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An information sign changes the way the public perceives exotic pond sliders *Trachemys scripta* in the Altrhein of Kehl (Germany)

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ABSTRACT – Invasive pond sliders (*Trachemys scripta*) have been released in thousands of freshwaters within Europe and reproduce in the southern states and even in warm areas of Germany. All member states of the European Union must have an action plan how to fight this invasive species. The German action plan focusses on informing the public, but to date no study investigated the impact of such actions. Instead, NGOs setting up information signs report that this has not stop the release of exotic pond turtles but have provided no quantitative data to back this up. In 2019, we put up an information sign at the Althrein of Kehl, an oxbow lake where for the first time it had been shown that *T. scripta* is breeding in Germany. I interviewed people walking along the oxbow lake before the sign was put up in 2019, and again in 2022. Counts of exotic pond turtles still increased, but this was mainly due to an increased number of small pond turtles, while the number of very large turtles did not increase. This suggests that the increase in peak counts might be rather due to local reproduction than additional release. After the information sign was set up, more people responded that the presence of exotic pond turtles is problematic for nature conservation and animal welfare, that it is illegal to release them, and that they should be removed. This response was especially strong in people who had read the information sign. Independent of the information sign, most interviewed people stated that one should not release pond turtles into the wild, but bring them to animal shelters. While the data here only represent one single case study, it is the first study showing that putting up information signs is effective in changing the attitude of people. This indicates that investment into informing the public is worthwhile, but also that at the same time evaluations of the impact of the measures are important. National action plans should focus on a combination of informing the public and removing the exotic pond turtles, but also on providing keepers of these animals the option to leave the animals at an animal shelter instead of releasing them into the wild.

INTRODUCTION

Invasive species, i.e. exotic species introduced by humans that establish themselves outside their natural distribution range, are threatening native biodiversity worldwide (Geiger & Waitzmann 1996; Wilson *et al.* 2009). One reptile species that has become invasive in Central and South America, Africa, Asia, and Europe is the north American slider *Trachemys scripta* (Böhm 2013; Standfuss *et al.* 2016; Mo 2019). This species is now widely distributed in Europe, where it has been released by pet owners into thousands of fresh water habitats (Cadi *et al.* 2004; Prevot *et al.* 2007; Kopecký, Kalous & Patoka 2013; Standfuss *et al.* 2016).

The European Union identified *T. scripta* as an invasive species (European_Commission

2016) against which the member states must take action to prohibit the import, breeding and release of this species (European_Parliament 2014). As environmental conditions differ between member states, the national action plans also differ. In south European countries like Spain and France, where this species breeds and spreads very fast, removal of exotic pond turtles is one main action. In Germany, the main proposed action against *T. scripta* is to increase public awareness (StA_„Arten-_und_Biotopschutz“ 2018), which is also part of the general actions proposed by the European Union (European_Parliament 2014). However, I am not aware of any study investigating the effects of such actions; one study exists that evaluated the impact of public awareness actions including signs to protect endangered reptiles (Başkale & Kaska 2005). While signs not to release exotic pond turtles have been set up at some localities, for example in Munich by the Reptilienauffangstation (https://www.reptilienauffangstation.de), effects of these public awareness actions have not been measured. Instead, as the release of exotic pond turtles seems to have continued, there has been considerable frustration at the low efficacy of interventions (anonymous communication by different NGOs). However, it was never measured, only assumed, that releases continued and that public awareness actions were ineffective. So far it is unknown whether such information signs influence the awareness of the public and lead to a decrease in the release of exotic pond turtles.

Here I present a case study conducted at an oxbow lake, the Altrhein of Kehl, the only location in Germany where successful reproduction of *T. scripta* has so far been reported (Schradin 2020). This population has been monitored by me since 2016. In 2019, I set up an information sign for the public and I continued monitoring the population, to determine whether it was still increasing. Before the information sign was set up, I conducted interviews with people walking along the oxbow lake, asking them about how they evaluate the presence of exotic pond turtles. These interviews were repeated in 2022. If the information sign had a positive impact in educating the public, I predicted that in 2022 - 1) More people would regard the presence of exotic pond turtles as problematic, 2) There would be increased awareness of the problems posed for both nature conservation and animal welfare, and 3) there would be increased understanding of why the release of exotic pond turtles is illegal, and why they should not be released, or removed, from the oxbow lake.

MATERIALS AND METHODS

Study area and study period

The study was conducted from 2016 to 2022 at the Altrhein of the city Kehl (48° 34'1.95"N, 7° 48'35.41"E), which is a 90 m long and 25 to 80 m wide oxbow lake formed over 100 years ago from the River Rhine. Kehl is in the Upper Rhine Valley, the warmest area of Germany. A community of six different species of exotic pond turtles exists in the Altrhein, which has been continuously growing in population size from 2016 to 2020 (Schradin 2020). Of these, *T. scripta* is the most common species, and both clutches and hatchlings have been found in several years, proving for the first time successful reproduction of this species in Germany (Schradin 2020).

Monitoring

In the years 2016-2020, the population of exotic pond turtles was monitored on six to eight afternoons per year, during April to July. These data are already reported in a previous publication (Schradin 2020), but included here as a baseline to determine whether further releases of exotic pond turtles occurred after the information sign was put up. Due to the Coronavirus lockdown in

2021, and the focus on getting more data from interviews in 2022, during these two years turtles were counted only during four afternoons per year. In all cases, observations were made using binoculars at five locations along the eastern shore of the lake, that were previously determined to have a high abundance of pond turtles. In addition, any pond turtle observed between these locations was recorded. For every individual, the carapace length was estimated to be in one of the following categories: 5 cm (hatchlings), 10 cm, 20 cm or 30 cm.

Setting up an information sign

An information sign was created by me during a course I give at the Hector Akademie Kehl. In this course, I teach highly gifted school children 8-9 years old about ecology and nature conservation, using the exotic pond turtles as a case study. The information sign and its translation into English are shown in Figure 1. The sign provides information about the origins of the animals, how many species there are, that one species is invasive, and why releasing exotic pond turtles is a problem for nature conservation and animal welfare, and thus illegal. As the German city of Kehl is next to the French city of Strasbourg, it is visited by many French citizens and has several thousand French residents, and so the information sign also includes a summary in French (Fig. 1).

The city of Kehl installed the information sign at a bridge over the Altrhein next to the communal hospital on the 16th of July 2019. This spot was chosen as from here people often observe the exotic pond turtles sun-basking on some branches of a dead tree that are lying in the water.

Figure 1. Top: The information sign put up in July 2019. Bottom: English translation of the information sign.

Interviews

Interviews were conducted during 5 afternoons in June and July 2019 and 4 afternoons in May and June 2022. In 2019, 28 people were interviewed, in 2022 30 people, 13 of whom had read the information sign. Nobody had read the sign immediately before the interview, though many interviewees read the sign after the interview. Interviews were conducted by myself and by pupils from the Hector course I was teaching. The pupils were trained in the interview technique, and observed me performing the initial interview. I was present while students performed their interviews. As the interviews were anonymous, no ethical clearance was needed under French or German law and CNRS administration.

First the pupils introduced themselves, that they are from the Hector Kinderakademie undertaking a survey about the exotic pond turtles. They made clear that it was no test, but the aim was to find out what people know about these animals. We only used the term "pond turtles", without "exotic" during the interviews. The questions were identical in both years. In 2022 we added a final question about whether the interviewee had read the information sign or not. After the interview was concluded the interviewees could ask questions and get more information, if they requested it.

The questions and the possible categorised answers (in brackets) were:

1. Do you find it problematic that there are pond turtles in the Altrhein? (yes / no).
2. Why do you think its problematic? (not problematic / animal welfare / nature conservation / other / don't know).
3. Is it legal to release pond turtles here? (is illegal / is legal / don't know).
4. In your opinion, what should someone do who has an pond turtle as pet but can no longer keep it, e.g. because they no longer have time or are moving away? (animal shelter / sell/ keep/ release/ don't know).
5. What should happen to the pond turtles in the Altrhein? (leave them and don't disturb / trap and remove / kill / don't know).

Data analysis

Data on pond turtle abundance are expressed as peak counts, the maximum number of live individuals observed in one survey afternoon of a particular year. Data from the interviews were analysed by comparing the ratios of correct answers vs. unknown plus wrong answers, comparing between years or between people who read / did not read the sign, using the Fisher`s Exact test.

RESULTS

Turtle numbers

The annual peak counts increased continuously from 2016 to 2020, even after the information sign was put up (Fig. 2). After the count in 2020 (May-July), 58 turtles were trapped and removed by the end of July 2020. This influenced the expected pond turtle numbers for the following year: if there was no recruitment in turtle numbers, I expected the peak count in 2021 to be similar to that in 2020 minus 58; instead, it was higher in 2021 and further increased in 2022 (Fig. 2). The number of very large pond turtles (carapax size 30 cm) did not increase after the information sign was put up and was not higher than the expected peak number. However, the number of large pond turtles (carapax size 20 cm) increased, which could be due to medium sized pond turtles (carapax size 10 cm) growing, as their numbers decreased (Fig. 2).

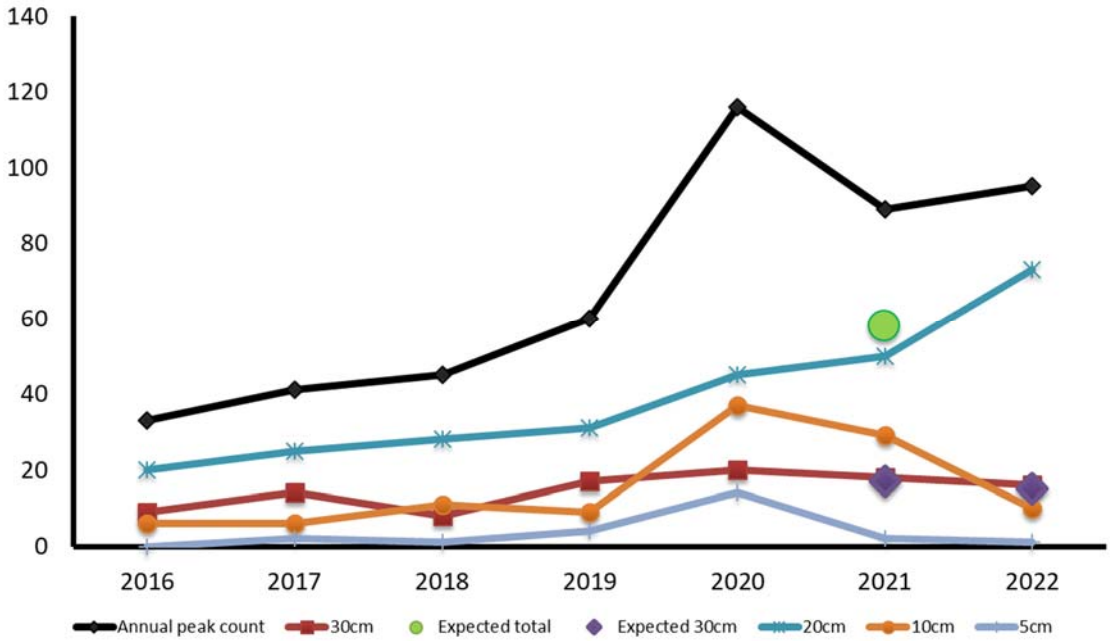
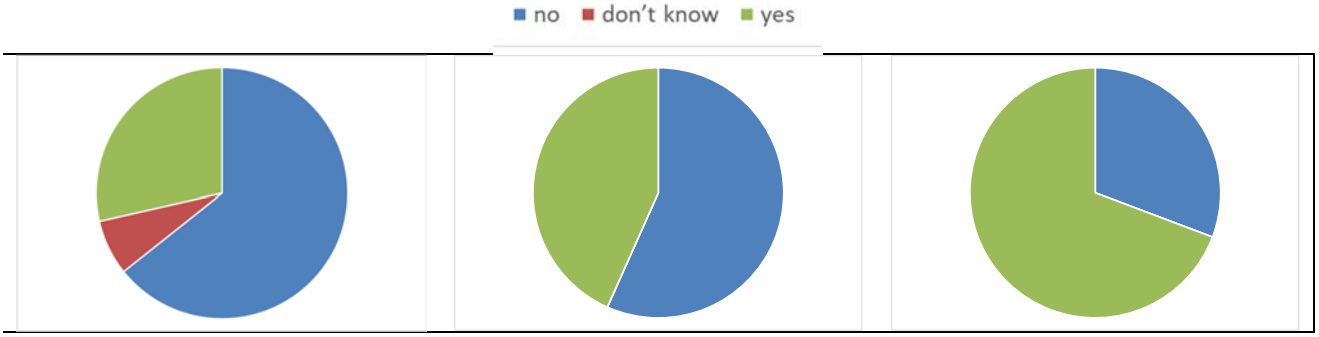


Figure 2. Annual peak count for all turtle species in the Althrein of Kehl. In black, total numbers. In red shown are the very large turtles which are most likely to be released, in other colours smaller turtles. After the count in 2020, a total of 58 turtles were removed, indicated by the green spot as expected value for 2021 (count 2020-58). Of these 58 turtles, one was very large; additionally, two large turtles caught on land were removed in 2021. The diamonds indicate the number of expected large turtles if no new ones were released.

Responses to interview questions

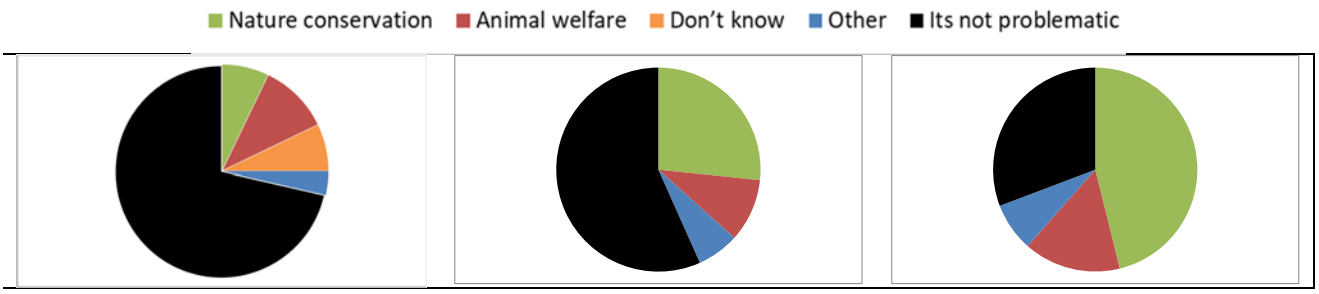
2019 (N=28) before information sign installed	2022 all (N=30) 3 years after information sign installed	2022 only people who had read the sign (N=13)

1. Do you find it problematic that there are pond turtles in the Altrhein?



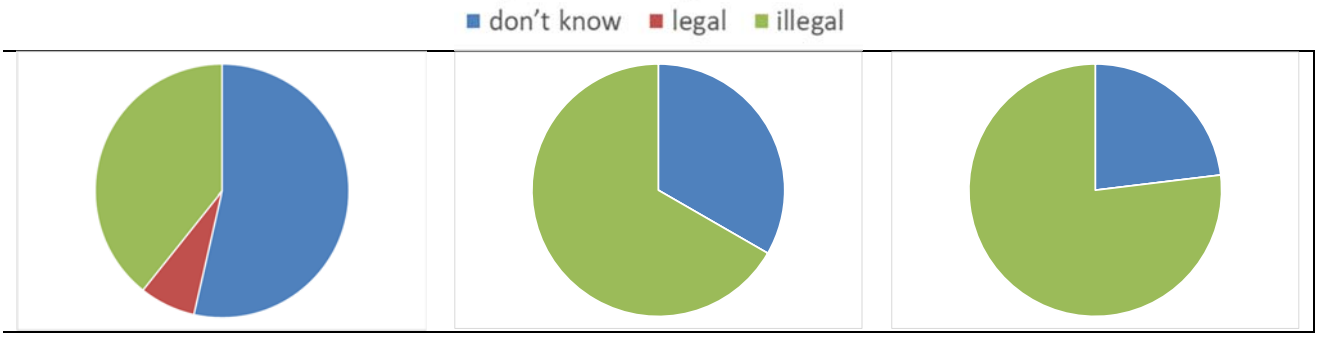
There was no statistical difference in the proportion of people reporting the pond turtles to be a problem or to be unproblematic between 2019 and 2022 (p=0.28). However, when only the people that had read the sign are considered then significantly more regarded the pond turtles as problematic, both compared to 2019 (p=0.02) and to the people in 2022 who had not read the sign (p=0.02).

2. Why do you think its problematic?



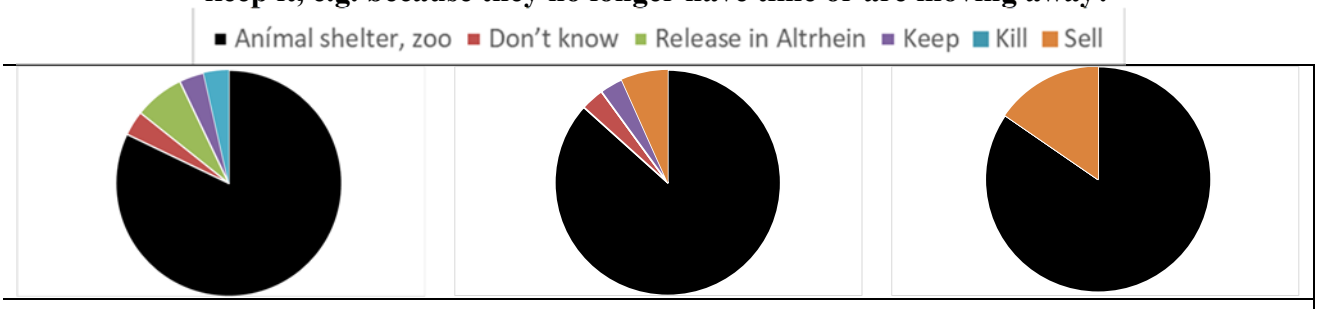
In 2022, no more people reported nature conservation and /or animal welfare to be a problem than in 2019 (p=0.15). However, when only considering the people that had read the sign, then significantly more identified nature conservation and /or animal welfare to be the problem, both compared to 2019 (p=0.02) and to the people in 2022 who had not read the sign (p=0.01).

3. Is it legal to release pond turtles here?



In 2022, more people assumed it to be illegal to release pond turtles than in 2019, though the difference was not significant (p=0.06). Considering only the people that had read the sign, the difference was significant (p=0.04), while the difference between people who had and who had not read the sign in 2022 was not significant (p=0.44).

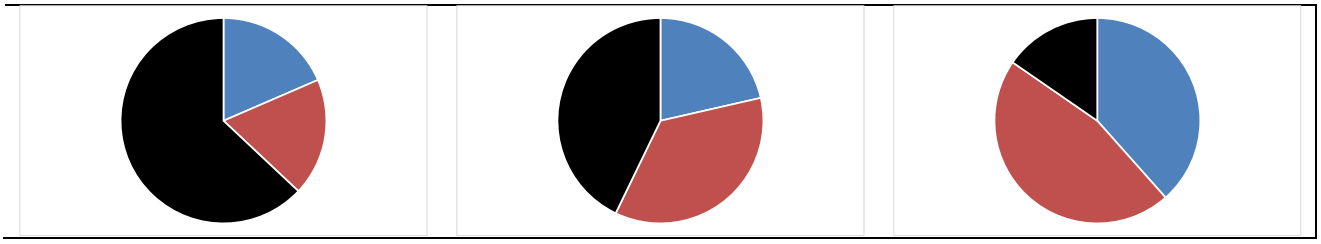
4. In your opinion, what should someone do who has a pond turtle as pet but can no longer keep it, e.g. because they no longer have time or are moving away?



Asked what somebody should do with a pond turtle they have as a pet if they cannot keep it anymore, in both years most people suggested that the pet owner should bring the pond turtle to an animal shelter or a zoo. Only in 2019 did two people suggest releasing them in the Altrhein.

5. What should happen to the pond turtles in the Altrhein?

don't know catch and remove nothing, leave them



In 2022, no more people suggested trapping and removing the exotic pond turtles from the Altrhein than in 2019 (p=0.23). Considering only the people who had read the sign, the difference was more pronounced, but did not reach significance (p=0.07).

DISCUSSION

In this case study, I found that the awareness of the general public to the problem of invasive *T. scripta* increased significantly three years after an information sign was put up. At the same time, there was no evidence that a large number of additional pond turtles were released. Therefore, this study gives the first empirical support that informing the public is a suitable tool of the action plan against invasive exotic pond turtles

The current study has several shortcomings reducing its general significance. First, the findings are based on a small sample of interviewees and evaluated a single sign at one location. How the results would apply at different localities and with different information signs is unknown. But this study indicates that it is worthwhile to try informing the public using such signs and then to evaluate whether it raises awareness and knowledge. Second, the monitoring of the population was done without individual identification or reliable population estimates, and was carried out during very few afternoons. As such, the data do not allow me to unequivocally conclude that no pond turtles were released after the sign was put up. Nevertheless, the data do not provide evidence that a large number of additional exotic pond turtles have been released. If the pond turtles could be identified individually, for example via photos and the use of artificial intelligence (AI), it would be possible to identify which animals are recruited from year to year into the population, and whether they are small (possibly due to reproduction) or large (possible releases).

Comparing responses to the interview questions before and three years after the information sign was put up indicated a clear change in public awareness: after the information sign was installed, many more people were aware that the exotic pond turtles represent a problem for nature conservation and / or animal welfare, that it is illegal to release them, and that it would be appropriate to remove them. Theoretically, this response could have been influenced by many co-factors and not the information sign alone, for example by reports in the local newspaper about the problem, or by people having had more time to walk along the Altrhein during the Coronavirus pandemic and then inform themselves at home about the exotic pond turtles they saw. However, the difference in awareness was most obvious in people that are reported to have read the information sign, and these were also significantly better informed than people interviewed during the same period in 2022 that had not read it. Thus, the most parsimonious explanation is that reading the information sign increased the awareness about the problem of exotic pond turtles.

The answer to one question did not differ between years and was not dependent on whether or not the interviewees had read the information sign: what should somebody do with a pond turtle pet if they cannot keep it anymore? Few respondents suggested releasing the pet into the Altrhein, but the large majority suggested depositing them in a zoo or an animal shelter. The problem is that neither zoos nor animal shelters are usually interested in taking exotic pond turtles, as they do not

have the facilities or resources to care for them indefinitely. This can explain why ten thousands of these pets have been released within Europe, as there are few alternatives to place them elsewhere. This means that if the release of exotic pond turtles is to be reduced, then potential animal shelters need supporting. In Germany, private organisations exist, like the Reptilienauffangstation in Munich (https://www.reptilienauffangstation.de), but these are heavily underfunded. National and regional authorities interested in reducing the number of releases should provide funding for such organisations, and funding to local animal shelters to provide facilities to keep exotic pond turtles.

The European Union demands that all member states should take action against invasive species (European_Parliament 2014) including *T. scripta* (European_Commission 2016). In Germany, it has been believed that the it is too cold for the released individuals to survive for long periods or to reproduce (Geiger & Waitzmann 1996; Pieh & Laufer 2006; Laufer 2007; Nehring 2016). The German action plan focusses on increasing public awareness (StA_„Arten-_und_Biotopschutz“ 2018), but this is neither enforced nor evaluated. A previous study, demonstrating successful reproduction of *T. scripta* at the Altrhein of Kehl (Schradin 2020) and the ever increasing population size there (Fig. 2), makes it clear that public awareness has to be increased, and that additional actions are required (Teillac-Deschamps *et al.* 2009).

In conclusion, the information sign was successful in increasing public awareness. The national action plan (for Germany and all other countries) for *T. scripta* should include three main components - 1) Increasing public awareness by providing information, and evaluating the effectiveness of these actions, 2) Providing funding to animal shelters to take in exotic pond turtles, and 3) Removing *T. scripta* from natural habitats to avoid them establishing viable and spreading populations (Cadi *et al.* 2004; Sancho & Lacomba 2016).

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