



Data Article

Multi-level network dataset of ten Swiss wetlands governance cases based on qualitative interviews and quantitative surveys



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ABSTRACT

The dataset of this paper originated from quantitative online surveys and qualitative expert interviews with organizational actors relevant to the governance of ten Swiss wetlands from 2019 till 2021. Multi-level networks represent the wetlands governance for each of the ten cases. The collaboration networks of actors form the first level of the multi-level networks and are connected to multiple other network levels that account for the social and ecological systems those actors are active in. 521 actors relevant to the management of the ten wetlands are included in the collaboration networks; quantitative survey data exists for 71% of them. A unique feature of the collaboration networks is that it differentiates between positive and negative forms of collaboration specified based on actors' activity areas. Therefore, the data describes not only if actors collaborate but also how and where actors collaborate. Further additional two-mode networks (actor participation in forums and involvement in other regions outside the case area) are elicited in the survey and connected to the collaboration network. Finally, the dataset also contains data on ecological system interdependencies in the

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form of conceptual maps derived from 34 expert interviews (3–4 experts per case).

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Specifications Table

Subject	Social Science
Specific subject area	Governance of social-ecological systems
Type of data	Tables & Graphs
How data were acquired	Qualitative expert interviews across ten cases with 34 participants. Quantitative online surveys (see Repository/data_gathering) across ten cases with 371 participants.
Data format	Raw and partially filtered because of reasons of confidentiality.
Description of data collection	The goal of the sampling is to include the set of most important actors relevant to wetland management in the respective case study area. In order to arrive at this set of actors, we rely on a combination of decisional, positional, and reputational approaches (Knoke, 1993). From this initial set of actors, some actors that are exceptionally experienced in the local case study areas are selected for expert interviews. The expert interviews should give a qualitative overview of local wetland governance processes from different perspectives and complement the initial selection of actors. For the survey, all actors identified using the combination of decisional, positional, and reputational approaches, as well as additional actors that are mentioned to be relevant by experts, are included. The expert interviews were organized as semi-structured face-to-face interviews. Instead of transcribing the interviews, we used the experts' statements in the interview to construct a conceptual map that was also used to guide the interviews. An online survey to gather quantitative data on actor networks, activities, and additional characteristics was sent to all actors identified beforehand and a few other actors that were identified later during the survey process. Depending on the location of the case study area, the survey was made available in one or multiple of the following languages: German, French, and Italian. The case study areas are located in either German-, French-, or Italian-speaking regions of Switzerland or on the border of two language regions.
Data source location	Country: Switzerland, Regions (see Fig. 3 for map of cases): Rhein (Canton Graubünden / St. Gallen) Murtensee (Canton Freiburg / Waadt) Reussebene (Canton Aargau / Zürich / Zug) Rhonemündung (Canton Wallis / Waadt) Neuenburgersee (Canton Graubünden / St. Gallen) Sense (Canton Freiburg / Neuenburg / Waadt) Alte Aare (Canton Bern) Maggia (Canton Tessin) Untere Saane (Canton Freiburg) Bolle (Canton Tessin)
Data accessibility	Repository name: Zenodo identification number: 10.5281/zenodo.6907175 Direct URL to data: https://doi.org/10.5281/zenodo.6907175

Value of the Data

- The dataset is particularly useful as it combines social and ecological interdependencies into one multi-level network. Therefore, collaboration patterns can be analyzed using underlined structures of the ecological and/or social systems. Further, the multi-level networks are not only available for one wetland but across ten comparable cases. The comparative setting across multiple cases for multi-level networks of social-ecological systems is unique and allows to analyze the results within and across cases.
- All research interested in the governance of ecosystems and intertwined social-ecological systems can benefit from the dataset. While the separate analysis of the social and ecological systems included in the data is possible, the dataset is particularly valuable for researchers interested in the analysis of interdependent systems.
- The dataset is valuable to researchers who want to compare our analysis results on social-ecological networks with other cases around the world. Further, the nested structure of the multi-level networks enables the analysis of the dataset from multiple perspectives, many of which are not yet fully exploited. Finally, the dataset can also be used by researchers who want to perform a systematic review and meta-analysis study in the future.
- The dataset can be used to inform policy making in wetlands and, more broadly, for the governance of threatened ecosystems. Especially for policies that want to promote integrated, collaborative governance approaches, the data set gives valuable insights as it combines information on collaborative structures among actors with information on environmental interdependencies.

1. Data Description

We collected data from ten cases of wetlands governance in Switzerland that are presented in the form of a separate multi-level network for each case. For each case, face-to-face interviews with at least three local experts for the management of those wetlands were conducted. In the following, online surveys were sent out to all actors present in the wetlands and relevant for the wetlands governance. The survey structure was identical for all cases, but some of the questions were slightly modified to fit the particular case settings. The questions for the expert interviews, the online survey, all resulting datasets, and the codebooks describing the variables are available through the Zenodo (see [Table 1](#) for the structure of the dataset [1]).

Primarily, the dataset contains information to construct the multi-level networks from sub-networks across all cases. Network data on two unipartite (actor collaboration and conceptual maps) and two bipartite (forum participation and involvement outside wetland area of actors) is stored in edge list form containing a specific set of links and link attributes between network nodes. Second, two-node attribute datasets contain additional node attributes for nodes present within collaboration networks and conceptual maps. The dataset also contains supporting information on the data gathering, case information, and structure of the dataset.

The dataset is structured around the collaboration network of actors (Dataset ID: 2). Further, a conceptual map – or ecological network – exists that conceptualizes ecosystem interdependencies relevant to the governance of those wetlands (Dataset ID: 8). Additionally, three two-mode networks exist that are connected to the collaboration network (see [Fig. 1](#) for an illustration of the interdependencies between datasets). The first two-mode network has actors and activities as the two types of nodes, and ties indicate for which activities actors are responsible (Dataset ID: 3). Note that even though the networks from all cases are aggregated together, no ties between the cases are possible. The nodes in the second two-mode network are actors and forums, and ties exist when actors participate in a forum (Dataset ID: 4). The third two-mode network has actors and outside areas as the two types of nodes (Dataset ID: 5). Outside areas are wetlands not directly included in the analysis but located within the same region. A tie between an actor and an outside area exists if an actor is active in one or multiple of those outside areas. Further, power relations among actors are stored in a directed network dataset where a tie

Table 1
Overview of datasets.

	Dataset ID	Data content	Data file name
Survey data	1	Node attributes of actors	dataset/1_na_actors.csv
	2	Edge list of collaboration networks	dataset/2_el_collab.csv
	3	Edge list of two-mode network actor-activity	dataset/3_el_actor_activity.csv
	4	Edge list of two-mode network actor-forum	dataset/4_el_actor_forum.csv
	5	Edge list of two-mode network actor-outside area	dataset/5_el_actor_outside.csv
Interview data	6	Edge list of power relations	dataset/6_el_actor_power.csv
	7	Node attributes of conceptual map	dataset/7_na_conceptual_map.csv
Cases	8	Edge list of conceptual maps	dataset/8_el_conceptual_map.csv
Supporting information	9	List of cases	dataset/9_cases.csv
	10	Codebook	codebook.csv
	11	Interview structure	data_gathering/interview_structure.pdf
	12	Survey structure (German)	data_gathering/survey_structure_de.pdf
	13	Survey structure (English)	data_gathering/survey_structure_en.pdf

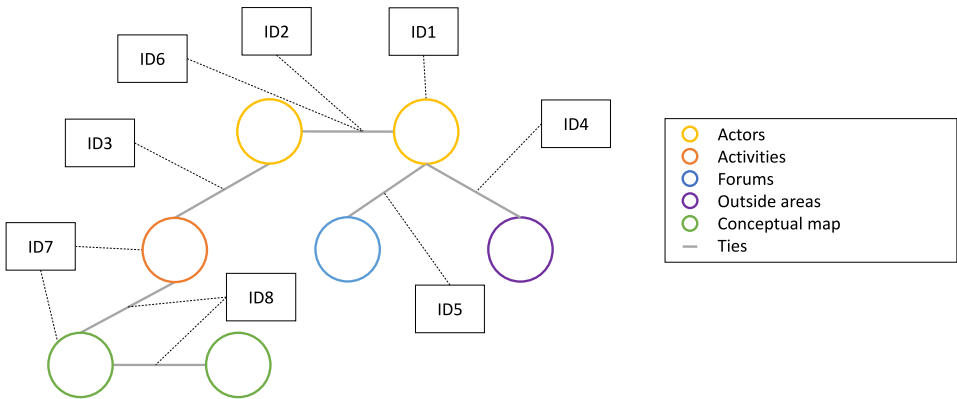


Fig. 1. Illustrations of the interdependencies between the datasets.

indicates that a sender perceives the receiver to be powerful related to a prioritized outcome of wetlands governance in a given case (Dataset ID: 6). Actors can perceive other actors to be powerful regardless of whether they share a collaboration tie or not. Additional to the network, multiple datasets contain information on the network nodes (Dataset ID 1 & 7) that are also mostly based on interviews and surveys. Besides the datasets ID 1-8 mostly based on interviews and surveys a separate dataset lists all the relevant cases (Dataset ID: 9). Finally, the last three-three datasets contain information on the interview and survey structure (Dataset ID: 11-13). For confidentiality reasons, any comments, qualitative data, or other personal information such as contact details of actors were removed from the dataset.

1. Node attributes of actors – survey data

The survey participants were asked multiple questions that served to characterize the participants. Those questions can be grouped into two categories. First, the participants were asked to rank outcomes related to the governance of wetlands based on their prioritization and describe the state of those outcomes on a 3-point scale. Second, participants were asked if they agreed to some wetland-specific statements based on a 4-point scale. Further, some information that was

easy to gather by the researchers and/or not possible to ask for by the participants was added manually. This includes information on (1) actor type (state actors, cantonal actors, municipal actors, NGOs, and associations, and others), (2) the region an actor is active in on the level cantons (the equivalent of states in the US), and (3) if actors responded to the online survey.

Not all of the questions mentioned above are relevant to all the survey participants as the statements are sometimes specific to one particular case. In such cases, "NR" indicates that those questions are not relevant for those specific actors.

2. Survey data – Edge list of collaboration networks

To elicit collaboration ties between actors, participants were confronted with a list of potential collaboration partners. Potential collaboration partners are actors that are present in the wetlands and directly or indirectly relevant to the management of the wetlands. Collaboration exists when actors exchange information, collaborate on projects, or if actors generally have worked together within the past three years. The participants could choose collaboration partners from this list but also add further collaboration partners if needed. Actors not included in the list of collaboration partners but still mentioned by multiple participants were in a follow-up also asked to participate in the survey. Further participants are also asked to indicate based on which ecosystem management activities they collaborate with other actors and if the collaboration is mostly positive or negative. Positive/Negative collaboration exists when participants agree/disagree with their indicated collaboration partner regarding management outcomes and approaches to reach those outcomes relevant for the indicated activity.

3. Survey data – Edge list of two-mode network actor-activity

In the survey, participants were confronted with a list of ecosystem governance activities present in the conceptual map of the specific wetland. Based on their answers, a two-mode network is constructed where actors can have one or multiple outgoing ties connecting them with ecosystem management activities. The actor-activity network can be used to connect the conceptual map (Dataset ID 7) with the collaboration network (Dataset ID 2). Information on the network nodes can be found in datasets ID 1 & 6.

4. Survey data – Edge list of two-mode network actor-forum

The survey also included one question where the participants could indicate from a list of forums where they participated or also add new forums to the list. Forums are organizations or platforms that enable cross-sectoral coordination; that is, they facilitate contact among actors from public administration, science, and public and private interest organizations. Based on the answers from the participants, a two-mode network with directed ties from actors to forums is constructed. Further Information on the actor nodes can be found in dataset ID 1.

5. Survey data – Edge list of two-mode network actor-outside area

The survey also included one question where the participants could indicate from a list of wetlands outside the case areas but still in the same region if they are active there. Additionally, participants could also add new areas to the list. Based on the answers from the participants, a two-mode network with directed ties from actors to outside areas is constructed. Further Information on the actor nodes can be found in dataset ID 1.

6. Survey data – Edge list of power relations among actors

In the survey, participants also had to indicate which other actors they perceived to be powerful for achieving the governance outcome that is most important for them. Actors could therefore choose from the same list of actors that are also potential collaboration partners regardless if they prior choose them as collaboration partners or not. For every other actor they perceive to be powerful, a directed tie exists. Further Information on the actor nodes can be found in dataset ID 1.



Fig. 2. Cutout from the conceptual map from Alte Aare that shows how ecosystem management activities (blue), factors (orange), and outcomes (yellow) are connected by positive (blue) and negative (red) ties.

7. Conceptual map – Node attributes of conceptual map

The node attributes of the conceptual maps are based on three questions from the expert interviews:

1. The participants were asked what relevant outcomes to the management of the specific wetland are. Outcomes can be objectives to nature conservation and generally to activities present in the wetlands (e.g., biodiversity or recreational value). Also, the participants had to indicate how they would describe the state of the outcomes based on a 3-point scale. As the outcome state is only relevant for the outcome category, it is for all other categories in the dataset marked as not relevant ("NR").
2. Participants were asked which threats and chances (e.g., water quality or fish population) directly or indirectly impact the achievement of the governance outcomes mentioned before. Later threats and chances were combined to general factors.
3. The participants had to indicate which ecosystem management activities (e.g., fishing or hiking) influence the factors present in the wetland. The activities are later grouped into multiple categories (e.g., leisure-related activities) by the researchers.

For each case, outcomes, factors, and ecosystem management activities are elicited multiple times based on separate expert interviews and later aggregated by the researchers (see section Data gathering for further information on the conceptual maps).

8. Conceptual map – Edge list of conceptual maps

To construct the conceptual map (see Fig. 2), the participants in the expert interviews were not only asked about outcomes, factors, and ecosystem management activities as described above but also about interdependencies between the three types of nodes. However, not between all types of nodes ties are possible. Activities can only have a tie to factors but not to other activities or outcomes. Factors can have ties to all the others nodes and also to other factors. Outcomes can have ties to all the others nodes but not to other outcomes. All ties are directed and are either positive or negative. However, the positivity/negativity of the ties is not based on the expert interviews but later added by the researcher. An example of a positive impact is the operation of a wastewater treatment plant that improves water quality. It is important to mention that the level of the factors is never specified, and the ties just describe a general increase/decrease but do not give any information about the actual level of the factors. As for the dataset ID 7, separate conceptual maps are elicited in the expert interviews and then later aggregated on a case level by the researchers.

9. Cases – List of cases

This dataset gives basic information on the cases and the data gathering process. This includes information on the researchers responsible for the data gathering, the expert interviews, and further information on the case areas. Finally, also the shortcodes for the names of the cases are listed, which are used later in the other datasets when referring to individual cases.

10. Supporting information – Codebook

The codebook lists all column names of the datasets and gives information about the type of content and how the content needs to be interpreted. The information is grouped in four categories: 1) An identifier that specifies the relevant dataset, 2) The name of the variable, 3) The type of the variable (e.g., number or character), and 4) A short description for the interpretation of the variable.

11. Supporting information – Interview structure

The dataset ID 11 contains information about the organization of the semi-structured expert interviews. As the interviews are semi-structured, not a full transcript of the questions are listed but rather key elements and concepts that should be explained in the same way for all the expert interviews.

12/13. Supporting information – Survey structure

The dataset ID 12/13 contain information about the survey structure. To ensure the long-term availability of the dataset ID 12/13, not the original online survey, but a simplified offline version is provided where variables items are marked in square brackets. Dataset ID 12 contains the original survey version in German, and dataset ID 13 contains the English translation of it.

2. Experimental Design, Materials and Methods

2.1. Case selection

We selected the ten cases of wetlands (see Fig. 3) in Switzerland based on multiple criteria. First, only wetlands were considered that are listed in the inventory for alluvial wetlands of national importance [2]. This ensures that all areas show characteristic features of Swiss wetlands. Second, the case selection covers different regions and cantonal administrations across Switzerland to account for geographical and socio-cultural diversity. While some cases are located within one canton's administration area, other cases cut across cantonal borders and are governed by multiple cantons. Third, types of wetlands were selected that represent goal conflicts between societal, economic, and ecological interests. Therefore, the focus lies on river wetlands and wetlands along lakes, often located in densely populated areas. Finally, the wetlands' size was also a factor when deciding on the case selection of the wetlands. Small wetlands (< 0.6 km²) were excluded from the study to avoid cases with only a few actors. To identify cases based on the criteria listed above, we used ArcGIS (Geographic Information System) [3]. ArcGIS particularly supports the identification of cases of wetlands that are split up into different sections but still form one wetlands system due to factors such as spatial proximity or presence in the same river catchment areas. From the wetlands that fulfill all criteria, we selected ten cases across Switzerland that are included in the analysis.

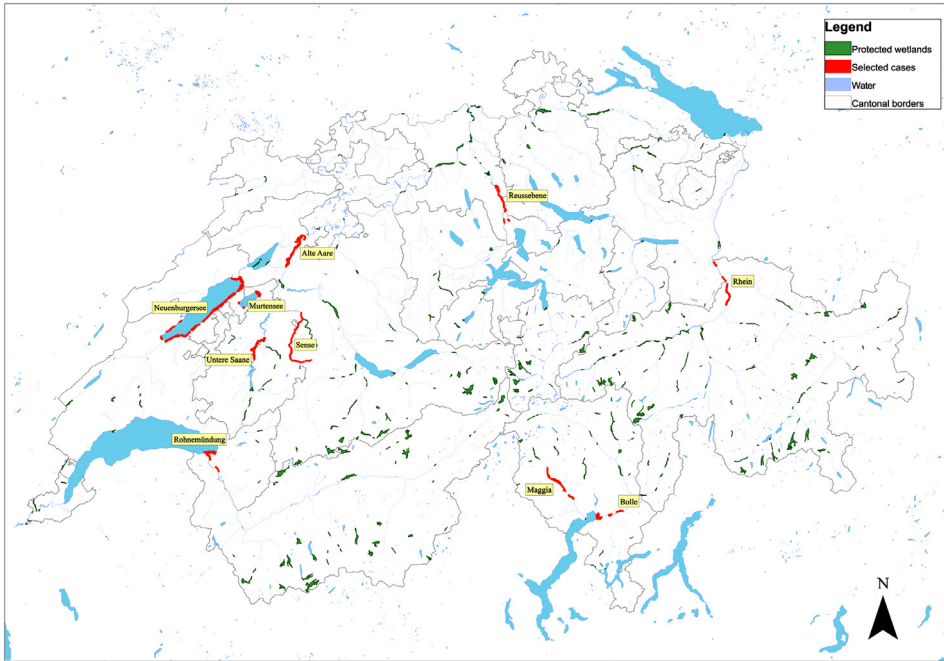


Fig. 3. Map of Switzerland with the ten selected wetlands in red and other protected wetlands listed in the inventory for alluvial wetlands of national importance in green.

2.2. Data gathering

The data gathering was conducted in three phases from 2019 to 2021. The first phase of the data gathering aims to confirm the case areas and identify an initial set of relevant actors. To analyze the case-specific institutional settings, desktop research included documents, such as action plans, project reports, fact sheets, or monitoring reports. The case selection was also discussed together with the Federal Office of the Environment (FOEN) for its external validation. To identify an initial set of actors, we used a combination of decisional, positional, and reputational approaches [4] to analyze the data from the document analysis. First, we identified actors with decisional power, that is, actors that participate in events relevant to wetland governance in the case areas. In line with the positional approach, we identified actors with formal decision-making positions in deciding about processes relevant to the wetland governance in the relevant areas. Those actors do not need to be present at events but can influence the decision-making process, such as the government or parliament. Finally, in line with the reputational approach, we validated the actors identified with local experts in the area. The combination of decisional, positional, and reputational approaches allows us to identify the most relevant actors for the cases.

The second phase of the data gathering is based on expert interviews with a limited number of experienced actors for each case. The experienced actors are selected out of the actor list from the initial data gathering phase. The selection of experienced actors is not based on quantitative criteria but should give a qualitative overview of local wetland governance processes from different perspectives. Therefore, we equally included cantonal, municipal, and private actors for the expert interviews. The expert interviews (for details on the structure of expert interviews, see [Repository/data_gathering/interview_structure](#)) were organized as semi-structured interviews aimed at developing a conceptual map of the area based on the Open Standards (OS)

framework [5]. The OS framework is applied and developed mostly by conservation practitioners to inform projects by structuring the governance of ecosystems as conceptual maps. Therefore the OS framework is well suited to capture issues related to the governance of ecosystems. The conceptual maps are structured based on the categories of ecosystem management activities of actors, threats/chances (direct and indirect), management outcomes, and interdependencies between the latter ones. The threats and chances were later aggregated to factors (in some of the publications on the dataset, factors are also referred to as ecological issues). The individual conceptual maps from the expert interviews were later aggregated on the case level by the researchers. The aggregation of the conceptual map was done in a collaborative and iterative effort between the involved researchers till further iterations did not result in any changes anymore. Together with the initial analysis, the conceptual maps aggregate and illustrate the available case knowledge.

The case knowledge from the first two phases of data gathering is then used in the third phase to construct a survey (for details on the structure of surveys, see Repository/data_gathering/survey_structure) sent out to all previously identified actors relevant to the governance of the wetlands. To build the survey, we used LimeSurvey [6]. The survey is mainly used to identify which actors collaborate for the governance of wetlands. Additionally, the survey also assessed the achievement of individual governance outcomes and which actors are especially influential in achieving those governance outcomes. Besides, the survey also explores how the participants perceive governance settings and if they agree with current governance decisions. Finally, the participants also had the chance to add additional actors, which were then also included in the survey if relevant.

Survey participation ranged from 26 to 52 across cases (median 32), which accumulates to a total number of 371 actors and a response rate of 71%. The number of actors in the dataset is, however, higher as all actors are included in the dataset regardless of whether they participated. To account for missing data due to the non-response but also as not all questions were answered by all participants, imputation should be considered. One way to do so is by imputing missing information using the mice package [7] in R to estimate incomplete multivariate data by chained equations.

Ethics Statement

All interviewees and survey participants were thoroughly informed about the content and the scope of the study before participation. Thus, informed consent was obtained from the participants prior to the interviews/surveys. Participation was completely voluntary. Moreover, the anonymity of the data is guaranteed by excluding all personally identifiable information of respondents. No further ethical approval was not needed as the participants represent organizations and not individuals. Therefore, no personal, sensitive information is included in the dataset.

CRedit Author Statement

Lavinia Tommaso: Data gathering (survey management and interviews), Data curation; **Rea Pärli:** Data gathering (interviews), Data curation; **Iris Bhatia:** Data gathering (interviews), Data curation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships which have or could be perceived to have influenced the work reported in this article. The research leading to these results has received funding from the Swiss National Sci-

ence Foundation (SNF) for the project: Ecosystem governance and socio-ecological networks in Switzerland: bringing politics back in.

Data Availability

Data for: Multi-level network dataset of ten Swiss wetlands governance cases based on qualitative interviews and quantitative surveys (Original data) (Zenodo).

CRedit Author Statement

Martin Nicola Huber: Data curation, Conceptualization, Writing – original draft; **Mario Angst:** Data curation, Conceptualization, Writing – review & editing; **Manuel Fischer:** Supervision, Writing – review & editing.

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