

## **Project title: Transfer of evidence-based and co-produced Knowledge for Human Wolf Coexistence**

**Project number: SAW T46/2018**

**Project partners:** Senckenberg – Leibniz Institution for Biodiversity and Earth System Research; Leibniz Institut für Wissensmedien

### **Executive Summary**

Wolves have made a remarkable comeback in Germany, which has been perceived as an asset by most of the public. However, misinformation leading to an inflated perception of wolf-related risks can result in negative emotions and attitudes, with negative consequences for residents' quality of life and for wolf conservation. Our project aimed to counteract misinformation and improve human-wolf coexistence by providing a public digital application enabling the transfer of evidence-based information about wolves. Such an application is now available online and on a touchscreen media station in the Senckenberg Naturmuseum Frankfurt, and four additional media stations shall soon be placed at additional venues abroad.

The application features four different modules. In the information module, users can easily access information about wolf ecology, behavior, and human-wolf coexistence. In the quiz module, they can test their knowledge and gain information about wolves via the implemented feedback function. The survey module allows users to share their emotions, attitudes, and preferences regarding wolves and wolf management, and collects valuable data for future research on attitudes towards wolves and their drivers. The quiz and survey modules are available in six different languages to enable a quantification of the target variables across different cultural contexts.

The group-awareness module features an interactive interface where users can create graphic visualizations of the data collected in the survey and quiz modules. This allows them to independently i) discover links between knowledge, emotions, attitudes, and other parameters, ii) explore how those variables may vary within and between different societal or stakeholder groups, and iii) compare their own input to that of others.

For a more direct transfer and interaction with the public, we additionally engaged in several outreach activities. These included an exhibit on social-ecological wolf research, multiple Q&A sessions, a panel discussion, and an online wolf quiz hosted by Leibniz and t-online.

The project has yielded several important scientific results. We have developed and validated a survey instrument for quantifying wolf-related knowledge, emotions, attitudes, and perceived risks and benefits. In two separate online studies, we found that framing an informative text about wolves to match the readers' emotion towards wolves did not increase knowledge gained from the text, but that performing a memory retrieval practice before or after reading the text did. We have developed and validated a scale for quantifying media literacy, and developed a media literacy training. In an online study, we found that despite increasing participants' ability to identify a text with fake information about wolves as untrustworthy, our media literacy training did not prevent a negative attitude change after reading the text. Our findings highlight that more research will be needed to develop new approaches for effectively fostering factual knowledge that prevent negative impacts of misinformation on human-wolf coexistence.

### **1. Achievement of objectives and milestones**

Wolves show a remarkable comeback in Germany, whose wolf population has grown from zero in the 1990s to over 150 packs in 2023. To date, most of the public have perceived the wolf's return as an asset, but increasing political, societal, and media debates in combination with the growing wolf population can inflate the perception of risks associated with wolves. Resulting negative emotions may reduce residents' quality of life, cause societal conflict,

and/or pose a barrier to wolf conservation. To counteract misinformation and improve human-wolf coexistence, our project focused on fostering factual knowledge. The main objective was to develop an interactive digital tool for adaptive knowledge transfer. 'Adaptive knowledge transfer' refers to innovative approaches of knowledge transfer that allow to overcome potential transfer barriers such as confirmation bias, emotional barriers, low media literacy, or lacking trust in scientific institutions.

A central element of the developed digital application is the information module, which conveys insights from social-ecological wolf research in Germany and Europe (Milestone 1.1). To adapt this module to other ecological contexts (Milestone 3.1), it has been programmed to accommodate information about wolf ecology, behavior, and human-wolf coexistence also for Asia and North America. Most of the content for those additional ecological contexts has been compiled, but still needs to be uploaded.

To identify effective approaches for adaptive knowledge transfer, we first developed and validated psychometric scales for quantifying knowledge, emotions, attitudes, and perceived risks and benefits based on an extensive literature review (Milestone 2.1). We extended the literature review to other cultural settings, which allowed us to include items for cross-cultural comparisons of the target variables (Milestone 3.1). The developed instrument for quantifying knowledge, emotions, and attitudes towards wolves has been implemented in the digital application as a quiz and a survey module (Milestone 1.2), which are available in German, English, Swedish, Italian, French, Spanish, and Mongolian (Milestone 3.3).

Second, we tested different approaches for adaptive knowledge transfer (Milestone 2.3). In a first study we found that the approach suggested in the proposal, i.e., framing an informative text to match the reader's emotions towards wolves, did not improve knowledge gain. In a second study, we investigated how a memory retrieval practice would influence knowledge gain and attitudes towards wolves. We found that reading the informative text about wolves administered in the study led to higher knowledge and more positive attitudes towards wolves. Performing a memory retrieval practice before or after reading the text increased the observed knowledge gain, but not the attitude change.

To address potential barriers associated with low media literacy, we first developed a scale for measuring media literacy and successfully tested it in an online study (Milestone 2.2). Then, we developed a media literacy training, which proved to increase participants' media literacy in an online study (Milestone 2.5). We did not integrate the media literacy training into the digital application, however, because the resulting improved ability to identify a text with fake negative information about wolves as untrustworthy did not buffer against a deterioration in attitude towards wolves after reading the text.

The digital application also features a group-awareness module, where an interactive interface invites users to explore how attitudes and emotions towards wolves vary across and within countries, regions, and stakeholder groups, or with explanatory variables such as perceived risks or benefits of wolves (Milestone 2.4). Users who participate in the survey or quiz can also visualize their own responses in comparison to previous participants. This way, social-science research insights regarding human-wolf coexistence are not communicated top-down by a scientific institution, but the users can discover drivers of attitudes or differences between stakeholder groups (or between themselves and other users) on their own. This horizontal flow of information can help to overcome knowledge transfer barriers rooted in low trust in scientific institutions.

Aiming for an improved understanding of public wolf management preferences and their drivers, we have developed a concept for assessing management preferences via choice experiments in a game-like setting. The planned integration of the management game into the digital application (Milestone 1.3) and its extension to other social-ecological contexts (Milestone 3.2) were not possible, however, because the collaborator involved unexpectedly had to quit the project. To compensate, we have included several questions about management preferences in the survey module, which will allow us to investigate preferences of different stakeholder groups and link them to knowledge, attitude, and emotions.

The digital application is freely available online as a web version (<https://wolf.senckenberg.science>). Additionally, the application is running as an installable version on six media stations with a large touchscreen (Milestone 1.5). One of those media stations is accessible in a permanent exhibition at the Senckenberg Naturmuseum in Frankfurt, and another will be placed at a public venue in Frankfurt (Milestone 1.4). Communication to secure this as well as additional sites in natural history museums and public venues abroad is ongoing, with positive responses so far (Milestone 3.3).

As the digital application could only be launched towards the end of the project (see Section '2. Activities and obstacles'), the envisioned evaluation and update of its different modules (Milestone 1.6) could not be implemented.

There were some changes in the financial plan. We had to switch the digital agency programming the application, which resulted in a 30% increase of the Digital Agency budget. Travel costs (particularly outside Europe) were lower than expected due to travel limitations associated with the Covid-19 pandemic.

## 2. Activities and obstacles

The project was implemented jointly by the two project partners, Senckenberg – Leibniz Institution for Biodiversity and Earth System Research (SGN), and the Leibniz Institut für Wissensmedien (IWM), with support from various collaborators. SGN performed tasks associated with developing the digital application and making it available to the public. Administrative tasks included the procurement of touchscreen media stations, tender, and the contracting of digital agencies, photographers, and videographers. Other tasks included developing the overall application structure and hierarchy, regular meetings with the contracted agencies, communication with potential host institutions for the media stations, as well as assembling, uploading, and updating the content for the different modules of the application.

The IWM developed the scale for quantifying media literacy and the media literacy training, and validated them in an online study. The scales for measuring knowledge, emotions and attitudes towards wolves were jointly developed by both project partners, with critical input from additional collaborators (LUPUS institute, Norwegian Institute for Nature Research/Inland Norway University of Applied Sciences, Stirling University, Institute for Social-Ecological Research, Instituto de Estudios Sociales Avanzados). SGN and IWM did several online studies together where they validated the developed scales, quantified the target variables in different populations, and tested the suitability of emotion-matching as an approach for adaptive knowledge transfer.

Beyond that, SGN and the LUPUS institute were involved in several outreach activities (see Section '3. Results and Successes'), and SGN contributed to an online study investigating alternative approaches of adaptive knowledge transfer led by the DIPF - Leibniz Institute for Research and Information in Education.

SGN developed the concept for the management choice experiment with support from Stirling University and another project partner who unexpectedly had to quit the project before being able to implement the concept.

Delays in the schedule were caused by issues with the digital agency initially contracted to program the application, and by the Covid-19 pandemic. For example, we had initially planned to use a first version of the digital application to collect data on knowledge, emotions, and attitudes via our touchscreen media stations, and to then develop an updated version of the application based on the results emerging from the analysis of those data. This was not possible, however, because the first agency did not manage to program the application within the agreed-upon time scale, and museums, national parks, airports etc. were closed for a longer time period, which resulted in an overall later launch of the application.

All work performed was necessary and appropriate for achieving the project objectives. For some of the objectives, additional research will be needed to fully achieve them (e.g., effective

approaches for adaptive knowledge transfer fostering human-wolf coexistence by buffering against misinformation).

### 3. Results and successes

Two scientific publications resulted from the projects' scientific activities. Both center on an extensive literature review that the SGN postdoc performed as a basis for developing the survey instrument for cross-cultural comparisons of emotions and attitudes towards wolves and their drivers. A review article on societal attitudes towards the wolf's return to Germany, where collaboration partners at the LUPUS institute and the Norwegian Institute for Nature were also involved, was published in 'Natur und Landschaft', a peer-reviewed journal reaching conservation practitioners and scientists in Germany alike. A conceptual article on human relationships with wolves and other entities of nature, which involved our collaborator at the Instituto de Estudios Sociales Avanzados, was published open-access in 'People and Nature', an international journal with high visibility in the scientific community (Impact Factor 7.5).

Beyond the knowledge transfer approaches listed in the proposal, we also engaged in direct knowledge transfer via outreach activities. A major success was an exhibit on social-ecological wolf research that was developed by the SGN postdoc together with Germanisches Nationalmuseum – Leibniz-Forschungsmuseum für Kulturgeschichte aus Nürnberg. The swimming science center 'MS Wissenschaft' harbouring our exhibit toured more than 30 cities in Germany and Austria, with more than 65,000 registered visitors. Our exhibit featured a prototype of the quiz and survey modules of the application, which were completed > 600 and > 1,300 times, respectively. During the exhibition tour, we provided several opportunities to directly ask scientists involved in the project about our social-ecological wolf research. The SGN postdoc and our collaborator from the LUPUS institute offered Q&A sessions at the exhibit in Frankfurt and Potsdam, respectively, and two SGN scientists were part of a panel discussion and Q&A session (Dialog an Deck) about the wolf comeback in Germany.

Beyond that, the SGN postdoc engaged in a 'Science live' event at the AHA?! science lab of the Frankfurt Naturmuseum, where she presented the project to a diverse audience of more than 100 visitors, moderated a wolf quiz, and offered a Q&A session. The event also featured a prototype of the digital application, which allowed us to collect visitor feedback and implement it in a later version. Additionally, the SGN postdoc developed a wolf quiz for the Leibniz/t-online quiz series. As this wolf quiz has been taken more than 20,000 times since its launch in December 2021, the detailed information about wolves provided in the quiz feedback has reached a very large audience.

Envisioned future exploitations of the project results include the publication of our research findings gained from the various online studies mentioned in Section '1. Achievement of objectives and milestones'.

### 4. Equal opportunities, career development and internationalisation

Providing equal opportunities and internationalization were key criteria for the selection of project partners, and job advertisements for the project's postdoc positions explicitly encouraged female, non-binary, and disabled researchers to apply. As a result, 5 out of 9 collaboration partners are based outside Germany, and 7 of the 15 team members were female (including the SGN postdoc, 1 PI and 1 co-PI).

Both postdoc positions were assigned to early-career researchers. The SGN postdoc benefitted from the diversity of free courses available to SGN employees by participating in multiple soft skill and career development trainings (e.g., grant-proposal writing, science communication, open science, CV writing and applications, supervision of PhD theses).

## 5. Structures and collaboration

The project allowed us to further strengthen existing collaborations with the LUPUS institute, the Norwegian Institute for Nature Research, Stirling University, and the Institute for Social Ecological Research, whose joint expertise on social-ecological wolf research greatly benefitted the development of the quiz and survey modules. An important contribution to those modules was also gained from establishing a new collaboration with an expert in human-carnivore coexistence research and transfer at the Instituto de Estudios Sociales Avanzados. One of the co-PIs and one of the collaborating researchers remained involved in the project after changing their affiliation, which resulted in new collaborations with the Inland Norway University of Applied Sciences and Université Paris Saclay. Another new collaboration was successfully established with the DIPF - Leibniz Institute for Research and Information in Education, to investigate additional approaches of adaptive knowledge transfer.

## 6. Quality assurance

The SGN postdoc underwent a 1-day training in Good Scientific Practice before starting the position, and participated in an open-science workshop during the project. SGN regularly provides information on Good Scientific Practice for all staff, and an ombudsperson is available should any questions or issues regarding that topic arise.

In compliance with Open Science principles, the hypotheses tested in studies conducted during the project were pre-registered prior to data collection. Where possible, articles resulting from the project are published open access (no open-access option is offered by 'Natur und Landschaft'). The developed digital application is freely available online. Most of the outreach events were free entry. (The museum entry fee had to be paid for the Science live event, but no extra fee was incurred for attending the event).

No animal testing has been conducted in this project.

## 7. Additional resources

In-kind resources were generated in the form of personell costs. At both partner institutes, PIs and co-PIs not paid from the project led work packages and provided critical input. We estimate that those scientists at SGN and IWM together invested a total of 8 person months. Collaboration partners who were involved in developing the survey and quiz or the concept for the management game contributed another estimated 2.5 person months in total.

## 8. Outlook

The approach for adaptive knowledge transfer suggested in the proposal did not yield the expected results: Contrary to our prediction, matching the framing of an informative text to the reader's emotions towards wolves did not increase knowledge gain. A later study showed that a memory retrieval task, in contrast, resulted in a better uptake of information. However, while study participants had a more positive attitude towards wolves after reading the text, this effect was not increased by the memory retrieval task. Additionally, the media literacy training developed in the project was successful in improving study participants' media literacy. However, being able to identify a text as untrustworthy did not prevent study participants from having a more negative attitude towards wolves after reading the text. Consequently, more research is needed to investigate links between knowledge and media literacy on the one hand, and attitudes towards wolves on the other hand, and to identify effective approaches that not only increase factual knowledge about wolves, but also contribute to a functioning coexistence of humans and wolves by preventing negative impacts of fake information.