Tagfalter-Monitoring teilzunehmen?**

- o Nein, ich werde bestimmt nicht mehr teilnehmen (bitte kurz unter Punkt 14 begründen).
- o Ich werde eher nicht mehr teilnehmen.
- o Ich bin unentschlossen.
- o Ich werde eher teilnehmen.
- o Ja, ich werde auf jeden Fall teilnehmen.

14. **Begründung, falls Sie nicht vorhaben teilzunehmen:**

_____

_____

_____

15. **Wie bedroht sind Ihrer Einschätzung nach Tagfalter in Deutschland bzw. in ihrer Region?**

	Gar nicht bedroht				Sehr stark bedroht
In Deutschland	O	O	O	O	O
In meiner Region	O	O	O	O	O

16. **Bitte geben Sie eine Einschätzung: Hat sich Ihre Transektstrecke bzw. haben sich Ihre Transektstrecken in der Zeit, in der Sie Tagfalter zählen, strukturell (z.B. Vegetation, bauliche Maßnahmen) verändert?**

Transektstrecke 1:
- o Ja, sie hat sich völlig verändert, und zwar wie folgt: …………………………………………………………………….
- o Ja, einzelne Abschnitte haben sich völlig verändert: ………………………………………………………………………
- o Es gab leichte Veränderungen: ………………………………………………………………………………………………
- o Es gab keine Veränderungen: …………………………………………………………………………………………………

Transektstrecke 2:

- o   Ja, sie hat sich völlig verändert, und zwar wie folgt: …………………………………………………………………..
- o   Ja, einzelne Abschnitte haben sich völlig verändert: ……………………………………………………………………
- o   Es gab leichte Veränderungen: ……………………………………………………………………………………………………
- o   Es gab keine Veränderungen: ……………………………………………………………………………………………………..

Transektstrecke 3:

- o   Ja, sie hat sich völlig verändert, und zwar wie folgt: …………………………………………………………………..
- o   Ja, einzelne Abschnitte haben sich völlig verändert: ……………………………………………………………………
- o   Es gab leichte Veränderungen: ……………………………………………………………………………………………………
- o   Es gab keine Veränderungen: ……………………………………………………………………………………………………..

Transektstrecke 4:

- o   Ja, sie hat sich völlig verändert, und zwar wie folgt: …………………………………………………………………..
- o   Ja, einzelne Abschnitte haben sich völlig verändert: ……………………………………………………………………
- o   Es gab leichte Veränderungen: ……………………………………………………………………………………………………
- o   Es gab keine Veränderungen: ……………………………………………………………………………………………………

17.   Bitte geben Sie, ohne lange zu überlegen, eine Einschätzung, wie sich die Anzahl der Tagfalter auf Ihrer Transektstrecke im Laufe der Jahre verändert hat?

	Hat stark abge-nommen				Hat stark zuge-nommen
Veränderung der Anzahl (Individuenzahl) insgesamt	o	o	o	o	o
Veränderung der Artenzahl	o	o	o	o	o
Auffällige Veränderung einzelner Arten					
Name der Art:	o	o	o	o	o
Name der Art:	o	o	o	o	o
Name der Art:	o	o	o	o	o
Name der Art:	o	o	o	o	o
Name der Art:	o	o	o	o	o

18. Falls Sie eine Veränderung wahrnehmen konnten: Was sind Ihrer Meinung nach die Hauptursachen für die Veränderung der Anzahl von Tagfaltern auf Ihrer Transektstrecke?

_____

_____

_____

_____

_____

19. Welche Rolle spielen Tagfalter bzw. allgemein der Natur- und Artenschutz in Ihrem Leben?

Ich stimme dieser Aussage …					
	… gar nicht zu				… völlig zu
Ich achte sehr auf Tagfalter.	O	O	O	O	O
Ich bewirtschafte meinen Garten schmetterlingsfreundlich.	O	O	O	O	O
Ich weise andere Personen auf die Bedeutung von Tagfaltern hin.	O	O	O	O	O
Ich geben anderen Personen Hinweise für eine schmetterlingsfreundliche Gartengestaltung.	O	O	O	O	O
Ich engagiere mich, wann immer möglich, für den Schutz von Tagfaltern.	O	O	O	O	O
Ich unterstütze den Naturschutz passiv (z.B. durch Spenden).	O	O	O	O	O
Ich unterstütze den Naturschutz aktiv (z.B. als Vereinsmitglied).	O	O	O	O	O
Ich setze mich für die Belange der Natur politisch ein (z.B. Demonstrationen, Petitionen).	O	O	O	O	O

20. Nun haben wir einige Fragen zu Ihrer persönlichen Einstellung zu Umweltproblemen.

Ich stimme dieser Aussage …					
	… gar nicht zu				… völlig zu
Mich umweltschonend zu verhalten, ist ein wichtiger Teil von mir.	O	O	O	O	O
Ich bin jemand, dem Umweltprobleme sehr am Herzen liegen.	O	O	O	O	O
Wenn ich mich nicht umweltschonend verhalten könnte, würde mir das viel ausmachen.	O	O	O	O	O

21. **Wie gut können Sie Ihrer Meinung nach durch eigenes Handeln den Verlust der Artenvielfalt verhindern?**

Ich stimme dieser Aussage …					
	… gar nicht zu				… völlig zu
Ich kann dazu beitragen, den Rückgang von Tagfaltern zu verhindern.	O	O	O	O	O

22. **Stehen Sie im Austausch mit anderen Tagfalterzähler*innen?**

- o Ja
- o Nein (weiter mit 25)

23. **Wie regelmäßig tauschen Sie sich mit anderen Tagfalterzähler*innen aus? (bitte nur eine Antwort ankreuzen)**

Jede Woche	Jeden Monat	Alle 2–3 Monate	Alle 4–5 Monate	Alle 6–7 Monate	Alle 8–9 Monate	Alle 10–11 Monate	Einmal im Jahr	Weniger als einmal im Jahr
O	O	O	O	O	O	O	O	O

24. **Sind die Personen, mit denen Sie sich austauschen, mehrheitlich in … (bitte nur eine Antwort ankreuzen)**

- o Meiner unmittelbaren Nachbarschaft
- o Meinem Ort/Meiner Stadt
- o Meinem Landkreis
- o Meinem Bundesland
- o Deutschland
- o Woanders, nämlich in: ……………………………………….

25. **Welchen der folgenden Gruppen fühlen Sie sich zugehörig? (Mehrfachnennungen möglich)**

- o Gruppe der Tagfalterzähler*innen
- o Gruppe der Naturschützer*innen
- o Gruppe der Citizen Scientists
- o Andere Gruppe, nämlich: ……………………………………………………..

26. Wie stark identifizieren Sie sich mit den eben genannten Gruppen?

Ich identifiziere mich mit der …					
	Gar nicht				**Völlig**
… Gruppe der Tagfalterzähler*innen	O	O	O	O	O
… Gruppe der Naturschützer*innen	O	O	O	O	O
… Gruppe der Citizen Scientists	O	O	O	O	O
… Andere Gruppe	O	O	O	O	O

27. Als Teilnehmer*innen des Tagfalter-Monitorings können …

Ich stimme dieser Aussage …					
	… gar nicht zu				**… völlig zu**
… wir zusammen mehr in Bezug auf den Schutz von Tagfaltern erreichen als jeder Einzelne.	O	O	O	O	O
… wir den Verlust von Tagfaltern stoppen.	O	O	O	O	O
…wir gemeinsam Interventionen planen und umsetzen, die sich gegen den Verlust von Tagfaltern richten.	O	O	O	O	O

28. Haben Sie die mediale Diskussion zum Insektenrückgang in den letzten Jahren verfolgt?

- o Ja
- o Nein (bitte weiter mit Frage 32)

29. Was waren bzw. sind ihre wichtigsten Informationsquellen zum Thema Insektenrückgang? (Mehrfachnennungen möglich)

- o Gespräche mit Nachbarn, Verwandten, Bekannten
- o Regionale Presse
- o Nationale Presse
- o Online Presse
- o Soziale Medien wie Facebook oder Twitter
- o Lokal-/Regional-Radio
- o Fernsehen
- o Wissenschaftliche Publikationen
- o Informationsveranstaltungen
- o Andere: …………………………….

30. **Wie schätzen Sie die Berichterstattung zum Insektenrückgang im Allgemeinen ein?**

Sie spielt das Problem herunter.				Sie neigt stark zur Übertreibung.
o	o	o	o	o

31. **Möchten Sie uns zu diesem Thema noch etwas schreiben?**

_____

_____

_____

32. **Das Tagfalter-Monitoring leistet einen Beitrag zur Erstellung wissenschaftlicher Trendanalysen in Bezug auf Tagfalter, also ob die Anzahl der Tagfalter bzw. ihrer Arten über die Zeit zu- oder abnimmt. Dazu haben wir noch einige Fragen an Sie.**

Ich stimme dieser Aussage …					
	… gar nicht zu				… völlig zu
Ich leiste einen wichtigen Beitrag bei der Erstellung von Trend-Analysen.	o	o	o	o	o
Ich würde gerne mehr darüber erfahren, was mein Beitrag bei der Erstellung von Trend-Analysen ist.	o	o	o	o	o
Ich wäre gerne stärker bei der Auswertung der Daten involviert.	o	o	o	o	o
Trendanalysen sind wichtig, da sie die Grundlagen für den Schutz von Tagfaltern sind.	o	o	o	o	o

33. **Haben Sie neben den TMD-Daten auch Beobachtungsdaten (z.B. „alte" Daten oder Daten aus anderen Regionen), die Sie für wissenschaftliche Zwecke zur Verfügung stellen können?**

     o   Ja, nämlich: ……………………………………………………………………………………

            Welchen Zeitraum umspannen die Daten? ……………………………

            Auf welche Region(en) beziehen sich die Daten? …………………………

     o   Nein

34. **Haben Sie sich auch mit anderen Tier- und/oder Pflanzengruppen beschäftigt oder tun dies noch?**

     o   Ja, nämlich: ……………………………………………………………………………………

            Welchen Zeitraum umspannen die Daten? ……………………………

     o   Nein

35. Nehmen Sie neben dem Tagfalter-Monitoring noch an anderen Citizen Science-Projekten teil? Wenn ja, an welchen und seit wann?

- o Ja, nämlich: ………………………………………………………………… Seit: ………… (Jahr)
- o Nein

36. Was wünschen Sie sich von der Koordination des Tagfalter-Monitoring? (Mehrfachnennungen möglich)

- o Mehr Austausch
- o Bessere Erreichbarkeit
- o Mehr Benachrichtigungen per E-Mail
- o Mehr Benachrichtigungen per Briefpost
- o Mehr Benachrichtigungen über Social Media (Facebook, Twitter…)
- o Mehr Fortbildungsangebote
- o Mehr Veranstaltungen, z.B. regionale Treffen, Exkursionen, Seminare
- o Anderes: …………………………………………………………………………….

37. Auf welche Art und Weise wünschen Sie sich mehr Informationen / Austausch zum Projekt? (Mehrfachnennungen möglich)

- o Briefpost
- o Telefonische Erreichbarkeit
- o E-Mail-Austausch
- o Infos auf der Homepage www.tagfalter-monitoring.de
- o Infos auf der Facebook-Seite
- o Infos per Twitter
- o Anderes: …………………………………………………………………..

38. Haben Sie weitere Wünsche oder Verbesserungsvorschläge für die Projekt-Koordination?

Wir würden uns freuen, wenn Sie noch einige persönliche Fragen beantworten. Diese helfen uns, besser zu verstehen, wer am Tagfalter-Monitoring teilnimmt.

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39.   **Bitte tragen Sie hier Ihr Geburtsjahr ein.**

…………. (Jahreszahl)

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40.   **Was ist Ihr höchster schulischer Ausbildungsabschluss?**

o   Hauptschul- / Volksschulabschluss, POS 8. / 9. Klasse
o   Mittlere Reife / Realschulabschluss, POS 10. Klasse
o   Hochschul- / Fachhochschulreife
o   Ohne Abschluss / vor der 8. Klasse abgegangen
o   Noch in der Schule

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41.   **Was ist Ihr höchster beruflicher Ausbildungsabschluss?**

o   Anlernzeit, Volontariat, Teilfacharbeiter*in
o   Abgeschlossene Lehre, Facharbeiter*in
o   Fachschul- / Meister- / Technikerabschluss
o   Fachhochschulabschluss
o   Hochschul- / Universitätsabschluss
o   Ohne Abschluss
o   Noch in der Ausbildung

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42.   **Sind Sie …**

o   … ein Mann?
o   … eine Frau?

VIELEN DANK FÜR IHRE ZEIT UND MITARBEIT!

Sie haben uns mit Ihren Antworten sehr geholfen.

Wir planen, die Auswertung der Befragung für ein Fachjournal aufzubereiten, werden diese aber auf alle Fälle im nächsten Jahresbericht vorstellen.