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

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11 the Altrhein of Kehl (Germany). *The Herpetological Bulletin*, **162**, 11-16.

12
13
14 **ABSTRACT** – Invasive pond sliders (*Trachemys scripta*) have been released in thousands of
15 freshwaters within Europe and reproduce in the southern states and even in warm areas of
16 Germany. All member states of the European Union must have an action plan how to fight this
17 invasive species. The German action plan focusses on informing the public, but to date no study
18 investigated the impact of such actions. Instead, NGOs setting up information signs report that this
19 has not stop the release of exotic pond turtles but have provided no quantitative data to back this
20 up. In 2019, we put up an information sign at the Althrein of Kehl, an oxbow lake where for the
21 first time it had been shown that *T. scripta* is breeding in Germany. I interviewed people walking
22 along the oxbow lake before the sign was put up in 2019, and again in 2022. Counts of exotic pond
23 turtles still increased, but this was mainly due to an increased number of small pond turtles, while
24 the number of very large turtles did not increase. This suggests that the increase in peak counts
25 might be rather due to local reproduction than additional release. After the information sign was
26 set up, more people responded that the presence of exotic pond turtles is problematic for nature
27 conservation and animal welfare, that it is illegal to release them, and that they should be removed.
28 This response was especially strong in people who had read the information sign. Independent of
29 the information sign, most interviewed people stated that one should not release pond turtles into
30 the wild, but bring them to animal shelters. While the data here only represent one single case
31 study, it is the first study showing that putting up information signs is effective in changing the
32 attitude of people. This indicates that investment into informing the public is worthwhile, but also
33 that at the same time evaluations of the impact of the measures are important. National action plans
34 should focus on a combination of informing the public and removing the exotic pond turtles, but
35 also on providing keepers of these animals the option to leave the animals at an animal shelter
36 instead of releasing them into the wild.

37
38 **INTRODUCTION**

39 Invasive species, i.e. exotic species introduced by humans that establish themselves outside their
40 natural distribution range, are threatening native biodiversity worldwide (Geiger & Waitzmann
41 1996; Wilson *et al.* 2009). One reptile species that has become invasive in Central and South
42 America, Africa, Asia, and Europe is the north American slider *Trachemys scripta* (Böhm 2013;
43 Standfuss *et al.* 2016; Mo 2019). This species is now widely distributed in Europe, where it has
44 been released by pet owners into thousands of fresh water habitats (Cadi *et al.* 2004; Prevot *et al.*
45 2007; Kopecký, Kalous & Patoka 2013; Standfuss *et al.* 2016).

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

47 2016) against which the member states must take action to prohibit the import, breeding and release
48 of this species (European_Parliament 2014). As environmental conditions differ between member
49 states, the national action plans also differ. In south European countries like Spain and France,
50 where this species breeds and spreads very fast, removal of exotic pond turtles is one main action.
51 In Germany, the main proposed action against *T. scripta* is to increase public awareness
52 (StA „Arten- und Biotopschutz“ 2018), which is also part of the general actions proposed by the
53 European Union (European_Parliament 2014). However, I am not aware of any study investigating
54 the effects of such actions; one study exists that evaluated the impact of public awareness actions
55 including signs to protect endangered reptiles (Başkale & Kaska 2005). While signs not to release
56 exotic pond turtles have been set up at some localities, for example in Munich by the
57 Reptilienauffangstation (<https://www.reptilienauffangstation.de>), effects of these public awareness
58 actions have not been measured. Instead, as the release of exotic pond turtles seems to have
59 continued, there has been considerable frustration at the low efficacy of interventions (anonymous
60 communication by different NGOs). However, it was never measured, only assumed, that releases
61 continued and that public awareness actions were ineffective. So far it is unknown whether such
62 information signs influence the awareness of the public and lead to a decrease in the release of
63 exotic pond turtles.

64 Here I present a case study conducted at an oxbow lake, the Altrhein of Kehl, the only
65 location in Germany where successful reproduction of *T. scripta* has so far been reported (Schradin
66 2020). This population has been monitored by me since 2016. In 2019, I set up an information sign
67 for the public and I continued monitoring the population, to determine whether it was still
68 increasing. Before the information sign was set up, I conducted interviews with people walking
69 along the oxbow lake, asking them about how they evaluate the presence of exotic pond turtles.
70 These interviews were repeated in 2022. If the information sign had a positive impact in educating
71 the public, I predicted that in 2022 - 1) More people would regard the presence of exotic pond
72 turtles as problematic, 2) There would be increased awareness of the problems posed for both
73 nature conservation and animal welfare, and 3) there would be increased understanding of why the
74 release of exotic pond turtles is illegal, and why they should not be released, or removed, from the
75 oxbow lake.

76
77

78 MATERIALS AND METHODS

79 Study area and study period

80 The study was conducted from 2016 to 2022 at the Altrhein of the city Kehl (48° 34'1.95"N, 7°
81 48'35.41"E), which is a 90 m long and 25 to 80 m wide oxbow lake formed over 100 years ago
82 from the River Rhine. Kehl is in the Upper Rhine Valley, the warmest area of Germany. A
83 community of six different species of exotic pond turtles exists in the Altrhein, which has been
84 continuously growing in population size from 2016 to 2020 (Schradin 2020). Of these, *T. scripta*
85 is the most common species, and both clutches and hatchlings have been found in several years,
86 proving for the first time successful reproduction of this species in Germany (Schradin 2020).

87

88 Monitoring

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

93 2021, and the focus on getting more data from interviews in 2022, during these two years turtles
94 were counted only during four afternoons per year. In all cases, observations were made using
95 binoculars at five locations along the eastern shore of the lake, that were previously determined to
96 have a high abundance of pond turtles. In addition, any pond turtle observed between these
97 locations was recorded. For every individual, the carapace length was estimated to be in one of the
98 following categories: 5 cm (hatchlings), 10 cm, 20 cm or 30 cm.

99

100 **Setting up an information sign**

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

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

112

Die Schmuckschildkröten im Altrhein von Kehl

Woher kommen die Schildkröten?
Die Tiere wurden von Zoofachgeschäften verkauft. Die Haltung ist teuer, die Tiere werden bis zu 50 Jahre alt und von Jahr zu Jahr größer. Viele Halter haben ihre Tiere ausgesetzt, weil sie kein Interesse mehr an ihnen hatten.

Alternativen zum Aussetzen
Wenn Sie die Tiere nicht mehr halten können, suchen Sie aktiv nach einer neuen Unterkunft für das Tier. Tierheime und Auffangstationen können Schildkröten aufnehmen, sind aber häufig schon voll, so dass Sie nach einem privaten Halter aktiv suchen müssen, der die Tiere übernimmt.

Achtung: Die Haltung von Tieren der invasiven Art *Trachemys scripta* (Rotwangen-, Gelbwangen- und Cumberland-Schmuckschildkröten) muss vom zuständigen Regierungspräsidium genehmigt werden.

Viele verschiedene Arten im Altrhein!
Es gibt 6 Arten von exotischen Schildkröten im Altrhein, 5 davon aus den USA. Etwa 40% der Tiere sind Buchstaben-Schmuckschildkröten (*Trachemys scripta*), mit den drei Unterarten Rotwangen-, Gelbwangen- und Cumberland-Schmuckschildkröte. Zudem gibt es zwei Arten der Gattung *Pseudemys*, Höckerschildkröten (*Graptemys*), wenige Zierschildkröten (*Chrysemys*) und chinesische Streifenschildkröten (*Mauremys*).

Buchstaben-Schmuckschildkröten: Eine invasive Art!
Die Buchstaben-Schmuckschildkröten (Gattung *Trachemys*) können sich in Europa erfolgreich fortpflanzen und somit dauerhaft für die heimische Natur eine Gefahr darstellen. Auch beim Altrhein von Kehl kam es schon zu erfolgreicher Fortpflanzung. Deshalb hat die EU diese Art 2016 als invasiv eingestuft. Es ist verboten, sie ohne Erlaubnis der Behörden zu handeln, zu züchten oder auszusetzen.

Probleme des Umweltschutzes
Die Schildkröten sind Allesfresser. Sie bevorzugen meist tierische Nahrung. Sie fressen unter anderem geschützte Amphibien und deren Kaulquappen. Das Aussetzen von exotischen Schildkröten kann also zu erheblichen Veränderungen in der heimischen Natur führen, besonders in ökologisch wertvollen Gewässern.

Probleme des Tierschutzes
Viele Arten stammen aus den Subtropen, wo es viel wärmer ist als in Kehl. Für diese Tiere ist es in Kehl eigentlich viel zu kalt! Die Tiere frieren, wachsen langsam, werden krank und in einem sehr kalten Winter werden Tiere erfrieren! Schmuckschildkröten auszusetzen ist daher Tierquälerei!

§ Achtung: Rechtliche Hinweise §
Das Aussetzen nichtheimischer, gebietsfremder und invasiver Arten ist nach § 40 Bundesnaturschutzgesetz (BNatSchG) verboten. Nach § 69 Abs. 3 Ziff. 17 BNatSchG handelt ordnungswidrig, wer vorsätzlich oder fahrlässig solche Tiere ausbringt. Das Bußgeld beträgt bis zu 10 000 €.

Finden Sie Gelege oder Tiere, kontaktieren Sie bitte die Stadt Kehl telefonisch unter Telefon: 07851 88-4321.

L'ensemble des tortues exotiques vivant entre l'Altrhein à Kehl se compose de sept espèces : six originaires du sud des États-Unis et une de Chine. Elles proviennent de régions plus chaudes, et les relâcher dans la froideur de l'Artrhein est par conséquent contraire à l'éthique. De plus, ces espèces sont nocives pour la faune locale, pour les amphibiens particulièrement. Ainsi, leur seule présence crée donc d'importants problèmes pour l'environnement. Il est d'ailleurs illégal de relâcher ces tortues dans l'Altrhein et l'amende pour ce délit peut atteindre les 10 000 Euros.

Invasive Gelbwangenschildkröte
Trachemys scripta scripta

Invasive Rotwangenschildkröte
Trachemys scripta elegans

Herzoglyphen-Schmuckschildkröte
Pseudemys concinna

Florida-Rotbauch-Schmuckschildkröte
Pseudemys melsoni

Mississippi-Höckerschildkröte
Graptemys pseudogeographica

Zierschildkröte
Chrysemys picta

Chinesische Streifenschildkröte
Mauremys sinensis

Unterstützt durch:

The pond turtles in the Altrhein of Kehl

Where do the pond turtles come from?
The animals were sold in pet shops. It's expensive to keep them, they can get up to 50 years old and grow from year to year. Many keepers released them as they lost interest in their pets.

Alternatives to release them
If you cannot keep your pond turtle, you should actively search for a new home for them. Animal shelters only can take them if they have space.

Attention: Animals of the genus *Trachemys* (read- and yellow sliders) are an invasive species. They must be registered at the local conservation office.

There are many different species in the Altrhein!
There are 6 species of exotic pond turtles in the Altrhein, 5 from the USA. Around 40% of the individuals are sliders (*Trachemys scripta*), with the three subspecies read-eared, yellow-bellied and Cumberland slider. There are two species of the genus *Pseudemys*, map turtles (*Graptemys*), a few painted turtles (*Chrysemys*), and a few Chinese stripe-necked turtles (*Mauremys*).

Pond sliders: An invasive species!
Pond turtles (genus *Trachemys*) can breed and multiply in Europe. Thus, they are threatening our natural fauna and flora. They are also breeding at the Altrhein of Kehl. Because of this the EU categorised this species as invasive in 2016: It is illegal to trade, breed, or release them.

Problems for nature conservation
The pond turtles are omnivores, but they prefer animal food. Among others, they eat endangered amphibians and their tadpoles. Releasing exotic pond turtles can significantly change and damage our native ecosystems, especially in biodiversity hotspots.

Problems of animal welfare
These species are from the sub-tropics, where it's much warmer than in Kehl. It's too cold for them here. The animals grow slowly, can get sick, and in a very cold winter many of them might die.

§ Attention: Legal advice §
Releasing exotic animals is illegal § 40 Bundesnaturschutzgesetz (BNatSchG). After § 69 Abs. 3 Ziff. 17 BNatSchG the fine can be up to 10 000 €.

If you find clutches or animals, contact:
Environmental officer of the city of Kehl, telephone: 07851 88-4321.

Le cortège des tortues exotiques de l'Altrhein à Kehl se compose de sept espèces : six provenant du sud des États-Unis et une de Chine. Elles proviennent de régions plus chaudes, les relâcher dans la froideur de l'Artrhein est par conséquent contraire à l'éthique. De plus, ces espèces sont nocives pour la faune locale, pour les amphibiens particulièrement, leur seule présence crée donc d'importants problèmes dans l'environnement. Il est illégal de relâcher ces tortues dans l'Altrhein et l'amende pour ce délit peut atteindre 10 000 Euros.

Invasive red-bellied slider
Trachemys scripta scripta

Invasive red-eared slider
Trachemys scripta elegans

River cooter
Pseudemys concinna

Florida red-bellied cooter
Pseudemys melsoni

False map turtle
Graptemys pseudogeographica

Painted turtle
Chrysemys picta

Chinese stripe-necked turtle
Mauremys sinensis

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

119 **Interviews**

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

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

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

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

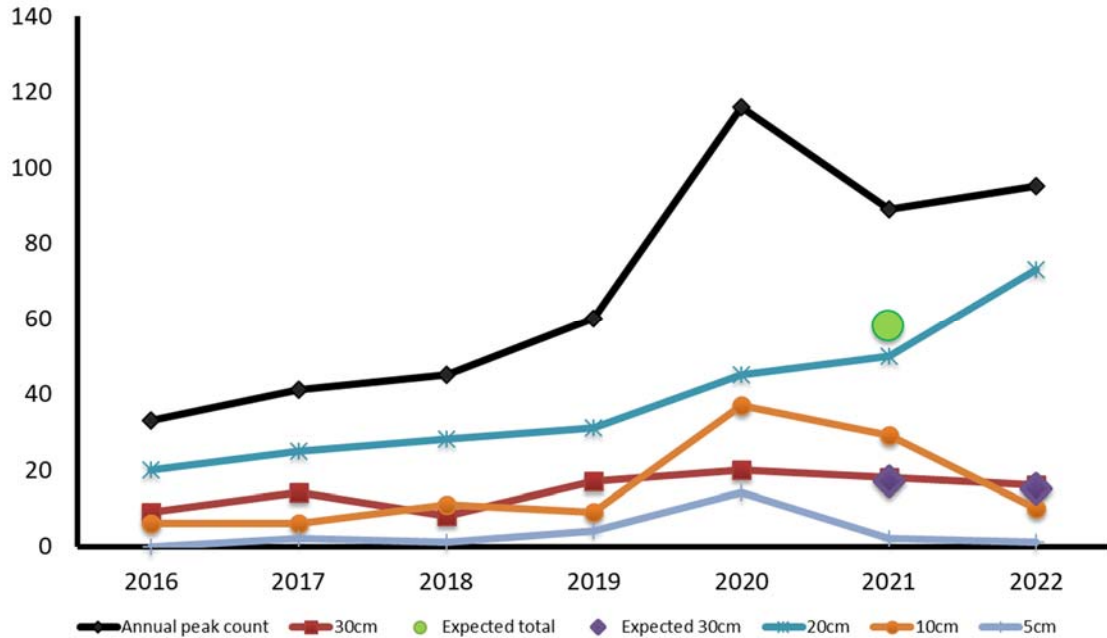
145
146 **Data analysis**

147 Data on pond turtle abundance are expressed as peak counts, the maximum number of live
148 individuals observed in one survey afternoon of a particular year. Data from the interviews were
149 analysed by comparing the ratios of correct answers vs. unknown plus wrong answers, comparing
150 between years or between people who read / did not read the sign, using the Fisher's Exact test.
151

152 **RESULTS**

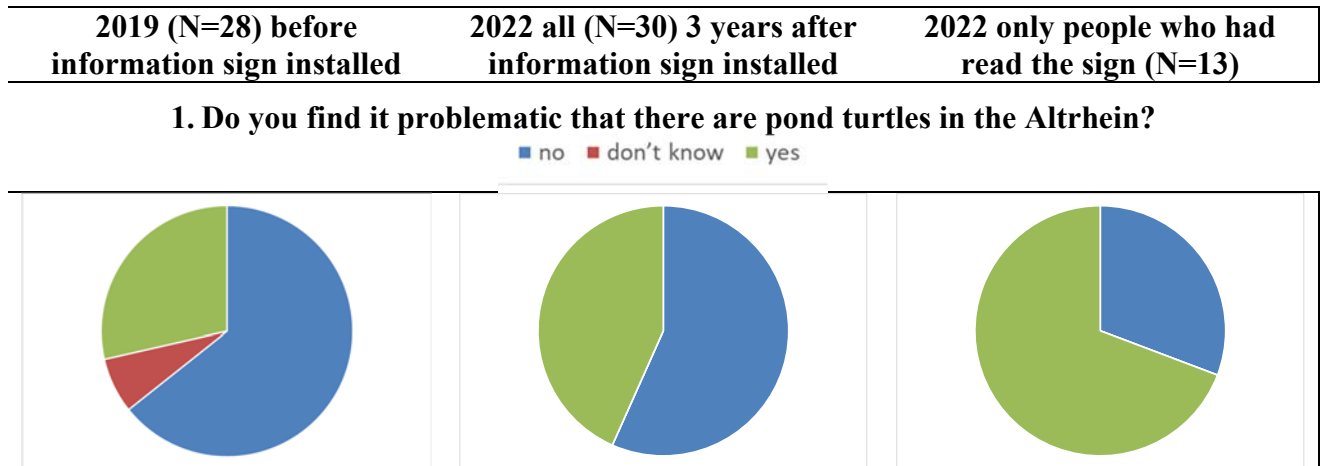
153 **Turtle numbers**

154 The annual peak counts increased continuously from 2016 to 2020, even after the information sign
155 was put up (Fig. 2). After the count in 2020 (May-July), 58 turtles were trapped and removed by
156 the end of July 2020. This influenced the expected pond turtle numbers for the following year: if
157 there was no recruitment in turtle numbers, I expected the peak count in 2021 to be similar to that
158 in 2020 minus 58; instead, it was higher in 2021 and further increased in 2022 (Fig. 2). The number
159 of very large pond turtles (carapax size 30 cm) did not increase after the information sign was put
160 up and was not higher than the expected peak number. However, the number of large pond turtles
161 (carapax size 20 cm) increased, which could be due to medium sized pond turtles (carapax size 10
162 cm) growing, as their numbers decreased (Fig. 2).
163



164
 165 **Figure 2.** Annual peak count for all turtle species in the Althrein of Kehl. In black, total numbers.
 166 In red shown are the very large turtles which are most likely to be released, in other colours smaller
 167 turtles. After the count in 2020, a total of 58 turtles were removed, indicated by the green spot as
 168 expected value for 2021 (count 2020-58). Of these 58 turtles, one was very large; additionally, two
 169 large turtles caught on land were removed in 2021. The diamonds indicate the number of expected
 170 large turtles if no new ones were released.

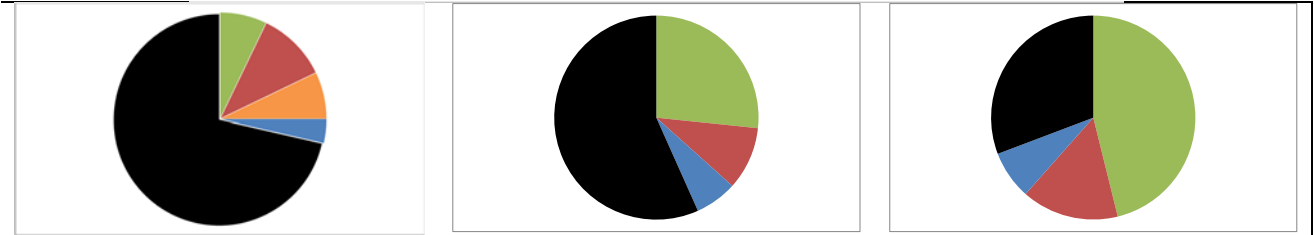
171
 172 **Responses to interview questions**



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?

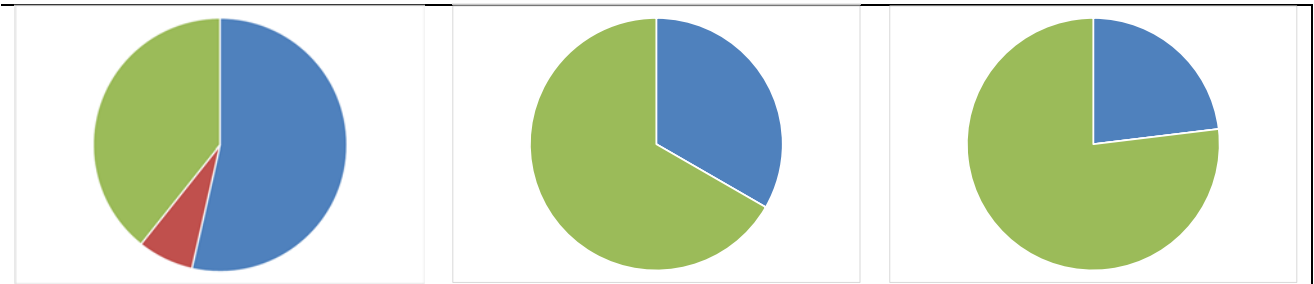
■ Nature conservation ■ Animal welfare ■ Don't know ■ Other ■ Its not problematic



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?

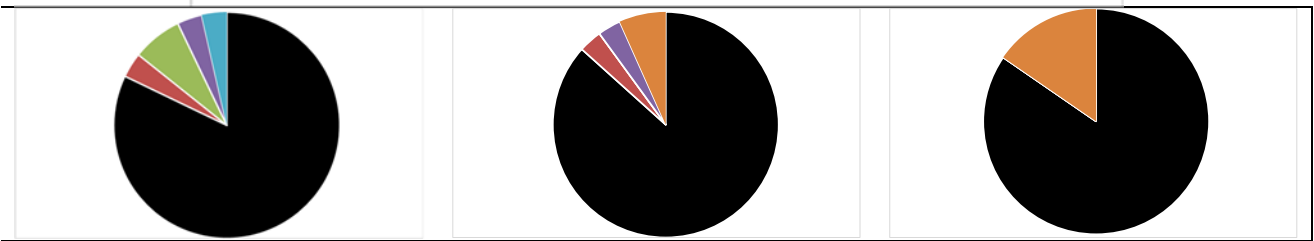
■ don't know ■ legal ■ illegal



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?

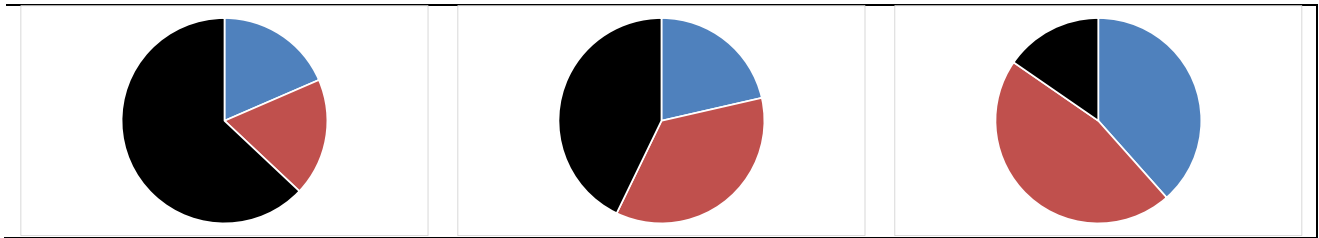
■ Animal shelter, zoo ■ Don't know ■ Release in Altrhein ■ Keep ■ Kill ■ Sell



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



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

177

178

DISCUSSION

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

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

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

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

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

220 The European Union demands that all member states should take action against invasive
221 species (European Parliament 2014) including *T. scripta* (European Commission 2016). In
222 Germany, it has been believed that it is too cold for the released individuals to survive for long
223 periods or to reproduce (Geiger & Waitzmann 1996; Pieh & Laufer 2006; Laufer 2007; Nehring
224 2016). The German action plan focusses on increasing public awareness (StA „Arten-
225 und Biotopschutz“ 2018), but this is neither enforced nor evaluated. A previous study,
226 demonstrating successful reproduction of *T. scripta* at the Altrhein of Kehl (Schradin 2020) and
227 the ever increasing population size there (Fig. 2), makes it clear that public awareness has to be
228 increased, and that additional actions are required (Teillac-Deschamps *et al.* 2009).

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

235

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238 Kinderakademie in Kehl, teaching 8 to 9 years old children about animal behaviour, population
239 biology, animal welfare and nature conservation. I am very thankful to the Hector Kinderakademie
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