Universiteit Leiden
The Netherlands

Plastic detectives and wildlife guardians: impact of volunteers monitoring plastic pollution and wildlife on science, society, and nature
Rambonnet, L.

Chapter 4

Wildlife rehabilitation centers and their potential for citizen science

Abstract

Under growing anthropogenic pressures, wildlife rehabilitation organizations care for sick, injured and displaced wildlife. Records on admitted wildlife are increasingly used for scientific research to understand threats to wildlife, including diseases. As volunteers are actively involved in wildlife rehabilitation, their contributions can be viewed as a form of citizen science. However, we know little about rehabilitators' backgrounds, motivations, and experiences with data collection and research.

To fill this gap, we interviewed representatives from thirteen Dutch wildlife rehabilitation centers and surveyed 205 Dutch rehabilitation volunteers. Our findings show that rehabilitators are primarily driven by an interest in and a desire to help animals. Women and middle-aged volunteers were overrepresented in the sample, compared to the Dutch population, while educational and employment background as well as their attitude towards science, were representative. Regarding the data collection, they are positive about the quality although finding location can be improved. Rehabilitators are open to sharing the data, especially to study success rate and diseases. Interviewees believed that education is an important part of their work. However, taking on tasks like research and education are experienced as challenging due to a lack of time and funding.

The involvement of wildlife rehabilitators in scientific research could extend the benefits of citizen science to a broader and more diverse audience than typically reached by citizen science or nature volunteering. By understanding wildlife rehabilitators' roles, challenges, and preferences, this study highlights the potential to involve them in scientific knowledge generation, thereby broadening the scope of citizen science.

4.1 Introduction

Anthropogenic events like floods, wildfires, oil spills threaten wildlife conservation. Since the 1960s and 1970s, when major oil spills impacted thousands of animals, volunteers have taken action to rescue wildlife (Newman et al., 2003). Many grassroots efforts evolved into wildlife rehabilitation centers (WRCs), with new centers still emerging (Wimberger et al., 2010). Globally, WRCs provide temporary care for injured, sick, or orphaned wildlife, aiming for their release. Increasingly, database programs enable researchers to access and utilize WRC data (Loyd et al., 2017; Miller et al., 2023). In response, Pyke & Szabo (2018a) proposed adding 'Research' to the traditional rehabilitation phases: 'Rescue, Rehabilitation, and Release.'

Research topics include WRCs' rehabilitation success (Lukesova et al., 2021; Paterson et al., 2021) and understanding anthropogenic threats (e.g. Kornreich et al., 2024; Thrift et al., 2023), and emerging diseases (e.g. Caliendo et al., 2022). Previous research shared some challenges regarding data quality and standardisation as well as volunteer retention (Haering et al., 2020b; Long et al., 2020). As WRCs rely on volunteer-collected data and public reports, their involvement in research resembles citizen science. Applying insights from this field could improve data quality, volunteer retention and overall outcomes and benefits for all involved. Understanding rehabilitators' motivations and experiences with data collection is key. Therefore, this study explores WRCs' potential research role from the perspective of their staff and volunteers.

4.1.1 Rehabilitation and research

Previous studies proposed that wildlife rehabilitators' roles in data collection can be considered citizen science (Ciprari et al., 2022; Pyke & Szabo, 2018b). This describes a scientific research method where people without a relevant academic background are involved in the scientific process, which benefits both parties and advances scientific knowledge (Bonney et al., 2016). This concept is clarified in ten principles described by Robinson et al. (2018), including the possibility for citizen scientists to "participate in multiple stages of the scientific process."

Many wildlife rehabilitators are already involved in the data collection, and they could also be involved in developing the research questions and, if desired, other phases of the scientific process. Another principle of citizen science is that "programs are evaluated for their scientific output, data quality, participant experience, and wider societal or policy impact" (Robinson et al., 2018). Previous studies using WRCs' records did emphasize potential sampling biases and the need for standardizing data collection (e.g. Long et al., 2020). Thus, when involving WRCs in scientific research, it is important to consider their data quality. Regarding the sharing of the data by the WRCs, trust can also play an important role, just as it did for biodiversity recorders (Ganzevoort et al., 2017). Therefore, learning about rehabilitators' experiences, preferences, and motivations for data sharing is crucial.

4.1.2 Rehabilitators' background and motivation

Previous studies show that over 75% of wildlife rehabilitators are female (Englefield et al., 2019; Haering et al., 2020b; Yeung et al., 2017). Middle-aged individuals were most represented, although males were more prevalent in older age groups (Englefield et al., 2019; Haering et al., 2020b). Around 75% had completed tertiary or vocational education, and nearly half worked full- or part-time (Haering et al., 2020b; Yeung et al., 2017). Australian wildlife rehabilitators volunteered a median number of seven hours per week (Haering et al., 2020b). Motivations mainly centered on a desire to help wildlife and an interest in animals (Englefield et al., 2019; Haering et al., 2020b).

Given the limited research on wildlife rehabilitators, we also examined studies on volunteers and citizen scientists in environmental projects. Gender ratio varies by project type and topic with women often more represented in nature volunteering, although men were overrepresented among Dutch nature volunteers (Ganzevoort & Van Den Born, 2020). Both nature volunteers and citizen scientists appear to be mainly of middle or high age (Mac Domhnaill et al., 2020; Ganzevoort & Van Den Born, 2020).

Previous studies on environmental volunteers showed that 'helping the environment' or 'contributing to nature conservation' are the most important motivations; though many different motivations were considered important, including 'learning about the natural environment' and 'socializing with people with similar interests' (Bruyere & Rappe, 2007; Ganzevoort & Van Den Born, 2020). Environmental citizen scientists are primarily motivated by helping wildlife or contributing to science and nature conservation (West et al., 2021).

With growing interest in research collaboration with WRCs, assessing volunteers' involvement in science is important. This can be determined using the science capital framework, which includes concepts such as knowledge of scientific developments, attitude towards science, participation in scientific activities, and engagement with science in daily life (De Witt et al., 2016; Peeters et al., 2022b). Understanding WRC volunteers' demographics, motivations and science capital can aid in recruitment and retention, as well as a beneficial involvement in scientific research.

4.1.3 Public education

As WRCs depend on residents to report wildlife needing rescue, they frequently interact with the general public. Because of this contact, some studies highlighted the potential role WRCs could play in knowledge dissemination between research and the public, such as diseases (Caliendo et al., 2022). However, our knowledge of the educational practices of WRCs is lacking. A previous study on New York state rehabilitators did find that over half were involved in additional educational activities, reaching both schools and youth as well as the general audience (Siemer et al., 1991). These activities involved mostly one-to-one dialogues and lectures. As dissemination and public education is an important part of the scientific process, we should find out how WRCs are taking up this role.

4.1.4 Dutch wildlife rehabilitation

Our study focussed on Dutch WRCs and their potential role in scientific research. In 2022 65 centers cared for over 115,000 wild animals annually (Asselbergs & De Baerdemaeker, 2024). A recent report highlighted that collected data at centers is underutilized for research, such as monitoring population trends or serving as an 'early-warning' system for diseases (Ottburg & Lammertsma, 2023). Most studies with Dutch WRCs focussed on marine mammal data, examining population trends, entanglement, and diseases (Osinga et al., 2012; Salazar-Casals et al., 2022; Wijngaarden et al., 2021). Other examples include studies on coronaviruses using bat feces collected at a WRC (Jaramillo Ortiz et al., 2023), and an avian influenza outbreak at a center (Caliendo et al., 2022). This current study investigated Dutch wildlife rehabilitators' background, motivation, science capital, data collection practices and their attitudes and ideas about research and education.

4.2 Methods

Because previous research was limited, we applied a mixed-methods approach to the current study. First, we conducted qualitative interviews with Dutch WRC representatives to learn about different centers' experiences, preferences, and ideas regarding their volunteers, recordkeeping, scientific research, and public education. Next, partially based on the interviews, we distributed a quantitative survey among Dutch WRC volunteers to identify their backgrounds, experiences, and ideas regarding recordkeeping and scientific research. We obtained approval from the ethical committee of Leiden University (reference number 2022-013). Before participating, the interviewees and the survey participants gave informed consent to process their data anonymously for research purposes. As the interviews and surveys were conducted in Dutch, we translated the interview protocol (Appendix 4.1), the survey (Appendix 4.4), and the quoted answers in the results section into English for this paper.

4.2.1. Qualitative interviews

We conducted semi-structured interviews with founders, coordinators, or other representatives from Dutch WRCs between November 2022 and February 2023. We approached fourteen centers, and to include a wide variety of views, we selected centers that differed in years since founding, geographic location, number of volunteers, and the species of animals they rehabilitate (Appendix 4.2). We interviewed people from thirteen different centers; one center declined to participate. Four interviews were held with two interviewees simultaneously. We treated each interview as one data point, as the interviewees represented the views of the same center. The interview protocol was based on existing literature and consultation with experts. Pilot interviews were conducted, and the protocol was adjusted afterwards by removing some questions to shorten the length of the interview. The protocol consisted of five topics: volunteers, data collection, data sharing, and communication (Appendix 4.1). All interviews were recorded and transcribed for data processing purposes.

The interviews were thematically analyzed using both deductive and inductive coding by the first author with the software Atlas.ti (version 24). As a result, a codebook was created, containing five themes mentioned above and thirty codes (Appendix 4.3). To ensure reliable coding, ten per cent of all coded segments were also checked by a second coder, resulting in a Cohen's Kappa of 0.844.

4.2.2. Quantitative survey

The quantitative survey for WRC volunteers was designed using Qualtrics XM and contained 25 questions with multiple-choice, open, and Likert-scale type questions (Appendix 4.4). The questions were divided into three parts: motivation (e.g. reasons for joining the WRC and motivation), research (e.g. data ownership and attitude towards science), and profile (e.g. age, gender, level of education). Questions were based both on the qualitative interview results and on previous research. For the question on motivation, we used the Citizen Science Motivation Scale developed by Levontin et al. (2022). We selected sixteen motivation statements from the 58 original statements, covering all fifteen motivational categories. In the second part about research, the question regarding data ownership was adopted from Ganzevoort et al. (2017). In the third part about the participants, the question about their attitudes toward science was adopted from Peeters et al. (2022). The age and employment categories were based on the Central Bureau for Statistics of the Netherlands (Statistics Netherlands) to compare the sample with the general population. The survey was pilot-tested with volunteers from one Dutch wildlife rehabilitation center, which was excluded from the final sample. After the pilot test we adjusted the survey by clarifying questions, excluding some questions that made the survey too long, and adding a few questions based on the interviews. The survey was sent to 53 Dutch WRCs, for which a corresponding email address was found online. The survey was also distributed via a newsletter from two larger Dutch animal protection organizations.

We received a total of 224 responses. Nineteen responses were excluded based on three criteria: 1) filled in less than 46% of the questions (n=13), 2) no details on the type of WRC (n=1), or 3) not a volunteer at an official WRC (n=5). This resulted in a final sample of 205 survey participants in April and May 2023. They represented 28 rehabilitation centers that cared for various wildlife species such as birds, bats, hedgehogs, and other mammals. Unfortunately, no volunteers from marine mammal centers responded to the survey. The answers were analyzed using RStudio (version 2024.04.2+764). Demographics were analyzed using descriptive statistics and compared to available data from Statistics Netherlands. The significance of the differences between our sample and the Dutch population was calculated using a chi square-test for goodness of fit. Only the genders female and male were included in these correlation tests, as only one participant identified as "other." For the Likert-scores, the mean, median, and interquartile range were calculated to show both the average score as well as the spread in the data. Answers to open questions were coded inductively for analysis using Microsoft Excel (version 16.88).

4.3 Results

Below, we present the interview and survey results per topic: the rehabilitators' background and motivation, rehabilitation and research, and public education. Quotations from the interviews were added to exemplify recurring themes and insights that we identified in the interview data. We refer to the WRCs' representatives who were interviewed with "interviewees", "centers" and "WRC." For the survey participants, both "participants" and "respondents" are used. When interviewees or participants mention WRC volunteers in general, these are referred to as "volunteers."

4.3.1 Rehabilitators' background and motivation

During the interviews, it became clear that organizations differed in set-up, with varying numbers of volunteers. Over half of the centers have several paid employees for tasks like coordination, veterinary care, and communication. More than half of the interviewees mentioned that they generally have enough volunteers but there is a shortage in the high season, during spring and summer. Also, several interviewees believed volunteers stay shorter periods of time than in the past, possibly due to more busy lives. They experience this as a challenge because training volunteers costs time.

The survey showed that 96.6% of the 205 total participants were involved in the care of wildlife (n=198). A fifth of the participants was also involved in communication and education activities such as answering the phone (20%; n=41) and giving guided tours or guest lectures (20%; n=41). Regarding the number of hours per week, the median was five hours per week (n=204) and almost half of the respondents worked at least three and less than six hours per week (47.9%, n=93). The median years of respondents' volunteer experience at a WRC was four years (n=203) and over a third had less than three years of experience (35%, n=71). A complete overview of respondents' general background can be found in Appendix 4.5.

Demographics and scientific attitude
The majority of survey participants identified as female (82.7%, n=163), 15.7% (n=31) as male, one respondent identified as another gender, and two persons rather did not share. Over half of the respondents were between 40 and 64 years old (52.3%, n=103), a quarter were between 20 and 39 years (25.9%, n=51), and 20.3% (n=40) were between 65 and 79 years and a few were younger than 20 years old (1.5%, n=3). Regarding education, 38.1% finished tertiary education (n=75) and 28.9% vocational training (n=57). Almost half of the respondents had paid work (45.7%, n=90), while nearly a quarter were retired (23.4%, n=46) or had no paid job (20.3%, n=40). A complete overview of respondents' demographics can be found in Appendix 4.6.

From the 5-point Likert-scale statements regarding science capital, we found that participants most strongly agreed with "*I do things that help me learn about science*" (*M*=4.1) and "*I have an interest in science*" (*M*=3.7). The other two statements about being aware of scientific developments and talking about science with others in their daily lives scored lower (*M*=3.3 and *M*=2.8; Appendix 4.7).

Motivation

Most interviewees became involved in wildlife rehabilitation because they encountered an animal needing rescue, which was also an important reason for the survey participants to become active at a WRC (22.4%, n=46; Appendix 4.5). Also, an interest in animals played a role for several interviewees. Most interviewees mentioned their volunteers were involved because they wanted to "*help animals*" or "*do something in return for nature.*" However, they also noted that some volunteers were motivated by personal interest: "*Volunteers think birds are very interesting.*" Some interviewees mentioned their preference for volunteers' motivation: "*The most important motivation for volunteers should always be helping the animals.*" This preference, as well as the other mentioned motivations, aligned well with survey participants' main motivations being *helping animals (M=4.8), interest in animals (M=4.8),* and *enjoy the work (M=4.6)*, although also other motivations seem to be important for the participants, including *learning (M=4.3;* Figure 4.1; Appendix 4.8).
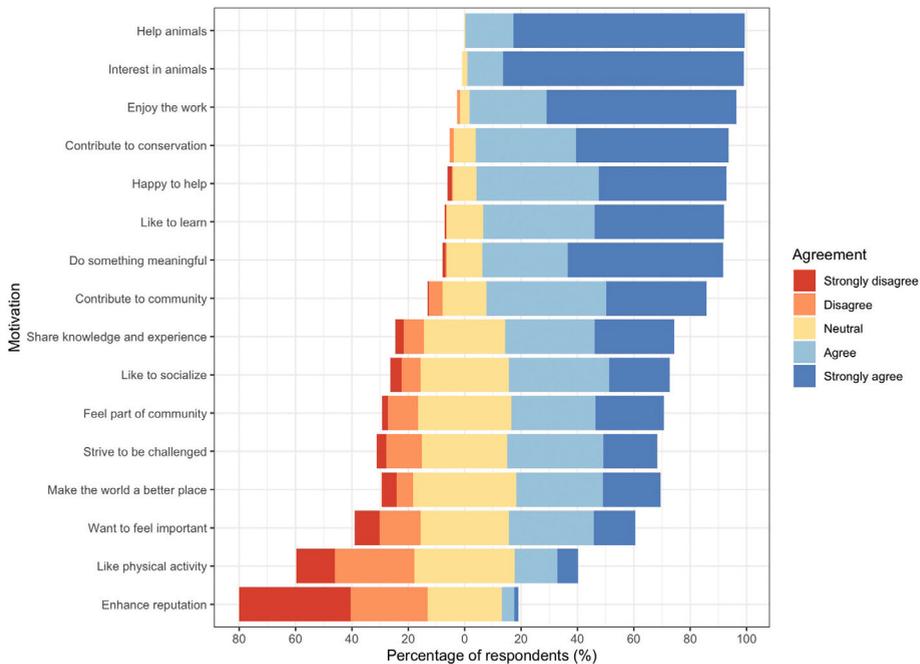

Figure 4.1 Diverging stacked bar chart of respondents' motivations (n=205), scored on a Likert scale, ranging from 1 (Strongly disagree) to 5 (Strongly agree) and ordered from high to low positive scores. Option "Don't know/rather not say" not included, see details in Appendix 4.8.

4.3.2 Rehabilitation and research

Record keeping

The motivation for data collection by WRCs, according to the interviewees, is, firstly, to have an overview of the animals in their center and to monitor and improve animal condition and treatment: "*It is good for us to see what the success percentage is per species. [..] I saw that thirteen per cent of our cases were due to fractures, which made us think about following training to specialize ourselves more in treating fractures.*" Secondly, WRCs are required to send the provincial government an annual overview of all admitted wildlife. However, almost none of the interviewees received a response: "*As far as I know, nothing is being done with our data. They just see if we registered the animals, released them within the province, and then it goes into a drawer.*" Thirdly, the centers use an overview of the animals they treat to substantiate the need for more funding.

We saw similar reasons among the survey respondents' ideas about what the data is being used for. Most of them think they know what the data is used for (68.8%, n=141; Appendix 4.9); of these, over half elaborated on their answer (56%, n=79). The most mentioned purpose was for monitoring the animal rehabilitation process (n=19), to share with the government because of the permit (n=15), and to have an overview of the animals (n=15), for example, for improving rehabilitation practices or substantiating the need for funding. Eight respondents mentioned that the data is being shared with knowledge institutions or other research organizations.

Data quality

While almost every center initially collected the data on paper, they all digitized part of their data, primarily species, date, and reason for admission. For this purpose, most used Microsoft Excel or Word, while some used database software hosted by an external organization. The level of detail in the finding location varied between WRCs. Some recorded the full location of the finding, including street and house number if available, while others only recorded the municipality. For some centers, the provincial government required a certain level of detail. A few centers only recorded municipalities to show the need for funding. Also, different ideas regarding the release of an animal influenced the chosen level of detail for the finding location. While some centers release animals in the centers' backyard, some also release wildlife at the finding or another more suitable location. Most interviewees were critical regarding the accuracy of the location when this was recorded by animal ambulance organizations that transport wildlife from the public to the WRCs. Some mentioned that the animal ambulance volunteers did not always register the original finding location, instead of the collection location, due to time pressure: "*They do what they can. If they have the information, they share it. However, you cannot expect this, especially in busy times when they are running around.*" In addition, over half of the interviewees noted that the cause of admission is sometimes missing, uncertain, or questionable, and some interviewees made remarks on the correct identification of species. A third of the interviewees mentioned the data quality depends on the experience of the animal ambulance volunteers: "*[...] there are certainly people with many years of experience, but most volunteers are too new and have too little information.*"

4

Around half of the survey participants were involved in data collection (51.2%, n=105; Appendix 4.9). They were generally positive about the data quality they collected themselves, feeling the most confident about *Species* (*M*=4.4) and equally confident about the quality of *Reason for admission* and *Finding location* (*M*=4.1; Appendix 4.10), although some participants added remarks on the difficulty of identifying the reason for admission. Some participants mentioned that more experienced staff members register animals upon arrival, which could be beneficial for the data quality. In line with the interviewees, some respondents noted that the data quality also depends on the individuals or organizations that drop off the animals.

Research

All interviewees were positive about collaborating with researchers. Half of the survey respondents thought their organization owns the data but should share it with anyone interested (50%, n=102). A third thought that their organization is the owner, and they don't have to share the data (32.8%, n=67), and almost ten per cent thought there is no data owner, and data should be publicly available (8.8%, n=18). The others did not have an opinion or thought that it depends on if it will help wildlife conservation (8.3%; n=17; Appendix 4.9).

When asked about citizen science, over two-thirds of the participants were unfamiliar with this term or the Dutch word 'burgerwetenschap' (69%, n=140), When this term was explained, 78.2% (n=158) thought the WRCs' practices could be a form of citizen science. When asked what type of research would be interesting and important, most interviewees were interested in studying the success of their rehabilitation practices. They also saw it as an important opportunity regarding disease monitoring: "*I think the signaling function we have for wildlife diseases is one of importance for the upcoming years. That is something we need to prepare for, also regarding quarantine space.*" These two research priorities align with survey participants' research interest in the success of their rehabilitation practice (74.6%, n=153) and monitoring diseases (63.9%, n=131; Appendix 4.9).

However, over half of the interviewees mentioned a lack of time, energy, and financial resources to execute their research ideas: "*Of course, you can do [research] within your own center [...], but our people are already happy when they can still keep their eyes open at the end of the day. What is needed is good collaboration with scientists.*" Several WRCs mentioned existing collaborations with research organizations and natural history museums. With these organizations they share both data as well as animal carcasses. One center emphasized the importance of deceased wildlife: "*when you bring a wild animal to a center, it is often more dead than alive, so a lot die. However, these dead animals also hold much information on ecology and public health.*" The respondents were primarily neutral towards initiatives that require extra effort, time, or interest (e.g., gaining insights into data from colleagues and contributing to more research with this data).

Also, with these kinds of collaborations, centers need more time and resources. Some interviewees were also hesitant about future research collaborations due to a lack of feedback from previous research collaborations: "*The student did not send the results, which is too bad because you invest much time, especially when you collect samples.*" This sharing of results was also of great

importance to the respondents (*M*=4.2; figure 4.2; Appendix 4.10). When getting the results from an academic institute, one WRC also shared their difficulty understanding it: "[*the report] was very technical and not plain simple language, it was not even all in Dutch but also Latin was used.*"
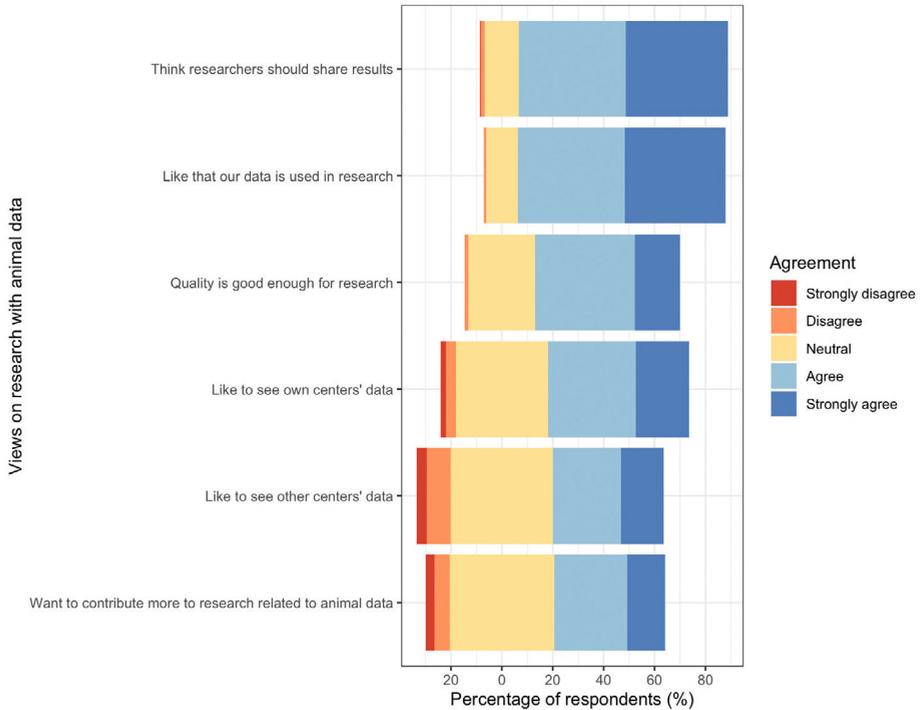

Figure 4.2. Diverging stacked bar chart of survey respondents' agreement with statements regarding their views on scientific research with their centers' animal data (n=199), scored on a Likert scale, ranging from 1 (Strongly disagree) to 5 (Strongly agree) and ordered from high to low positive scores. Option "Don't know/ rather not say" not included, see details in Appendix 4.10.

Some interviewees emphasized the importance of sharing knowledge between centers to improve their rehabilitation practice. For example, the hedgehog centers mentioned a meeting with a national hedgehog working group where a hedgehog expert taught them different methods for researching hedgehog feces, and an international hedgehog expert and book author was also invited to give a talk. The interviewees experienced this as both "*fun and interesting.*"

4.3.3 Public education

All centers engaged with the public; for example, via phone, when people reported wildlife needing rescue or reached out for advice and face-to-face when people dropped off animals at the center. Most centers also organized educational activities like open days and school visits. All interviewees thought public education is an important part of their work, and several interviewees mentioned how it helps with prevention: "*Over 80% of wildlife admissions are caused by human activities. So, if you can connect humans and their natural environment more through*

education, you can minimize the negative encounters between humans and wildlife." Their educational messages mainly focussed on how the public can create a nature-friendly environment. In addition, almost half of the interviewees mentioned they teach people when wildlife does and doesn't need help: *"Often people have very good intentions, but with these good intentions also many animals unnecessarily end up in the center."* An example of this is animals appearing orphaned, like young birds: *"chicknapping, when people find a young bird and immediately pick it up [...].* However, almost all interviewees mentioned a lack of time and capacity: *"During the past few years, we noticed it became increasingly difficult to keep everything running. So, the focus goes to wildlife care, especially in spring and summer.*

4.4 Discussion

This study examined wildlife rehabilitators' backgrounds and perceptions of data collection and involvement in research and education. Interviews with thirteen WRC representatives and a survey of 205 WRC volunteers, revealed a positive attitude toward research and education but highlighted time and funding as key barriers.

4.4.1 Rehabilitators' motivation and background

Wildlife rehabilitators' primary motivations were *helping animals* and *having an interest in animals*, although many other motivations such as *enjoyment* and *learning* were important too. These findings align with prior studies highlighting "love for and desire to help injured animals" (Kidd et al., 1996) and "to help native animals" (Haering et al., 2020b) as key motivations. Nearly half of the respondents had less than four years of experience, consistent with retention challenges noted in earlier research (Kidd et al., 1996). To improve recruitment and retention, WRCs could address diverse motivations by for example offering activities that foster their interest in and knowledge of wildlife. More research is needed to explore how motivations evolve over time.

Dutch wildlife rehabilitators were predominantly women (84%) and middle-aged (40-64 years), consistent with earlier studies (Englefield et al., 2019; Haering et al., 2020b). Only 1.5% of the rehabilitators were under 20 years, which is comparable to 1.1% of Dutch biodiversity recorders (Ganzevoort & Van Den Born, 2020). This reflected possibly a minimum age requirement of 16 years at most WRCs. Engaging younger age groups via other activities could foster interest in nature conservation and perhaps future volunteering (Brewer, 2006). Educational backgrounds were diverse, with 38% of rehabilitators having finished higher education, comparable to 36% nationally (Statistics Netherlands, 2024a). This contrasts with studies on nature volunteers and citizen scientists, which reported higher percentages (Ganzevoort & Van Den Born, 2020; Mac Domhnaill et al., 2020). Rehabilitators' attitude toward science aligns with the general Dutch population; although rehabilitators are more likely to engage in scientific activities, like museum visits (Verkade & Smeets, 2023). Involving them in scientific research could further enhance their knowledge and scientific attitude (Bonney et al., 2016; Rambonnet et al., 2024).

Regarding rehabilitators' involvement, respondents reported spending a mean of 8.1 hours per week volunteering, nearly double the national average of 4.3 hours (Statistics Netherlands, 2024b). However, our mean is skewed by a few participants who reported a relatively high number of hours, up to 100 hours per week. The median of five hours was lower than previous studies, likely due to differences in operating structures. Australian rehabilitators, for instance, work from home and care for species requiring longer rehabilitation periods (Englefield et al., 2019; Haering et al., 2020a). Comparable to a previous study by Haering et al. (2020b), half of the rehabilitators worked also a part- or full-time job elsewhere. However significantly more people worked part-time than full-time compared to the Dutch population (Statistics Netherlands, 2024a).

4.4.2 Rehabilitation and research

Survey participants were generally positive about the quality of their data, while interviewees were more hesitant, citing concerns about the reliability of finding locations and reasons for admission. This aligns with Haering et al. (2020b), who noted differing opinions between volunteers and coordinators on record-keeping. Positivity may reflect genuine confidence, a tendency to give positive answers (acquiescence bias), or a desire for approval from coordinators (social desirability bias). Concerns stemmed, for example, from errors during digitization and reliance on volunteers from animal ambulance organizations. Training both WRC and animal ambulance staff could enhance data quality and volunteer knowledge (Rambonnet et al., 2024; Ratnieks et al., 2016).

Participants expressed interest in research on rehabilitation success, wildlife diseases, and preventing wildlife rescue. While few respondents mentioned their centers shared data with researchers, over half thought their organization should share the data with those interested. This aligns with findings that half of Dutch biodiversity volunteers view their data as a public good (Ganzevoort et al. 2017; Lawrence & Turnhout, 2010), highlighting opportunities for greater collaboration between WRCs and researchers. Emphasizing how scientific research aligns with wildlife rehabilitators' motivation to help animals could further encourage involvement. Sharing research outcomes with centers can sustain motivation for future collaborations. Offering lectures or workshops by researchers may further inspire them. Since many are unfamiliar with the term 'citizen science' or its Dutch equivalent 'burgerwetenschap,' clear communication is key. Future studies could explore best practices and challenges faced by other collaborators, such as research institutions and policymakers, to enhance WRCs' role in knowledge generation.

While WRCs are positive about participating in scientific research, they face challenges such as limited time and funding. This aligns with a recent report highlighting WRCs' research potential if the government ensures the centers' stability and continuation (RDA, Raad voor Dierenaangelegenheden, 2022). Researchers should account for these constraints, involve WRCs in funding proposals, and give back through lectures or workshops.

4

4.4.3 Public education

In addition to wildlife care, WRCs view education as vital to preventing the need for wildlife rehabilitation. This aligns with prior studies emphasizing their role in public education (Willette et al., 2023). The WRCs especially want to educate the public on when a young animal needs help and how the public can make their gardens more nature-friendly. Recently a Dutch report stressed improving public knowledge about helping wildlife (RDA, Raad voor Dierenaangele-genheden, 2022). Heathcote et al. (2019) suggested that analysis of WRC data on anthropogenic causes could "guide the planning of public education and mitigation initiatives". Future research could explore public knowledge and attitudes toward wildlife and WRCs' role in improving them.

4.4.4 Limitations

This study has several limitations. First, it focused only on The Netherlands and only on the WRCs, not the animal ambulance organisations. This choice was made to scope the current research to organizations dealing with wildlife and not domestic animals. Comparing our findings with similar studies in other countries may help the field further.

Another limitation of this study is the self-selection bias that might have occurred as it was voluntary to fill out the survey. For example, this could have resulted in more positive responses to scientific research. Also, a possible social desirability bias might have occurred. Even though the interviews and surveys were processed anonymously, representatives and survey participants might have unintentionally or intentionally spoken more positively about their center or wildlife rehabilitation in general.

A third and last limitation of our study is the timing. The interviews and survey were conducted just after the COVID-19 pandemic and during the period when bird flu became endemic in the Netherlands. As a result, educational activities like open days and school guest lessons happened less frequently as mentioned by some interviewees.

4.5 Conclusion

We found that WRCs and their data-collecting volunteers are willing to share their data with interested people, including researchers. Their interest lies mainly in improving the success of their rehabilitation work, monitoring and preventing diseases, and other causes of admission. However, although centers acknowledge the importance of research and knowledge exchange, their limited time and capacity make them prioritize caretaking above research and education. More financial support is needed to fulfill the potential of WRCs for citizen science, taking on the roles of conducting or aiding research and educating the public.

Our study also found that helping and being interested in wildlife were the most important motivations for Dutch wildlife rehabilitators to volunteer at a WRC. These motivations need to be addressed to retain volunteers and when involving them in scientific research efforts. Also,

as their age and educational background are more representative of the general population than previous studies on citizen scientists and nature volunteers, involving wildlife rehabilitators in scientific research could engage a more diverse audience.

4