ValPar.CH

Working Paper

How can pluralist nature valuation impact Switzerland's biodiversity? Insights from the ValPar.CH project

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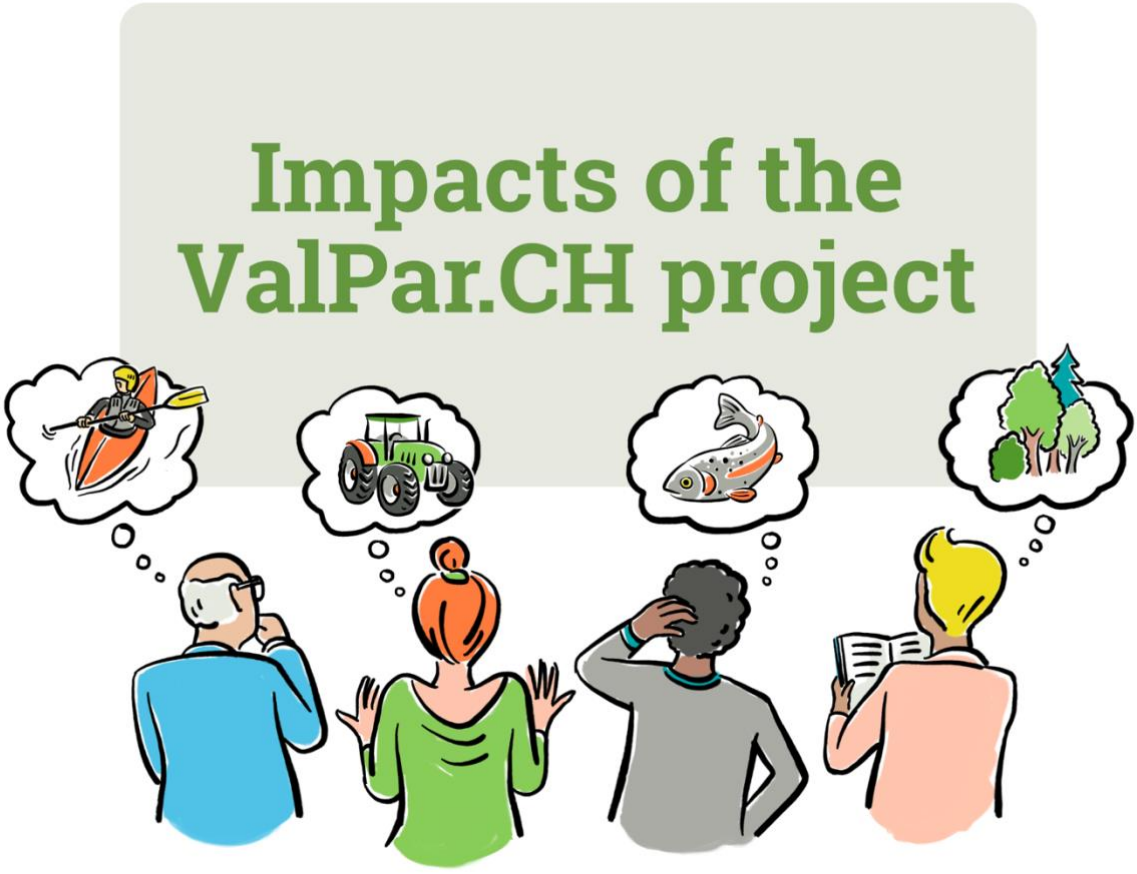

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Abstract

In the past, biodiversity research and conservation has often suffered from a narrow focus on either the instrumental or the intrinsic value of biodiversity. Authors and stakeholders from diverse knowledge systems have instead argued for the need to mobilize value pluralism in transdisciplinary approaches. However, the transformative potential of these approaches remains understudied. In this paper, we evaluate the potential impact of pluralist nature valuation on Switzerland's biodiversity by focusing on the transdisciplinary project ValPar.CH.

We collected data through semi-structured interviews and workshops held with the project's researchers and stakeholders to explore how they think about potential impacts. These data were analysed based on two frameworks used in international biodiversity and sustainability debates: theory of change and values-centred leverage points. Regarding the theory of change, we identified 11 pathways linking ValPar.CH's outputs to potential outcomes. Seven of these pathways originated from outputs explicitly planned for by the project. They emphasized that the knowledge produced can change the attitudes and skills of stakeholders whose decisions affect the state of biodiversity. Four pathways originated from unplanned outputs and stressed that the project can lead to collective learning and change power relations underlying the state of biodiversity. Regarding the values-centred leverage points, most statements about ValPar.CH's potential impacts on Switzerland's biodiversity elaborated on how the project's pluralist valuation can be integrated into current decision-making processes.

Based on our results, we suggest measures to maximize ValPar.CH's impacts. These include the re-examination of impact pathways based on the knowledge deficit model, the consideration of the effects of implicit outputs, the design of pathways to simultaneously activate different leverage points, the implementation of capacity building activities, the design of interventions to minimize oppositional forces to biodiversity conservation, and the explicit consideration of attitudes and social norms in the context of behavioural change.

This paper can provide inputs for federal and cantonal authorities, stakeholders and researchers to design follow-up activities that maximize transformative capacities for Switzerland's biodiversity in the context of the Swiss Biodiversity Strategy and beyond.

Content

1. Introduction

Transdisciplinarity is a research approach where researchers, stakeholders and citizens co-produce knowledge with the goal of solving complex social problems (Darbellay et al., 2014). This research approach has been used to address problems related to sustainability (Tejada et al., 2019) such as biodiversity loss (Margules et al., 2020). Scientists have developed methods to assess whether their transdisciplinary research contributes to solving the problems it is meant to solve and, if so, how (Hansson and Polk, 2018; Tobias et al., 2019; Schäfer et al., 2021, 2020; Pärli, 2023). These efforts are often driven by a desire to strengthen the transformative capacity of transdisciplinarity in the face of urgent sustainability problems. One of the main approaches used is the theory of change, which provides an explanation of how and why an activity such as a transdisciplinary project is expected to contribute to a process of change (Belcher & Claus, 2020; The Center for Theory of Change, 2023). For example, a theory of change approach can be used to assess the effectiveness of biodiversity conservation interventions as against baseline data and other factors with a potential effect on biodiversity (Zavaleta Cheek et al., 2023). New assessments of the potential capacity of transdisciplinarity to solve complex social problems are however needed.

In turn, the alarming pace of global biodiversity loss (IPBES, 2019) has prompted scholars to argue for more pluralist approaches to conservation. These approaches have been presented as an opportunity to acknowledge the perspectives from different knowledge and value systems on what should be conserved and why, in order to facilitate new alliances in pursuit of fair conservation (Pascual et al., 2017, 2021). Even if pluralist approaches share principles and practices with transdisciplinarity – e.g., a preference for participatory methods – their emergence is more recent, and their goal is more focused on nature. In particular, pluralist approaches aim at addressing the mismatch between how nature is valued by the mainstream conservation movement – either intrinsically or instrumentally – and the more diverse ways in which humans value nature (Pascual et al., 2021; Obura et al., 2021). In other words, neither the intrinsic nor the instrumental value of nature alone resonate with the ways in which most people in the world perceive and value nature in their everyday lives (Chan et al., 2016). Pluralism in nature valuation is thus increasingly invoked to catalyse transformative change towards a sustainable future (IPBES, 2022). To understand how transformative change can be catalysed by value pluralism, the notion of values-centred leverage points has been recently introduced (Pascual et al., 2023). Leverage points are places[1] where one can intervene to effect system transformation, and they have varying transformative potential, from low to high (Meadows, 1999). Values-centred leverage points are leverage points that mobilize value pluralism, such as for example embedding valuation into inclusive decision-making (Pascual et al., 2023). However, research on the potential mechanisms through which pluralist nature valuation can trigger transformative change is only beginning, and more studies are needed.

This working paper assesses the potential impact of pluralist nature valuation on biodiversity by focusing on the project ValPar.CH. ValPar.CH was a transdisciplinary research project on the values of ecological infrastructure commissioned by the Swiss Federal Office for the Environment (FOEN) and funded through the Action Plan of the Swiss Biodiversity Strategy as a pilot project (FOEN, 2017). It run between 2020 and 2024 and its goal was to analyse the values and benefits of ecological infrastructure – or more broadly of biodiversity and nature's contributions to people (NCP) – from a social, economic and ecological perspective (Reynard et al., 2021). A functioning ecological infrastructure was considered the basis to ensure the maintenance of biodiversity and the supply of

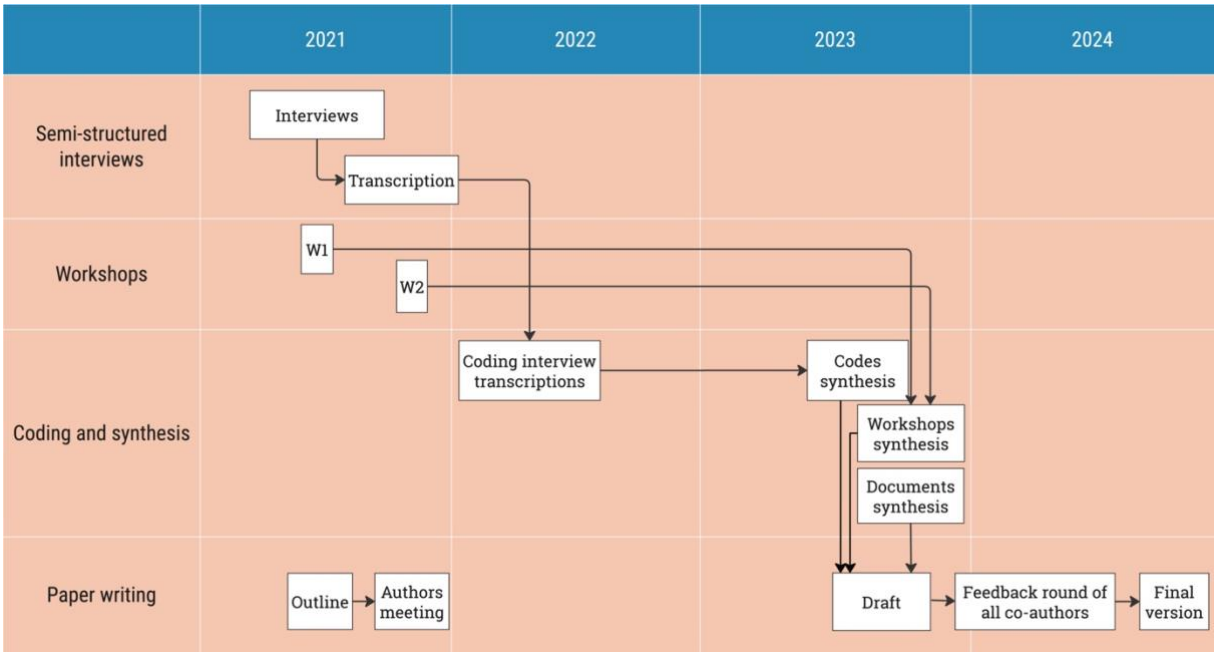
[1] *Places* is the word used by Meadows to define leverage points, although they go well beyond the geographic connotation of the word *place*. In particular, she defines leverage points are "places within a complex system (a corporation, an economy, a living body, a city, an ecosystem) where a small shift in one thing can produce big changes in everything" (Meadows, 1999: 1).

NCP (Grêt-Regamey et al., 2021).[2] ValPar.CH's team consisted of over 30 researchers from five Swiss universities with diverse expertise in the natural sciences, social sciences, and the humanities. This team collaborated with various stakeholders in four Swiss regional natural parks, public authorities at national, cantonal, and municipal levels, as well as the civil society.

2. Methods

To explore the potential impacts of ValPar.CH on the state of Switzerland's biodiversity, we combined different methods as summarised in Figure 1. We collected data from semi-structured interviews and workshops held with the project's researchers and stakeholders. These data were then coded and synthesized based on two complementary frameworks: the theory of change (Belcher et al., 2020) and the values-centred leverage points (Pascual et al., 2023) (Figure 2). In line with other self-reflexive approaches (Otero et al., 2017, 2020; Schneider et al., 2019), we studied how our transdisciplinary team expresses its ideas about the potential impacts of its research.

Figure 1. Methodological workflow to explore potential impacts of ValPar.CH on Switzerland's biodiversity. The size of the boxes indicates the duration of the different tasks. W = Workshop.



Source: own elaboration.

2.1. Semi-structured interviews

Semi-structured interviews were conducted with seven researchers working in ValPar.CH and with five stakeholders outside academia that collaborated with the project. Researchers were chosen to ensure diversity across disciplinary backgrounds (biology, environmental planning, economics, political science, etc.), institution (the five universities of the partnership), career stage (interviewees ranged from PhD students to full professors), and role within ValPar.CH (working in different modules with varying responsibilities). Some researcher interviewees are co-authors of this paper. We interviewed four out of the six stakeholders that are closely collaborating with ValPar.CH (from FOEN, the inter-cantonal Conference of Delegates for Nature and Landscape Protection, and two of the four ValPar.CH study regions (regional nature parks)) as well as one additional stakeholder (from the

[2] See Grêt-Regamey et al. (2021) for the concrete definition of ecological infrastructure used in the ValPar.CH project in relation to other notions such as green infrastructure or nature-based solutions.

Ecological Infrastructure Competence Centre). In total, eight of the interviewees were men and 4 were women.

Interviews were conducted in 2021 by using an interview guide that allowed us to gather comparable qualitative data across interviewees while being open to follow unexpected leads from the conversation (Bernard, 2002). The interview guide covered two main themes: i) inter- and transdisciplinary aspects of the project, and ii) the interviewee's conceptions of nature and nature's values. This paper used data only from the first theme, in particular from the questions *How do you think ValPar.CH can contribute to the Swiss Biodiversity Strategy?* and *How do you think ValPar.CH can contribute to improve biodiversity in Switzerland?* (see more details about the interviews in Otero et al., in press).

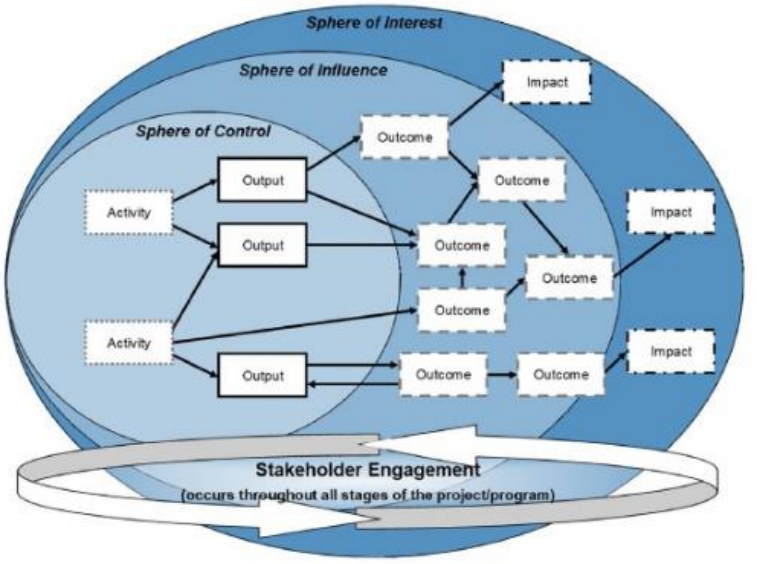
2.2. Workshops

Two workshops were organized to train ValPar.CH researchers on inter- and transdisciplinarity. The workshops were led by a facilitator with expertise in collaborative research processes. They combined theoretical input with self-reflexive exercises on knowledge integration, stakeholder analysis, and societal impact. The first workshop was held online in 2021 and was attended by 9 ValPar.CH researchers and the facilitator. One of the exercises consisted in developing a theory of change for ValPar.CH to explore how the project can address its societal challenge (biodiversity loss). For this, the team split in disciplinary groups: economists, social and political scientists, natural scientists, and hybrid scientists (scientists working at the interface between social and natural sciences). Each group had to answer a set of guiding questions to define the following elements: goal; context, actors and required changes; knowledge and other gaps; activities and pathways of impact; assumptions; monitoring and evaluation procedures; and change hypothesis. The groups noted the results of their deliberation and then presented them in the plenary. The results were later synthesized to capture the theory of change of each disciplinary group.

The second workshop was held in-person in 2021 and was attended by 7 ValPar.CH researchers and the facilitator. The goal was to reflect on how to maximize the outcomes in the sphere of influence (Figure 2A) by designing effective interactions with stakeholders. First, preliminary results from the interviews were presented on potential impacts of ValPar.CH as perceived by the interviewees. Then, several exercises were conducted. In this paper we use the insights from the first one, called *stakeholder analysis*, where the team split in three groups. Each group had to generate a list of potential stakeholders and situate them in a 4-quadrant grid according to their power (ability to influence the system by effecting or blocking change) and interest (in the project topic) (Figure 3). For this, they were given a set of guiding questions (Buser, n.d.). Notes were taken during this exercise and later synthesized to refine the contents of the 4-quadrant grid.

Figure 2A. Theoretical frameworks used to analyse the data: theory of change.

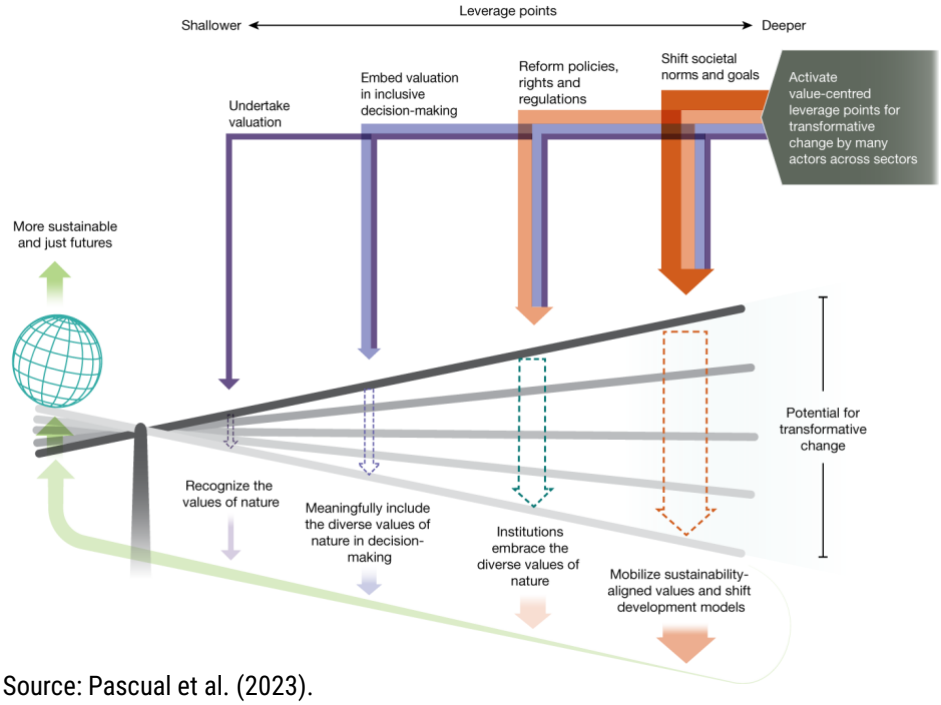
Sphere of control: what the project does; *Sphere of influence*: actors and processes that the project can influence. *Sphere of interest:* where social, economic, and environmental benefits are realized; *Activities:* actions conducted by the project; *Outputs:* products, goods, and services generated by the project; *Outcomes:* changes in knowledge, attitudes, skills, and relationships manifested as changes in behaviour; Impacts: changes in flow or state, resulting wholly or in part from a chain of events to which the project has contributed.



Source: Belcher et al. (2020).

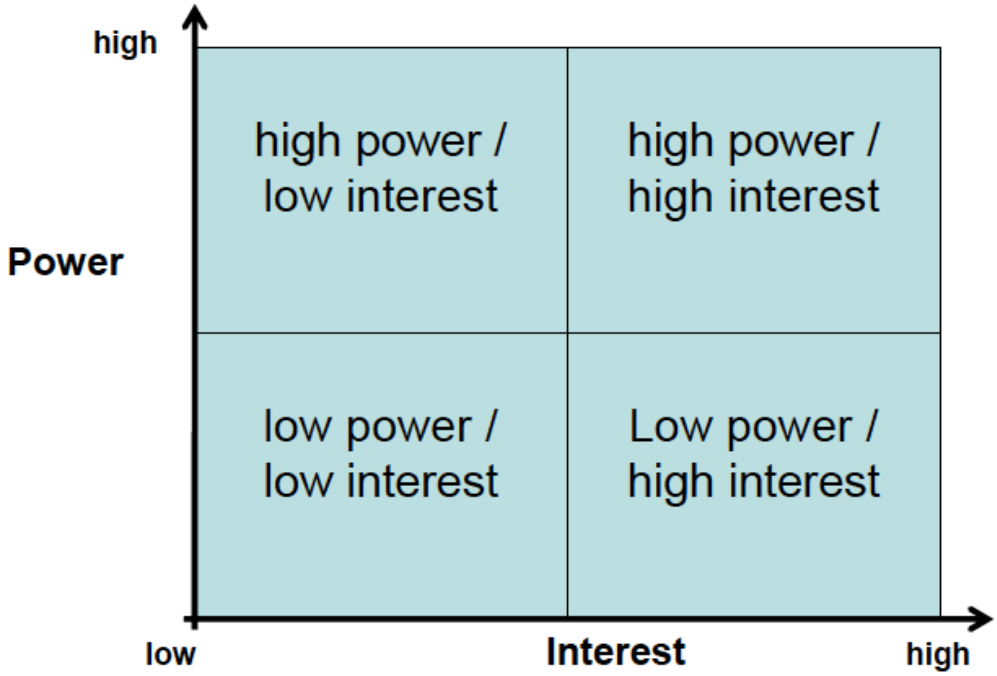
Figure 2B. Theoretical frameworks used to analyse the data: values-centred leverage points.

From left to right: Recognize the values of nature by undertaking valuation; meaningfully include the diverse values of nature into decisions by embedding valuation into inclusive decision-making; reform policies, rights, and regulations so that institutions embrace the diverse values of nature; shift societal norms and goals to mobilize sustainability-aligned values and shift development models (see extended descriptions in Supplementary Table 2).



Source: Pascual et al. (2023).

Figure 3. Grid used in the second workshop to classify stakeholders according to their power over and interest in ecological infrastructure.



Source: modified from Buser (n.d.), in turn based on Reed et al. (2009).

2.3. Coding and synthesis

A theory of change is intended to explain how and why an intervention – in this case the ValPar.CH project – is expected to contribute to changing a particularly problematic situation – in this case biodiversity loss (Belcher & Claus, 2020; The Center for Theory of Change, 2023; see Introduction). To build a theory of change for ValPar.CH, interview transcriptions were coded with a codebook based on Belcher et al. (2020) (Supplementary Figure 1). In particular, we relied on the information contained in the code *Outcomes*, defined as changes in knowledge, attitudes, skills, and relationships manifested as changes in behaviour of the stakeholders influenced by the project (Figure 2A). This information was used to create pathways between the project's outputs (products, goods, and services generated by the project) and potential outcomes. For example, the code *Outcomes* included a quote from a researcher explaining the potential applications of the species distribution maps produced by his team (output) to improve biodiversity conservation planning (outcome). This information was synthesized to produce pathway *a* in Figure 4. The information from the code *Outcomes* was also used to extract values-centred leverage points that ValPar.CH could potentially activate. Values-centred leverage-points are leverage points for system transformation that mobilize value pluralism (Pascual et al., 2023; see Introduction). For this, the information from the code *Outcomes* was re-coded based on the four values-centred leverage points identified by Pascual et al. (2023) (Figure 2B). For example, the quote mentioned in the previous paragraph was re-coded under leverage point 2, i.e., include the diverse values of nature into decisions (Table 1). The resulting information – pathways from outputs to outcomes and values-centred leverage points – was complemented with information extracted from internal ValPar.CH documents (BAFU, 2019, 2020) and a synthesis of the theories of change elaborated in the first workshop. Figure 4 and Table 1 summarize these results, while the complete results can be found in Supplementary Tables 1 and 2.

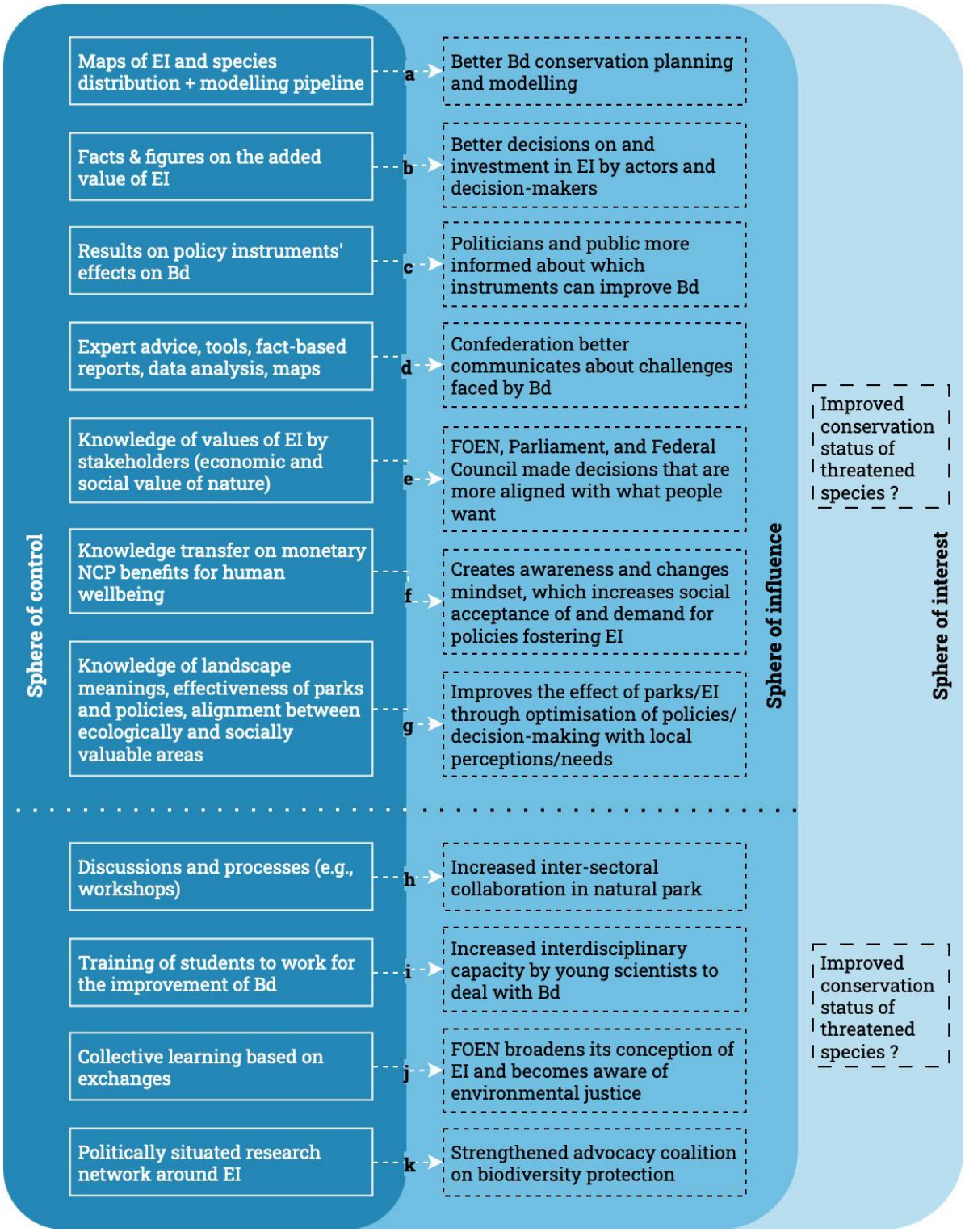
3. Results

3.1. Towards a theory of change for ValPar.CH: linking outputs to potential outcomes

The pathways linking ValPar.CH's outputs to potential outcomes, as expressed by the project's researchers and stakeholders, are illustrated in Figure 4.[3] We found seven pathways that originate from outputs explicitly planned for by the project (*a-g*). These outputs included maps, facts and figures, reports and other results and knowledge generated by the project. The reported order of these pathways is based on the number of sources – interviewees, workshop participants and project documents – adhering to them. Pathway *(b)* was the one backed by the largest number of sources. It corresponded to FOEN's impact model underlying the design of ValPar.CH (BAFU, 2019; one of the documents analysed) and was spelled out by one FOEN's officer, a representative from the Ecological Infrastructure Competence Centre, a political scientist, and the group of natural scientists participating in the first workshop. They all considered that ValPar.CH facts and figures on the added value of ecological infrastructure could help FOEN raise awareness about the importance of implementing it. Increased awareness was expected to improve the decisions of stakeholders such as landowners and farmers which have an impact on the state of ecological infrastructure. The cantons and the economic sector were also expected to recognize the added value of ecological infrastructure and invest more in its maintenance. Pathway *(e)* was shared by the director of a regional natural park and the hybrid scientists participating in the first workshop. This pathway suggests that the knowledge produced by ValPar.CH about the diverse values of ecological infrastructure held by stakeholders, in particular the socioeconomic value of nature, could help the FOEN, the Parliament and the Federal Council implement the Biodiversity Strategy. This pathway assumed that stakeholders' values influence their willingness to support a functional ecological infrastructure and that values are key aspects to implement such strategy.

[3] See Supplementary Table 1 for the complete results and their sources. See Methods for the definitions of the terms related to the theory of change.

Figure 4. Summary of pathways from ValPar.CH's outputs to potential outcomes. See Supplementary Table 1 for the detailed data. Pathways *a-g* refer to planned outputs, while pathways *h-k* refer to unplanned outputs. EI = Ecological Infrastructure; Bd = Biodiversity. *Sphere of control*: what the project does; it contains the outputs (products, goods, and services of the project) in solid squares. *Sphere of influence*: actors and processes that the project could influence; it contains the outcomes (changes in knowledge, attitudes, skills, and relationships manifested as changes in behaviour) in dashed squares. *Sphere of interest*: where social, economic, and environmental benefits are realized; it could contain the potential impacts (changes in flow or state, resulting wholly or in part from a chain of events to which the project has contributed) identified in a successive phase of this research.



Source: Based on our data and Belcher et al. (2020).

The rest of the pathways originating from planned outputs were articulated only by researchers (not by stakeholders) and were often linked to the outputs they were working on. In pathway *(a)*, a biologist considered that high resolution, open access maps of functional ecological infrastructure and species distribution would improve the biodiversity conservation planning of cantonal agencies, for example by anticipating whether current protected areas will be suitable in the face of climate and land-use changes. In turn, in pathway *(f)*, the economists participating in the first workshop considered that transferring knowledge on NCP benefits for human well-being (in monetary terms) could change the mindset of stakeholders and the general population regarding the importance of nature. According to them, this would increase the social acceptance of and demand for sectoral and inter-sectoral public policies benefiting ecological infrastructure. Similarly, the social and political scientists participating in the first workshop thought that the knowledge of landscape meanings, of the effectiveness of parks and policies, and of the (mis)alignment between ecologically and socially valuable areas could improve the sustainability of regional governance by optimizing policies with local needs *(g)*. Likewise, a landscape planner working on the development of scenarios considered that ValPar.CH results on the effects of certain policy instruments on land-use behaviours could make politicians and the public more informed about the capacity of these instruments to improve biodiversity *(c)*. In contrast with these pathways, pathway *(d)* includes a variety of outputs across research modules – from maps to expert advice. These outputs were expected to improve the communication of the Swiss Confederation about the challenges faced by biodiversity.

Four pathways originated from unplanned outputs, i.e., outputs that were not explicitly planned for in the project documents, but that conform to the definition of *output* by Belcher et al. (2020) (Figure 4, *h-k*). For example, the director of one regional natural park said that ValPar.CH could contribute to improve the biodiversity of the park thanks to the participatory workshops held throughout the project. According to this informant, this could help the park's stakeholders better understand each other and develop collaborative projects benefiting the region *(h)*. In turn, a researcher emphasized that the training of young scientists within the framework of ValPar.CH could increase the capacity to deal with biodiversity loss in Switzerland *(i)*. She added that biodiversity loss is an interdisciplinary challenge, and that ValPar.CH can contribute to the national capacity to address it by training young scientists in an interdisciplinary way. Similarly, an associated researcher spoke about the collective learning that takes place through the exchanges fostered by ValPar.CH. He considered that this could broaden the FOEN's conception of ecological infrastructure and make them more aware of the need to reduce Switzerland's impact on nature abroad, although he recognized that the latter aspect was lacking in ValPar.CH's research scope *(j)*. Finally, several researchers converged in pathway *(k)*, whereby ValPar.CH was considered to be a research network that is politically situated. According to this pathway, such research could reinforce the advocacy coalition [4] on nature protection by strengthening the case about the importance of nature and ecological infrastructure through for example the economic valuation of NCP. In particular, the prestige associated with the scientific nature of ValPar.CH was considered to have the potential to strengthen FOEN's position and capacity to convince about the importance of ecological infrastructure, and to lobby for better actions and policies related to its design and development.

[4] The Advocacy Coalition Framework simplifies the complex policy process and explains long-term policy changes by examining how actors, each holding specific beliefs about policy issues, form competing coalitions to influence public policy within a policy subsystem (Sabatier, 1998).

3.2. Values-centred leverage points: assessing the depth of potential impacts

Table 1 summarizes the thoughts of ValPar.CH researchers and stakeholders through the lens of the values-centred leverage points that could be activated by the project[5]. Researchers and stakeholders mostly targeted intermediate levels of leverage. In particular, leverage point 2 (*Embed valuation in inclusive decision-making*) contained the highest number of paraphrases (i.e., synthesized quotes from interviews and other sources), followed by leverage point 3 (*Reform policies, rights, and regulations*), leverage point 4 (*Shift societal norms and goals*) and leverage point 1 (*Undertake valuation*). We report on them by decreasing order of paraphrases. The less a leverage point is paraphrased, the less present it is in the ways of thinking of ValPar.CH researchers and stakeholders.

The paraphrases under leverage point 2 elaborated on key factors and processes that may play a role when embedding ValPar.CH's pluralist valuation into current decision-making (Table 1). For example, the biologist suggesting pathway *(a)* (Figure 4) emphasized that it is crucial to make all the data and products his team generated in ValPar.CH (high resolution ecological infrastructure/species maps and modelling pipeline) openly available. Together with the FOEN, several researchers stressed the importance of producing and communicating results on the value of ecological infrastructure in a way that is understandable by different target groups (pathway *(b)* in Figure 4). According to the perception of a FOEN officer, nowadays the scientific information does not reach the stakeholders, or it is not well understood by them. In this sense, the knowledge transfer measure of the pilot project in which ValPar.CH is embedded would have a key role in activating this leverage point by communicating the results of ValPar.CH in an appropriate way. A political scientist considered this reasoning to be somehow mechanistic but agreed that stakeholders and decision-makers could act better regarding biodiversity if they would have better information on the added value of ecological infrastructure. Another line of reasoning falling under leverage point 2 is that it is crucial to know why ecological infrastructure and nature are important for stakeholders. According to a director of a regional nature park and the hybrid scientists that participated in the first workshop, this could align the decisions of politicians with what people want while helping FOEN promote ecological infrastructure to protect biodiversity (pathway *(e)* in Figure 4). The economists that participated in the first workshop also considered that ValPar.CH outputs could support the FOEN in the implementation of the Swiss Biodiversity Strategy, in particular through the legitimacy of an independent scientific project showing the high value (e.g., monetary value) of ecological infrastructure (pathway *(k)* in Figure 4). Rather than through knowledge on the values of ecological infrastructure, the director of a natural park considered that ValPar.CH could improve the biodiversity in that natural park thanks to the workshops held by the project, as they could trigger a better collaboration between different sectors with benefits for the region (pathway *(h)* in Figure 4).

Leverage point 3 contained paraphrases referring to potential reforms of current policies and related challenges. These reforms would aim at scaling-up the integration of the diverse values of nature elucidated by ValPar.CH. For example, a political scientist considered that an implicit agenda of ValPar.CH is to reinforce the advocacy coalition[6] in favour of more biodiversity protection (pathway *(k)* in Figure 4), although he/she was sceptical that this could change power relationships affecting the state of biodiversity (Table 1). Similarly, a landscape planner raised doubts on whether ValPar.CH could have a measurable impact on biodiversity and considered that allocating the project funds directly to the development of ecological infrastructure – instead of on studying its values, as done through the ValPar.CH project – would have a clearer effect on the state of biodiversity. In turn, the social and political scientists that participated in the first workshop considered that the knowledge

[5] See Supplementary Table 2 for the complete results and their sources. See Methods for the definitions of the terms related to the values-centred leverage points.

[6] See footnote 4.

generated by ValPar.CH could reform the policies and decision-making processes related to ecological infrastructure and parks by aligning them with local perceptions and needs (pathway *(g)* in Figure 4).

The paraphrases under leverage point 4 referred to a potential modification of social norms and goals towards more importance given to ideals of sustainability and justice, not only in society at large but also in public agencies (Table 1). The economists for example considered that communicating knowledge about the monetary benefits of NCP for societal well-being could create awareness and change the mindset of stakeholders and the general population, something that could increase their demand for ecological infrastructure policies (pathway *(f)* in Figure 4). In turn, a biologist thought that the ValPar.CH project could be a step towards a broader conception of ecological infrastructure by the FOEN (pathway *(j)* in Figure 4) and emphasized that the impact of a project takes place at the level of collective learning rather than through planned outputs or deliverables. The same biologist said that the ValPar.CH project could be a first step to increase the awareness of federal authorities on the ethical challenges of nature conservation related to Switzerland's impacts on nature abroad (pathway *(j)* in Figure 4).

Leverage point 1 contained paraphrases from the ValPar.CH's research objectives and from the Ecological Infrastructure Competence Centre about the procedures used by ValPar.CH to identify diverse values of nature (Table 1). They highlighted that ValPar.CH assesses the values and benefits of ecological infrastructure for daily life through different methods.

Table 1. Summary of values-centred leverage points (according to Pascual et al., 2023) that ValPar.CH could potentially activate. See Supplementary Table 2 for the detailed data and an extended definition of the leverage points. EI = Ecological Infrastructure. FOEN = Federal Office for the Environment. NCP = Nature's Contributions to People.

	Leverage point	**ValPar.CH could improve biodiversity by...**
1	Adequately recognize the values of nature by undertaking valuation.	• Assessing ecological, social, and economic benefits and added value of EI through an analysis of the state and trends of ecosystem services. • Highlighting the uses of EI across sectors and their synergies, especially for daily life.
2	Meaningfully include the diverse values of nature into decisions by embedding valuation into inclusive decision-making.	• Delivering open access maps of functioning EI and species distribution at high resolution for all Switzerland. This can improve biodiversity conservation planning (e.g. to anticipate changes in species distribution due to climate change). • Communicating scientific results on the added value of EI to non-academic target groups like cantons, farmers or the economic sector. This may help them recognise the value of EI and persuade them to invest money and action on its development, thus improving biodiversity. • Showing the diverse values that stakeholders give to nature/EI. This can help FOEN and politicians promote EI as a way to protect biodiversity while implementing the Swiss Biodiversity Strategy. • Supporting FOEN in the development of the Swiss Biodiversity Strategy with the results of an independent scientific study showing that EI has a high value. • Helping stakeholders in our park to understand each other better and triggering collaborative inter-sectorial projects that transform the results into something useful for the region.
3	Reform policies, rights and regulations so that institutions embrace the diverse values of nature.	• Establishing an inter-university network of researchers in the domain of EI. This could reinforce the advocacy coalition on biodiversity protection. FOEN could use the results on the high value of EI to lobby for policies strengthening it. But it is not clear whether using the notion of EI can change power relationships. • Illustrating how changing some policy instruments could change some land-use behaviours with positive consequences on biodiversity. However, spending money directly on EI would have a more direct effect. • Providing knowledge on socially valuable areas and on the effectiveness of policies. This can help optimize policies and decision-making processes with local perceptions and needs, thus improving the effect of parks and EI.
4	Shift societal norms and goals, mobilizing sustainability-aligned values and shifting development models.	• Communicating knowledge about the benefits of NCP for human wellbeing. This can change the mindset of stakeholders and the broader population, which can in turn increase the social acceptance of and demand for policies fostering EI. • Accompanying FOEN towards a broader understanding of EI that goes beyond biodiversity and includes ecosystems services and a broader set of values (collective learning). • Starting a dialogue with federal authorities regarding the challenges of nature conservation. In particular, increasing the awareness that we don't have the right to protect nature within borders unless we decrease the impacts that our lifestyle is having abroad.

Source: based on our data.

4. Discussion

4.1. How does the ValPar.CH team perceive the potential impacts of its research?

This analysis explores the diverse ways in which ValPar.CH researchers and stakeholders think about the potential impacts of this transdisciplinary project on Swiss biodiversity. Both the pathways from outputs to outcomes and the values-centred leverage points show that the researchers' thought process is largely based on the so-called knowledge deficit model. In general, this model is a way of thinking assuming that solving a societal problem requires that experts communicate better information to the public, as a more knowledgeable public is expected to behave in a more socially conscious way (Heeren et al., 2016). The researchers and stakeholders that participated in our study believed that the facts and figures or the knowledge produced by ValPar.CH is going to make the behaviour of stakeholders (e.g., farmers, cantonal planners, decision-makers) more compatible with ecological infrastructure and biodiversity. However, the knowledge deficit model shows limitations with its portrayal of a linear unidirectional connection between knowledge and rational policy formation, and for ignoring psychological factors that explain behavioural change such as social norms (Heeren et al., 2016; Simis et al., 2016; Cook & Melo Zurita, 2019).

In other words, reading a report or a factsheet on the added value of ecological infrastructure does not automatically lead to a more sustainable behaviour. For example, stakeholders behaving as deniers of biodiversity loss will actively fight against or suppress fact-based arguments (Garcia & Waeber, 2022). Thus, we recommend that insights from psychology and other social sciences on behavioural change are considered. Such research shows that stakeholders make decisions based on beliefs and values, and that providing renewed beliefs and fostering a better understanding of each other's values is crucial for transformative change (Garcia et al., 2020; Garcia & Waeber, 2022; Waeber et al., 2021). In addition, it may also be useful to spell out the assumptions behind each pathway (Figure 4) and to verify its achievement through outcome monitoring and scientific evidence. For example, pathway *(b)* could be verified by monitoring how the farmers targeted by communication products change (or not) their decisions affecting ecological infrastructure while disentangling the effects from other information sources.

Our results also show that other ways of thinking beyond the knowledge deficit model are present in the ValPar.CH team. For some of the interviewees, ValPar.CH is thought to contribute to a better understanding between stakeholders, increased interdisciplinary capacity of young scientists, and collective learning on ecological infrastructure. This is closely related to *competence building* and *social learning*, two impact pathways identified by Schneider et al. (2019) for transdisciplinarity in general. In these pathways, transformative knowledge is not seen as a substance to be transferred from the research to other people, but as an emergent property of the project interactions that can trigger new competences and collective action for transformative change (Schneider et al., 2019). For these pathways to materialize after ValPar.CH, it is necessary to invest time in further inter- and transdisciplinary collaborations. In addition, we found a more nuanced understanding of the relationship between knowledge and policy as compared to the one implied by the knowledge deficit model. Some researchers for example highlighted that the research of ValPar.CH is politicized, as it has the potential to reinforce the advocacy coalition for biodiversity protection in Switzerland. According to this view, the fact that a team of 30 researchers from five universities reflect on the notion of ecological infrastructure may implicitly support a green agenda. However, doubts were also expressed on whether this could yield any change in the power relationships between those in favour and those against more biodiversity protection measures. As shown by our theory of change, all these impact pathways originated from unplanned outputs, i.e., those that are not explicitly foreseen by the project documents. Thus, in order to maximize the impact of ValPar.CH, we recommend that the effects of these implicit outputs are verified by federal and cantonal offices together with researchers in a follow-up phase. For example, pathway *(h)* could be verified by monitoring how many inter-sectorial projects are developed in the natural park (partly) triggered by ValPar.CH.

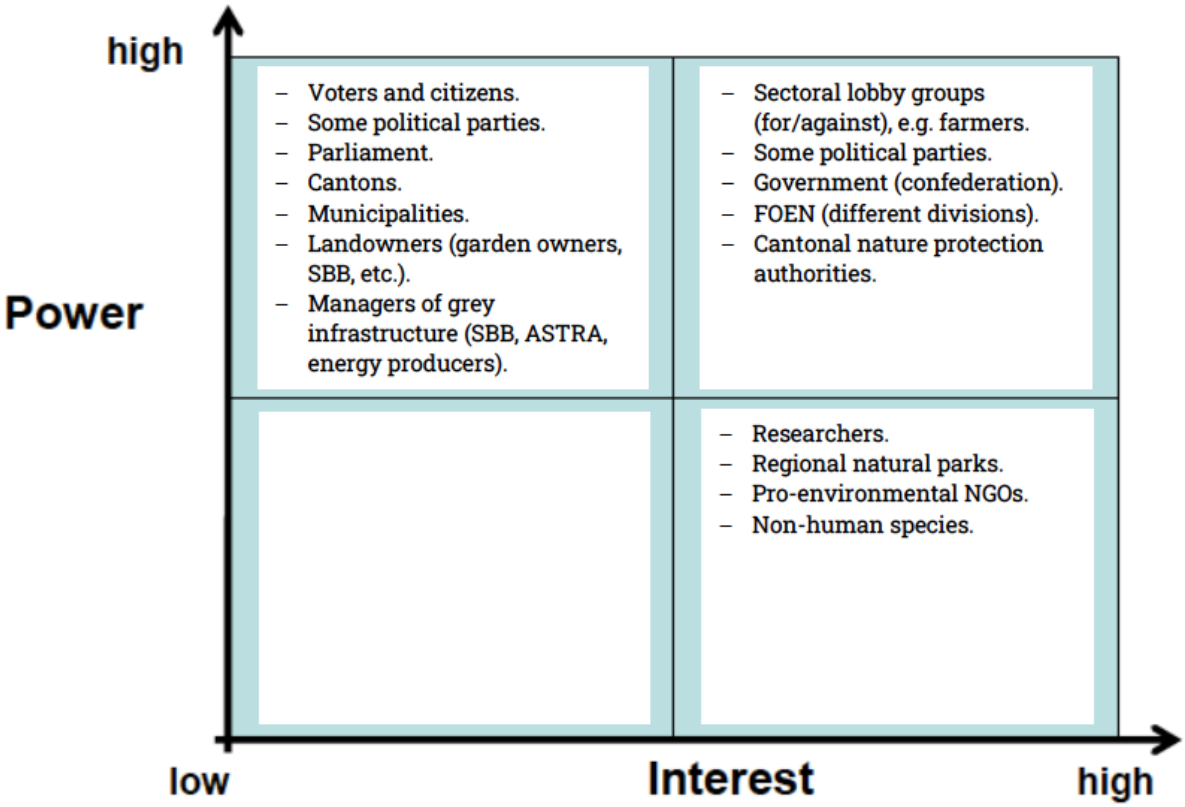
The values-centred leverage points complemented the theory of change with a focus on the amplitude and depth of ValPar.CH's potential impact. Interestingly, most of the thoughts of the project's researchers and stakeholders targeted leverage point 2, corresponding to the embedding of the valuation conducted by ValPar.CH into current decision-making processes affecting the ecological infrastructure. It is therefore a crucial domain of leverage that requires sufficient attention and resources, especially regarding the transfer of data and other outputs to the interested stakeholders. The project's researchers and stakeholders also discussed more transformative leverage points when considering that ValPar.CH could trigger a change in the FOEN's conception of ecological infrastructure and in the mindset of the general population regarding the importance of nature. Since transformative change is more likely to happen when interventions engage several leverage points (Pascual et al., 2023), we recommend that follow-up work tries to think how to jointly activate different leverage points based on the ideas expressed by ValPar.CH researchers and stakeholders. For example, an effective communication campaign (pertaining to leverage point 2) could contribute to change the mindset of the general population (pertaining to 4) who may consequently demand policy reforms to improve the state of ecological infrastructure and nature (pertaining to 3).

4.2. Maximizing outcomes in the sphere of influence: what actions are a priority?

We identified 11 pathways from project outputs to potential outcomes (Figure 4). As explained in Section 3.1, *outcomes* are defined as changes in knowledge, attitudes, skills, and relationships which manifest as changes in behaviour in the sphere of influence (Belcher et al., 2020). The sphere of influence contains the stakeholders that the project expects to influence, from project partners to potential users of outputs (Belcher et al., 2020). According to the identified pathways, the ValPar.CH team expects to see outcomes in a wide range of stakeholders from the individual to the federal levels (Supplementary Table 1). Thus, follow-up efforts could design and implement a program of interaction with stakeholders to maximize the potential outcomes sketched in Figure 4. This program should build on the intense collaborations held throughout the project with the FOEN, the inter-cantonal Conference of Delegates for Nature and Landscape Protection, the four regional natural parks, InfoSpecies, the Swiss Biodiversity Forum, the Swiss Parks Network, the Federal Office for Agriculture, as well as other stakeholders and scientists. Like other transdisciplinary processes, this will likely involve different phases and varying intensities of stakeholder participation (Stauffacher et al., 2008), something that has implications in terms of resources (funding, time, etc.). In highly dynamic institutional contexts, windows of opportunity for action on leverage points can emerge unexpectedly and benefit from ValPar.CH's outputs and collaborative network.

It is important to remember that not all stakeholders have the same power to shape the state of ecological infrastructure nor the same interest in this topic. The use of a 4-quadrant grid (Buser, n.d.; Reed et al., 2009) allowed us to distinguish stakeholder groups that may need to be approached differently in follow-up efforts (Figure 5). Among stakeholders with high power over and high interest in ecological infrastructure (upper right quadrant) the mentioned program of stakeholder interaction should differentiate between those holding favourable positions and those holding unfavourable positions towards the development of ecological infrastructure and the conservation of biodiversity. For those holding favourable positions, specific interventions could be co-designed to create synergies between their activities and ValPar.CH outputs. This could be the case of other divisions of FOEN beyond the Biodiversity and Landscape Division, which commissioned the project. For example, the Forest Division could use ValPar.CH maps of biodiversity and NCP to enhance the sustainability of the forest policy and to contribute to a functional ecological infrastructure in forests, considering the NCP delivered by trees in both rural and urban areas.

Figure 5. Classification of ValPar.CH relevant stakeholders according to their power over and interest in ecological infrastructure. Source: Modified from Buser (n.d.; based on Reed et al., 2009). SBB = Schweizerische Bundesbahnen (Swiss Federal Railways); ASTRA = Bundesamt für Strassen (Federal Roads Office); FOEN = Federal Office for the Environment.



Source: based on our data.

For those stakeholders holding unfavourable positions towards the development of ecological infrastructure, interventions could be foreseen to incentivize a shift to more favourable positions or to reduce conflicts in highly polarized debates. For example, the "common concern entry point" principle recommends to jointly identify easy-to-reach, short-term goals that appeal to all parties in a conflict between agricultural production and biodiversity conservation (Sayer et al., 2013). Working towards these goals can foster trust among stakeholders and facilitate negotiations about solutions (Sayer et al., 2013). A targeted communication of the monetary value that NCP like pollination have for agriculture, as estimated by ValPar.CH, could also help reduce the resistance of agricultural lobby groups to the development of ecological infrastructure.

Among stakeholders with high power over but low interest in ecological infrastructure (upper left quadrant in Figure 5) the key question is how to attract their interest while promoting favourable positions. The notion of relational value holds potential for this. Relational values derive from the relations that people establish with nature and include for example the value of nature for a good life and for identity (Anderson et al., 2022; Chan et al., 2018). This notion has been used by ValPar.CH to explore the importance that nature has for the populations of the regional natural parks through workshops and go-along interviews (Cracco et al., in press; Michel et al., submitted). Widely sharing these results among the citizens from the parks and beyond could make them more interested in nature and ecological infrastructure. The personal character, emotional content and concreteness of relational values for everyday live are indeed key to capture people's interest in nature (Chan et al., 2016).

However, the instrumental and monetary logic strongly shapes the decisions taken by Swiss citizens. The instrumental values of nature should not be ignored. Instrumental values are given to elements and processes from nature as means to achieve human ends (Anderson et al., 2022). Pathway *(f)* in Figure 4 indeed posits that transferring knowledge on the monetary benefit of NCP for human well-being may change the mindset of the general population, which would accordingly demand better policies to improve ecological infrastructure. In other words, voters and political parties who have so far not shown interest in ecological infrastructure could become favourable agents for its development if they realize how much nature contributes to their well-being. This could change the power relationships in the Swiss Parliament by increasing the support for ecological infrastructure and biodiversity among its members (similarly to pathway *(k)*). Importantly, a survey carried out in the context of ValPar.CH (d'Agostino & Kuebler, in prep.) found that Swiss citizens do not change their preference regarding biodiversity policy after being exposed to information about the state of biodiversity in Switzerland. Additional research is therefore necessary to differentiate between mere information on the state of biodiversity and actionable knowledge on the relational, instrumental and intrinsic importance of nature for people. When disseminating ValPar.CH's outputs to the interest public, monitoring the effects of different types of knowledge and dissemination techniques on the mindsets of the audience would be crucial to understand if the sphere of influence is reacting according to the theory of change developed in this project (see Figure 4). This could be an important contribution both for research purposes and to maximize outcomes of this and future theories of change related to biodiversity in Switzerland (e.g. as currently developed in the National Research Programme 82 (NRP 82) on Biodiversity and Ecosystem Services).

For stakeholders with low power over and high interest in ecological infrastructure (bottom right quadrant in Figure 5), we recommend exploring ways to increase their power so that they can have greater positive influence in the development of ecological infrastructure. Researchers can for example reflect on the potential impact of their research on ecological infrastructure with an eye on designing transformative follow-up measures, as we did in this paper. In any case, maximizing outcomes in the sphere of influence would benefit from more and better knowledge on stakeholders' differentiated power and interests under changing socioeconomic, political and ecological conditions, as well as on what makes a stakeholder become an agent of change. Moreover, researching about yet unknown benefits of a functioning ecological infrastructure for different stakeholders and disseminating the findings has the potential to increase their interest in and support for nature conservation.

Based on the findings discussed in sections 4.1 and 4.2, Box 1 offers some practical guidance to maximize the outcomes of ValPar.CH.

Box 1. Concrete follow-up steps that could be taken by FOEN and other stakeholders to maximize the outcomes of ValPar.CH.

The ValPar.CH synthesis report (Keller et al., 2024) provides recommendations for different target groups to improve the state of biodiversity and NCP. These recommendations were co-created between the research team, FOEN and other stakeholders. Based on these recommendations and the results of this working paper, the outcomes of ValPar.CH could be maximized by:

- *Optimizing cantonal plans of ecological infrastructure by contrasting them with ValPar.CH modelling results*. The scenarios and priority areas for biodiversity and NCP can be used to anticipate changes in the framework conditions of ecological infrastructure and to adapt the planning in the face of change. This may require accessible metadata descriptions and capacity building activities for cantonal agencies.
- *Anchoring participation in planning processes and instruments so that the social, economic and cultural value of nature is heard.* Considering diverse values of nature can create the basis for alliances between different demands thus minimizing conflicts. The methods developed by ValPar.CH like walk-along interviews or focus groups can be used or adapted for this purpose.
- *Encouraging experience-based education about nature*. The insights from ValPar.CH on the relational importance of nature can be used to promote educational programs where nature experiences take centre stage. Funding and educational packages for intermediaries (organizations related to tourism or nature conservation, etc.) can be developed and education requirements can be integrated into existing funding programs.
- *Using sectoral spatial planning processes underway (e.g., rural development processes) to improve the ecological infrastructure*. Strengthening regional management bodies can give them the capacity to mediate between conflicting land claims. ValPar.CH coalition analyses provide information on policy brokers than can find compromises between the environmental and the agricultural production coalition. Facilitating the understanding of each other's values and beliefs about what constitutes a good policy can help opposing stances come closer.
- *Increasing the binding nature of nature and landscape objectives in sectoral and inter-sectoral programs and policies*. A program for the management of biodiversity and NCP could be developed that integrates all cantonal plans for ecological infrastructure and allocates responsibility among different actors. The landscape archetypes generated by ValPar.CH can be used for the integrated management of nature across sectoral policies.

4.3. How to realize ValPar.CH's impact on Switzerland's biodiversity?

The researchers and stakeholders from ValPar.CH did not identify any impact in the sphere of interest, i.e., where the project aspires to see social, economic, and environmental benefits (Belcher et al., 2020; Figure 4). ValPar.CH was at an early stage when the interviews and the workshops were conducted, making it difficult to already identify potential impacts beyond a very general reference to improving the state of biodiversity. In addition, the definition of *impact* used to code the data (i.e., changes in flow or state, resulting wholly or in part from a chain of events to which the project has contributed; Belcher et al., 2020) is very concrete. Therefore, further reflection is needed on the mechanisms through which the outcomes identified in ValPar.CH's sphere of influence could manifest in impacts, and what are these impacts. Concrete impacts could include an improvement in the conservation status of threatened species or an increase in the flow of certain NCP. These would occur after a time lag and would be co-produced by many Swiss institutions (including institutions implementing the Biodiversity Strategy and research institutions) as well as broader political, socioeconomic, and climate changes.

Thus, attributing impacts to ValPar.CH would require a properly designed monitoring protocol and an evaluation process with enough hindsight (Otero et al., in prep.). In particular, we recommend considering interventions and societal trends that can facilitate and obstruct the translation of outcomes into impacts. For this, the scenarios for a functional ecological infrastructure developed by ValPar.CH could be useful (Mayer et al., 2023; Black et al., 2024; Keller et al., 2024). For example,

pathway *(a)* expects that species distribution maps will make cantonal nature agencies better equipped to plan biodiversity conservation measures (Figure 4). These maps may enable them to know the optimal location of protected areas by anticipating the effects of climate on species distribution. However, there is an arduous path from this outcome to an actual impact like an increase in the percentage of species that find suitable climate conditions in future protected areas under a warmer climate (as used for example by Araújo et al., 2011). The translation of cantonal agencies' enhanced knowledge on species distribution into a better status for species seems more likely in the scenario *Nature as culture* (where protected areas are expanded to 25% under a low level of climate change) than in *Business as usual* (where protected areas are expanded to only 17% under an intermediate level of climate change).

4.4. Limitations of this study

This study is based on data collected during the first year of ValPar.CH. As such, it provides a snapshot of how the team thought about the potential effects of the project back then. This perception may have changed over the course of the project and the many interactions that researchers and stakeholders had about the outputs' challenges and opportunities for transformative change. Had we conducted the interviews and workshops towards the end of the project or shortly after, the results could of course be different. The absence of impacts from our theory of change is another shortcoming of our study.

Another limitation comes from the fact that the results are based on perceptions, not on facts. In other words, we collected data on what the researchers and stakeholders perceived about the potential effects of ValPar.CH. These perceptions could be overestimations or underestimations of objectively measured effects. Further research could explore whether the impact pathways and values-centred leverage points identified by the interviewees become a reality or not.

In addition, the non-representative sampling technique that we used makes the results dependent on the selected interviewees. Had we interviewed more or different researchers and stakeholders, the results could be different. In this sense, it is worth noting that data saturation in impact pathways and value-centred leveraged points was not used as a criterion to stop sampling. This means that we may have ignored some potential impact pathways and values-centred leverage points.

These limitations are not particularly problematic, since the goal of the working paper was to explore potential impact pathways of ValPar.CH's pluralist nature valuation as a way to catalyse follow-up transformative efforts, something that our methods achieved.

5. Conclusion

We assessed the potential impacts of pluralist nature valuation on Switzerland's biodiversity by focusing on the transdisciplinary project ValPar.CH. To do so, we used a self-reflexive approach relying on qualitative data analysed with two complementary frameworks: theory of change and values-centred leverage points.

Our results show that the thought process of ValPar.CH researchers and stakeholders is largely based on the knowledge deficit model. In other words, they believe that the knowledge produced by the projects is going to make the behaviour of stakeholders more compatible with biodiversity conservation. Other ways of thinking are also present in the team, and they highlight the importance of competence building and social learning to address biodiversity loss, as well as the situated nature of ValPar.CH research within the Swiss political debates.

Based on our results, we suggested multiple measures to realize the potential outcomes and transform them into impacts. These include the re-examination of impact pathways based on the knowledge deficit model (since they do not work automatically), the consideration of the effects of implicit outputs, the design of pathways to simultaneously activate different leverage points, the engagement with a wide range of stakeholders at varying intensities, the implementation of capacity building activities, the design of interventions to minimize oppositional forces, and the explicit consideration of attitudes and social norms in the context of behavioural change.

These measures can be particularly useful for the FOEN as it continues to implement the Swiss Biodiversity Strategy after the end of the ValPar.CH project. Besides, they can also help researchers (e.g., within the NRP 82) and other stakeholders to design research and follow-up activities with the maximum transformative capacity for Swiss biodiversity.

Bibliography

Anderson, C.B., Athayde, S., Raymond, C.M., Vatn, A., Arias-Arévalo, P., Gould, R.K., Kenter, J., Muraca, B., Sachdeva, S., Samakov, A., Zent, E., Lenzi, D., Murali, R., Amin, A., & Cantú-Fernández, M. (2022). Chapter 2. Conceptualizing the diverse values of nature and their contributions to people. In: *Methodological Assessment Report on the Diverse Values and Valuation of Nature of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. Balvanera, P., Pascual, U., Christie, M., Baptiste, B., & González-Jiménez, D. (eds). IPBES secretariat, Bonn, Germany. https://doi.org/10.5281/zenodo.6493134

Araújo, M. B., Alagador, D., Cabeza, M., Nogués-Bravo, D., & Thuiller, W. (2011). Climate change threatens European conservation areas. *Ecology Letters*, *14*(5), 484–492. https://doi.org/10.1111/j.1461-0248.2011.01610.x

BAFU, Bundesamt für Umwelt (2019). *Pilotprojekt Inwertsetzung der Ökologischen Infrastruktur in Pärken. Projektbeschreibung*.

BAFU, Bundesamt für Umwelt (2020). *Forschungsvertrag betreffend Nutzen und Mehrwert der ÖI in den Pärken analysieren*.

Belcher, B., & Claus, R. (2020). Theory of Change. *Td-Net Toolbox Profile*, *5*. https://doi.org/doi.org/10.5281/zenodo.3717451

Belcher, B. M., Davel, R., & Claus, R. (2020). A refined method for theory-based evaluation of the societal impacts of research. *MethodsX*, *7*, 100788. https://doi.org/10.1016/j.mex.2020.100788

Bernard, H. R. (2002). *Research methods in anthropology: Qualitative and quantitative approaches* (3rd edition). AltaMira Press.

Black, B., Adde, A., Farinotti, D., Guisan, A., Külling, N., Kurmann, M., Martin, C., Mayer, P., Rabe, S.-E., Streit, J., Zekollari, H., & Grêt-Regamey, A. (2024). Broadening the horizon in land use change modelling: Normative scenarios for nature positive futures in Switzerland. *Regional Environmental Change*, *24*(3), 115. https://doi.org/10.1007/s10113-024-02261-0

Buser, T. (no date). *Context and actor analysis*. https://www.futurelearn.com/info/courses/partnering-for-change/0/steps/91246

Chan, K. M. A., Balvanera, P., Benessaiah, K., Chapman, M., Díaz, S., Gómez-Baggethun, E., Gould, R., Hannahs, N., Jax, K., Klain, S., Luck, G. W., Martín-López, B., Muraca, B., Norton, B., Ott, K., Pascual, U., Satterfield, T., Tadaki, M., Taggart, J., & Turner, N. (2016). Opinion: Why protect nature? Rethinking values and the environment. *Proceedings of the National Academy of Sciences*, *113*(6), 1462–1465. https://doi.org/10.1073/pnas.1525002113

Chan, K. M., Gould, R. K., & Pascual, U. (2018). Editorial overview: Relational values: what are they, and what's the fuss about? *Current Opinion in Environmental Sustainability*, *35*, A1–A7. https://doi.org/10.1016/j.cosust.2018.11.003

Cook, B. R., & Melo Zurita, M. de L. (2019). Fulfilling the promise of participation by not resuscitating the deficit model. *Global Environmental Change*, *56*, 56–65. https://doi.org/10.1016/j.gloenvcha.2019.03.001

Cracco, M., Walters, G., & Loup, R. (in press). Analysing perceptions of nature and nature's contributions to people for a Swiss Ecological Infrastructure. *People and Nature*.

Darbellay, F., Moody, Z., Sedooka, A., & Steffen, G. (2014). Interdisciplinary research boosted by serendipity. *Creativity Research Journal*, *26*(1), 1–10. https://doi.org/10.1080/10400419.2014.873653

d'Agostino, A., & Kuebler, D. (in prep.). What makes a biodiversity policy more attractive? Insights from a conjoint experiment in Switzerland.

FOEN, Federal Office for the Environment (2017). Action Plan for the Swiss Biodiversity Strategy.

Garcia, C. A., Savilaakso, S., Verburg, R. W., Gutierrez, V., Wilson, S. J., Krug, C. B., Sassen, M., Robinson, B. E., Moersberger, H., Naimi, B., Rhemtulla, J. M., Dessard, H., Gond, V., Vermeulen, C., Trolliet, F., Oszwald, J., Quétier, F., Pietsch, S. A., Bastin, J.-F., … Waeber, P. O. (2020). The global forest transition as a human affair. *One Earth*, *2*(5), 417–428. https://doi.org/10.1016/j.oneear.2020.05.002

Garcia, C., & Waeber, P. (2022). Why facts are not enough: Understanding on what basis we make decisions can change our planet. *Research Features*. https://researchfeatures.com/facts-not-enough-understanding-basis-make-decisions-change-planet/

Grêt-Regamey, A., Rabe, S.-E., Keller, R., Cracco, M., Guntern, J., & Dupuis, J. (2021). Operationalization of a functioning ecological infrastructure. *ValPar.CH Working Paper Series*, *1*. https://doi.org/10.5167/UZH-204025

Hansson, S., & Polk, M. (2018). Assessing the impact of transdisciplinary research: The usefulness of relevance, credibility, and legitimacy for understanding the link between process and impact. *Research Evaluation*, *27*(2), 132–144. https://doi.org/10.1093/reseval/rvy004

Heeren, A. J., Singh, A. S., Zwickle, A., Koontz, T. M., Slagle, K. M., & McCreery, A. C. (2016). Is sustainability knowledge half the battle? An examination of sustainability knowledge, attitudes, norms, and efficacy to understand sustainable behaviours. *International Journal of Sustainability in Higher Education*, *17*(5), 613–632. https://doi.org/10.1108/IJSHE-02-2015-0014

IPBES (2019). *Global Assessment Report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. Brondízio, E. S., Settele, J., Díaz, S., & Ngo, H. T. (eds). IPBES secretariat, Bonn, Germany. ISBN: 978-3-947851-20-1

IPBES (2022). *Summary for Policymakers of the Methodological Assessment Report on the Diverse Values and Valuation of Nature of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. Pascual, U., Balvanera, P., Christie, M., Baptiste, B., González-Jiménez, D., Anderson, C.B., Athayde, S., Barton, D.N., Chaplin-Kramer, R., Jacobs, S., Kelemen, E., Kumar, R., Lazos, E., Martin, A., Mwampamba, T.H., Nakangu, B., O'Farrell, P., Raymond, C.M., Subramanian, S.M., Termansen, M., Van Noordwijk, M., & Vatn, A. (eds.). IPBES secretariat, Bonn, Germany. https://doi.org/10.5281/zenodo.6522392

Keller, R., Steiger, U., Reynard, E., Grêt-Regamey, A., & ValPar.CH team (2024). *Werte und Leistungen der Natur. Erkenntnisse aus dem inter- und transdisziplinären Forschungsprojekt ValPar.CH*. Bundesamt für Umwelt (BAFU).

Margules, C., Boedhihartono, A. K., Langston, J. D., Riggs, R. A., Sari, D. A., Sarkar, S., Sayer, J. A., Supriatna, J., & Winarni, N. L. (2020). Transdisciplinary science for improved conservation outcomes. *Environmental Conservation*, *47*(4), 224–233. https://doi.org/10.1017/S0376892920000338

Mayer, P., Rabe, S.-E., & Grêt-Regamey, A. (2023). Operationalizing the Nature Futures Framework for ecological infrastructure. *Sustainability Science*. https://doi.org/10.1007/s11625-023-01380-7

Meadows, D. (1999). *Leverage Points: Places to Intervene in a System*. The Sustainability Institute. https://web.archive.org/web/20131008160618/http://www.sustainabilityinstitute.org/pubs/Leverage_Points.pdf

Michel, A. H., Hartmann, S., & Schneiter, R. (submitted). Exploring embodied experiences in rural landscapes in Switzerland. *Landscape Research*.

Obura, D. O., Katerere, Y., Mayet, M., Kaelo, D., Msweli, S., Mather, K., Harris, J., Louis, M., Kramer, R., Teferi, T., Samoilys, M., Lewis, L., Bennie, A., Kumah, F., Isaacs, M., & Nantongo, P. (2021).

Integrate biodiversity targets from local to global levels. *Science*, *373*(6556). https://doi.org/10.1126/science.abh2234

Otero, I., Darbellay, F., Reynard, E., Hetényi, G., Perga, M.-E., Rüegg, J., Prasicek, G., Cracco, M., Fontcuberta, A., Vaan, M. de, García, J., Bussard, J., Clivaz, C., Moos, C., Guisan, A., Schaefli, B., Mapelli, N., & Bellefroid, B. de. (2020). Designing inter- and transdisciplinary research on mountains: What place for the unexpected? *Mountain Research and Development*, *40*(4), D10. https://doi.org/10.1659/MRD-JOURNAL-D-20-00036.1

Otero, I., Keller, R., Deplazes-Zemp, A., & Reynard, E. (in press). Exploring the personal sphere of transformative change in researchers and stakeholders working on nature. *Ecosystems and People*. https://doi.org/10.1080/26395916.2024.2436374

Otero, I., Niewöhner, J., Krueger, T., Doğmuş, Ö. C., Himmelreich, J., Sichau, C., & Hostert, P. (2017). The position of scientists in transformations of human-environment systems. An inquiry into IRI THESys research practices. *THESys Discussion Papers*, *2017–1*.

Otero, I., Reynard, E., Pachoud, C., Arpin, I., Duglio, S., Sala, S., Nared, J., George, E., Beltramo, R., Mabika, H., Balzarini, R., Fontanella Pisa, P., Claramunt-López, B., Schneiderbauer, S., Haller, A., Polderman, A., Wymann von Dach, S., Bruley, É., Adler, C., … Palomo, I. (in prep.). Exploring the transformative capacity of transdisciplinary research in mountains.

Pärli, R. (2023). How input, process, and institutional factors influence the effects of transdisciplinary research projects. *Environmental Science & Policy*, *140*, 80–92. https://doi.org/10.1016/j.envsci.2022.11.019

Pascual, U., Adams, W. M., Díaz, S., Lele, S., Mace, G. M., & Turnhout, E. (2021). Biodiversity and the challenge of pluralism. *Nature Sustainability*, *4*(7), 567–572. https://doi.org/10.1038/s41893-021-00694-7

Pascual, U., Balvanera, P., Anderson, C., Chaplin-Kramer, R., Christie, M., González-Jiménez, D., Martin, A., Raymond, C. M., Termansen, M., Vatn, A., Athayde, S., Baptiste, B., Barton, D. N., Jacobs, S., Kelemen, E., Kumar, R., Lazos, E., Mwampamba, T. H., Nakangu, B., … Zent, E. (2023). Diverse values of nature for sustainability. *Nature*, *620*(7975). https://doi.org/10.1038/s41586-023-06406-9

Pascual, U., Balvanera, P., Díaz, S., Pataki, G., Roth, E., Stenseke, M., Watson, R. T., Başak Dessane, E., Islar, M., Kelemen, E., Maris, V., Quaas, M., Subramanian, S. M., Wittmer, H., Adlan, A., Ahn, S., Al-Hafedh, Y. S., Amankwah, E., Asah, S. T., … Yagi, N. (2017). Valuing nature's contributions to people: The IPBES approach. *Current Opinion in Environmental Sustainability*, *26–27*, 7–16. https://doi.org/10.1016/j.cosust.2016.12.006

Reed, M. S., Graves, A., Dandy, N., Posthumus, H., Hubacek, K., Morris, J., Prell, C., Quinn, C. H., & Stringer, L. C. (2009). Who's in and why? A typology of stakeholder analysis methods for natural resource management. *Journal of Environmental Management*, *90*(5), 1933–1949. https://doi.org/10.1016/j.jenvman.2009.01.001

Reynard, E., Grêt-Regamey, A., & Keller, R. (2021). The ValPar.CH project – Assessing the added value of ecological infrastructure in Swiss Parks. *Journal on Protected Mountain Areas Research and Management (eco.mont)*, *13/2*, 64–68. https://doi.org/10.1553/eco.mont-13-2s64

Sabatier, P. A. (1998). The advocacy coalition framework: Revisions and relevance for Europe. *Journal of European Public Policy*, *5*(1), 98–130. https://doi.org/10.1080/13501768880000051

Sayer, J., Sunderland, T., Ghazoul, J., Pfund, J.-L., Sheil, D., Meijaard, E., Venter, M., Boedhihartono, A. K., Day, M., Garcia, C., van Oosten, C., & Buck, L. E. (2013). Ten principles for a landscape approach to reconciling agriculture, conservation, and other competing land uses.

Proceedings of the National Academy of Sciences, *110*(21), 8349–8356. https://doi.org/10.1073/pnas.1210595110

Schäfer, M., Bergmann, M., & Theiler, L. (2021). Systematizing societal effects of transdisciplinary research. *Research Evaluation*, *30(4)*, 484–499. https://doi.org/10.1093/reseval/rvab019

Schäfer, M., Lux, A., & Bergmann, M. (2020). Editorial to the special issue "Transdisciplinary Sustainability Research—Linking research processes and outputs to societal effects." *Environmental Science & Policy*, *107*, 206–210. https://doi.org/10.1016/j.envsci.2020.02.018

Schneider, F., Giger, M., Harari, N., Moser, S., Oberlack, C., Providoli, I., Schmid, L., Tribaldos, T., & Zimmermann, A. (2019). Transdisciplinary co-production of knowledge and sustainability transformations: Three generic mechanisms of impact generation. *Environmental Science & Policy*, *102*, 26–35. https://doi.org/10.1016/j.envsci.2019.08.017

Simis, M. J., Madden, H., Cacciatore, M. A., & Yeo, S. K. (2016). The lure of rationality: Why does the deficit model persist in science communication? *Public Understanding of Science*, *25*(4), 400–414. https://doi.org/10.1177/0963662516629749

Stauffacher, M., Flüeler, T., Krütli, P., & Scholz, R. W. (2008). Analytic and dynamic approach to collaboration: A transdisciplinary case study on sustainable landscape development in a Swiss prealpine region. *Systemic Practice and Action Research*, *21*(6), 409–422. https://doi.org/10.1007/s11213-008-9107-7

Tejada, G., Cracco, M., Bouleau, C. R., Bolay, J.-C., & Hostettler, S. (2019). Testing analytical frameworks in transdisciplinary research for sustainable development. *Sustainability*, *11*(16). https://doi.org/10.3390/su11164343

The Center for Theory of Change (2023). *What is Theory of Change?* https://www.theoryofchange.org/what-is-theory-of-change/

Tobias, S., Ströbele, M. F., & Buser, T. (2019). How transdisciplinary projects influence participants' ways of thinking: A case study on future landscape development. *Sustainability Science*, *14*(2), 405–419. https://doi.org/10.1007/s11625-018-0532-y

Waeber, P. O., Stoudmann, N., Langston, J. D., Ghazoul, J., Wilmé, L., Sayer, J., Nobre, C., Innes, J. L., Fernbach, P., Sloman, S. A., & Garcia, C. A. (2021). Choices we make in times of crisis. *Sustainability*, *13*(6). https://doi.org/10.3390/su13063578

Zavaleta Cheek, J., Eklund, J., Merten, N., Brooks, J., & Miller, D. C. (2023). A guide to qualitative attribution methods for evaluation in conservation. *Conservation Biology*, *37*(4), e14071. https://doi.org/10.1111/cobi.14071

Supplementary Material

Supplementary Table 1. Pathways from ValPar.CH outputs to outcomes (*a-k*). The definition of *Output* and *Outcome* is taken from Belcher et al. (2020). EI = Ecological Infrastructure. In the column *Source*: # = number of interviewee; FOEN ToC = FOEN Theory of Change for pilot project on ecological infrastructure (BAFU, 2019); W1-NS = working group of natural scientists in workshop 1; W1-HS = working group of hybrid scientists in workshop 1; W1-SPS = working group of social and political scientists in workshop 1; W1-E = working group of economists in workshop 1 (see Methods).

	Output *Products, goods, and services generated by the research (e.g., knowledge, publications, fora, and processes generated by the activities).*	**Outcome** *Potential changes in knowledge, attitudes, skills, and relationships triggered by the research. They manifest as changes in behaviour of stakeholders of the system where the research operates.*	**Source**
a	Open access maps of functional EI and species distribution at high resolution for all Switzerland and species distribution modelling pipeline.	Better biodiversity conservation planning by accounting for the effects of climate and land-use changes on species distribution [by cantonal agencies in charge of planning]. Increased capacity to model species distribution, better planning of species sampling and better verification of citizen observation records by InfoSpecies.	#1
b	Facts & figures written in an understandable language and containing better information on the concept, uses, added value and importance of EI.	FOEN is equipped with a better concept of EI and can better communicate and raise awareness about it and its value. Better decisions [regarding EI and biodiversity] by stakeholders and decision-makers with an impact on the ground: landowners, farmers, municipal technicians that validate building permits, etc. Cantons, municipalities, population, park visitors and the economy recognise the added value of the EI. This leads to the maintenance of EI areas and the investment in upgrading measures. The recognition by the mentioned stakeholders of the added value of the EI also leads to an increased appreciation of nature and landscape by the population. This improves EI in the parks of national importance and thus the preservation and improvement of biodiversity, which in turn improves the maintenance of EI areas and the investment in upgrading measures (feedback).	#2, #4, #12, FOEN ToC, W1-NS
c	Results on policy instruments' effect on biodiversity.	Politicians and the public are more informed about potential policy instruments and their effect on changing behaviours related to land-use change in terms of what could be useful to improve biodiversity.	#7
d	Expert advice, tools, fact-based reports, data analysis, maps.	The confederation better communicates to stakeholders and the public about the challenges faced by biodiversity.	#10
e	Knowledge on the diverse values of EI held by stakeholders, in particular the economic and social value of nature.	It can help FOEN promote EI as a way to protect biodiversity. This involves not only FOEN, but also the Parliament and the Federal Council, who will decide on the	#11, W1-HS

		implementation of the biodiversity strategy. Decisions made by politicians become more aligned with what people want in relation to nature.	
f	Dissemination of knowledge on NCP benefits for human wellbeing (in monetary terms) to stakeholders and the wider population.	It can create awareness and change mindset. This can increase the social acceptance of and demand for policies fostering EI.	W1-E
g	Knowledge of everyday landscape meanings; of the effectiveness of parks with regards to different indicators; of the effectiveness and deficits of different policies; and of the (mis)alignment between ecologically and socially valuable areas.	It improves the effect of parks/EI through the optimisation of policies (and its decision-making process) with local perceptions and needs.	W1-SPS
h	Discussions and processes (e.g., workshops).	Stakeholders of the natural park understand each other better (e.g., department of economy and department of ecology) and develop collaborative inter-sectorial projects benefiting the region.	#9
i	Training of people, in particular students, to work for the improvement of biodiversity.	Increased interdisciplinary capacity to deal with biodiversity (which is an interdisciplinary challenge) by young scientists in CH.	#3
j	Collective learning based on exchanges.	FOEN moves from a biodiversity-based conception of EI to a conception of EI that also includes ecosystem services and a broader set of values. Moreover, federal authorities and people become aware of the importance of environmental justice between nations and the need to reduce Switzerland's impact in nature abroad.	#5
k	Politically situated research network on EI, producing economic valuation and other outputs.	Reinforcement of the advocacy coalition on nature and biodiversity protection. FOEN sees its position strengthened by a scientific study that helps them better communicate their biodiversity strategy and convince stakeholders and the general population about the importance of EI. The results can be used by FOEN to «lobby» in parliament for actions aimed at EI creation and preservation, and to implement policies. Sectoral and cross-sectoral public policies and instruments can internalize the NCP benefits.	#4, #6, W1-E

Supplementary Table 2. Values-centred leverage points that ValPar.CH could potentially activate. EI = Ecological Infrastructure. The source is indicated in brackets as: Goals = ValPar.CH goals (BAFU, 2020); # = number of interviewee; FOEN ToC = FOEN Theory of Change for pilot project on ecological infrastructure (BAFU, 2019); W1-NS = working group of natural scientists in workshop 1; W1-HS = working group of hybrid scientists in workshop 1; W1-SPS = working group of social and political scientists in workshop 1; W1-E = working group of economists in workshop 1 (see Methods).

	Leverage point	**ValPar.CH could improve biodiversity by...**
1	Adequately recognize the values of nature by undertaking valuation.	• ValPar.CH describes and assesses the ecological, social, and economic benefits of EI, as well as its added value. For this, ValPar.CH assesses the state and trends of ecosystem services, analyses their social, economic, and environmental values, elaborates scenarios and analyses instruments for a functional EI (Goals). • Highlighting the uses of EI across sectors and the synergies between them, especially for daily life, is the main need. It is a good approach to elicit the economic value of nature to have arguments that are understandable for the economic side, although I am not sure if this will succeed (#12).
2	Meaningfully include the diverse values of nature into decisions by embedding valuation into inclusive decision-making.	• ValPar.CH delivers maps of functional EI and species distribution at high resolution for all Switzerland. Our goal is to make all our data available for interactive visualization in open access platforms from the confederation or other repositories. This is key. These data will help to anticipate changes in species distribution due to climate and land-use changes, to know if current reserves will be suitable to conserve biodiversity, to show that regional parks may not be located in biodiversity rich areas, etc. They are an extraordinary tool to plan biodiversity conservation, including outside parks, in order to contribute to a life in harmony with nature where we [humans] live. Our data can also be used by InfoSpecies to plan species sampling in under-sampled areas and to verify the plausibility of citizen observation records. Additionally, if we manage to transfer our modelling pipeline, InfoSpecies could autonomously model species distribution and generate maps to feed the confederation's platforms (#1). • ValPar.CH communicates the results (on the ecological, social, and economic benefits of EI, as well as its added value) in a way that is understandable and adapted to the target group (Goals). Generation of scientific knowledge on the value of green areas and translation into an understandable language can have an impact if the authorities are willing to enable change (W1-NS). The cantons, municipalities, population, park visitors and the economy recognise the added value of the EI. This leads to an increased appreciation of nature and landscape by the population. This improves EI in the parks of national importance and thus the preservation and improvement of biodiversity, which in turn improves the maintenance of EI areas and the investment in upgrading measures (FOEN ToC). The facts & figures from ValPar.CH will allow us [FOEN] to argue why EI is important for Switzerland and why it is worth to take care of and invest money in it. The third measure of the pilot project, based on ValPar.CH results, will target stakeholders with an impact on the ground: landowners, farmers, municipal technicians in charge of validating building permits, etc. Nowadays, either the available scientific information does not reach the stakeholders, or when it reaches them, it is not well understood. We want it to have the right language so that the need to act becomes obvious and clear. This is the goal that we want to reach with this pilot project and its three measures. If we don't work with the people or if we work with bans or strong laws, we can't change anything. It is better to persuade and motivate people. That's why this project is so important. I think most of the population is ready to learn something, and when they will realize their impact, they will be ready to change (#2). FOEN's argument that stakeholders and decision-makers will act better regarding biodiversity if they have better information on the added value of EI, is not absurd, provided we know what EI is. It is a mechanistic understanding, but this is how federal offices work (#4). • Our work on the diverse values of EI held by stakeholders, aims to help FOEN promote EI as a way to protect biodiversity. This involves FOEN, the Parliament and the Federal Council, who will decide on the implementation of the biodiversity strategy. The values of stakeholders influence their willingness to support a functional EI and to protect nature (W1-HS). If we manage to show that there is an economic factor, that [EI] is really important, with numbers and examples, and communicate this to the policy, if we can have an impact here, it would be great. Politicians make decisions based on what people want. So, knowing the sociological value of nature, not only the economic one, is essential. In our park, is the same logic (#11).

		• FOEN is looking forward to ValPar.CH outputs to get more support for the development of the biodiversity strategy. These outputs will allow them to better communicate their strategy, why is it important, to convince stakeholders and the general population. In the past, they entrusted economic valuations of ecosystem services to private companies. But this time they really wanted to open a call for a research project, so that they can say that EI was studied by scientists and their results show that [EI] has very high value, it is necessary, and we have a lot at stake. The numbers and results of an independent scientific study can strengthen their position and their capacity to convince stakeholders and the population in what they are going to do (#6). • The project can contribute to improve biodiversity and nature in our park, but rather through discussion and process than through the definition of biodiversity or EI values. It can help different stakeholders understand each other better (like the department of economy and the department of ecology), and trigger collaborative inter-sectorial projects that transform the results into something useful for the region. This is anyway the principle of all our projects which target nature and people's quality of life (#9).
3	Reform policies, rights and regulations so that institutions embrace the diverse values of nature.	• It is about developing a research capacity in a certain domain that will allow to reinforce a certain political point of view. This is certainly also an agenda of ValPar.CH, a more or less secret one. We can hypothesize that all the people involved in ValPar.CH are greens, they love nature. Creating a network of different researchers from different institutions creates a community of ideas which reinforces the community of public policy, or the advocacy coalition on nature protection and biodiversity. This may be an implicit agenda of ValPar.CH which has nothing to do with the concrete research. For whatever reason, FOEN wants to push and reinforce the notion of EI and they spend 3 M CHF for this. Even if ValPar.CH discusses whether EI is a good term or not, the fact that 30 people are reflecting on this notion creates a legitimate political problem around it. Our research is politicized. But I am sceptical that using the notion of EI can lead to changing the power relationship on this matter (#4). Knowledge on monetary NCP benefits is expected to be used by FOEN in the Parliament to «lobby» for actions aimed at EI creation/preservation, and to implement policies. Sectoral and cross-sectoral public policies and instruments can internalize the NCP benefits (W1-E). • I am not sure if ValPar.CH can have a measurable impact on biodiversity. We will have some results and we can show how changing some policy instruments could change some behaviours related to land-use change, and what could be useful to increase biodiversity. But there is no direct effect. Maybe we can have some effect in the parks, although their stakeholders are already quite familiar with the topic of biodiversity. It is more about showing some possibilities to politicians, and showing the public what would be the effect of certain decisions. But spending the money directly on EI would have a more direct effect (#7). • Knowledge of everyday landscape meanings; of the effectiveness of parks with regards to different indicators; of the effectiveness and deficits of different policies; and of the (mis)alignment between ecologically and socially valuable areas can improve the effect of parks/EI through the optimisation of policies (and its decision-making process) with local perception/needs (W1-SPS).
4	Shift societal norms and goals, mobilizing sustainability-aligned values and shifting development models.	• Communication of knowledge about the monetary benefits of NCP (for human welfare and societal wellbeing) to stakeholders and the broader population will create awareness and change mindset. This can increase the social acceptance of and demand for policies fostering EI (W1-E). • ValPar.CH aligns with the new conception of biodiversity of the biodiversity strategy, which is based on ecosystem services and hence very close to the notion of nature itself. ValPar.CH aligns with or responds to this strategy since it is focused on parks where there is a mix of values that I love. However, FOEN's definition of EI is still very much based on biodiversity, at least until 3-4 years ago. Maybe ValPar.CH is a first step in the good direction. This is often the added value of big projects like this one: the exchanges, the collective learning. Deliverables are ok but it is rather at this level where impact takes place (#5). • Biodiversity impacts have been externalized. I hope this project will be a platform of dialogue with federal authorities regarding the challenges of nature conservation, in particular regarding international effects. Just sowing a seed for this, it would be good. I hope this exercise will allow more people to become aware that we don't have the right to protect our nature given our life standard. Either we keep our life standard and we destroy nature within borders or - and this is the ideal - we keep this beautiful nature and we decrease our impacts elsewhere (#5).

Extended description of values-centred leverage points (Pascual et al., 2023):

1. Adequately recognize the values of nature by undertaking valuation: It involves improved valuation by identifying more diverse values of nature and ensuring there are methods and procedures to describe, record and report them. Such recognition and accounting is still not widely done, but is an essential step for harnessing knowledge(s) and motivations to protect nature, including mobilizing a more inclusive set of specific values of nature and sustainability-aligned broad values. Yet, although enhancing recognition of nature's values and undertaking valuation are necessary, these efforts alone are insufficient to ensure pro-environmental decisions and behaviour.
2. Meaningfully include the diverse values of nature into decisions by embedding valuation into inclusive decision-making: It involves enabling value information generated through valuation approaches to be embedded into decision-making. Actions here may include using existing legal and economic policy measures (for example, green taxes) to make production and consumption decisions more sustainable or establishing guidelines for planning decisions that require consideration for the many values of nature. Whereas many theories explain causal relationships between values and behaviour, broader contexts partially determine people's capacity and ability to act on their values. Hence, interventions should be tailored accordingly. Furthermore, integrating values into policy decisions is more likely to occur when valuation is tailored for a specific policy purpose. For instance, at a national level, development of standardized, high spatial resolution ecosystem accounts can provide the biophysical indicators to inform policy design. Likewise, using valuation as part of incentives for pro-environmental behaviour in production and consumption practices (including certification, tax rebates, PES and so on) offers opportunities for strengthening people's sustainability-aligned values. In addition, embedding valuation into environmental and social safeguards (including land tenure rights, equitable access and benefits sharing and procedural justice) can promote conservation in IPLC territories. To enable the conditions for embedding valuation into decisions, it is particularly important to implement inclusive and legitimate processes that meaningfully represent stakeholders' values.
3. Reform policies, rights and regulations so that institutions embrace the diverse values of nature: It involves reconfiguration of societal structures, especially with regard to the decision-making architecture to normalize and scale-up the incorporation of diverse values in decisions. This requires reforms to core legal, economic and political institutions (for example, property rights, trade rules, parliamentary systems) in ways that change what and whose values gain decision-making power in society. Moderating the impetus towards short-term political decisions tied to electoral cycles (for example, instituting procedural rules that protect the interests of future generations) would also be an important structural reform. Another would be to enhance businesses' capacity to care for nature's values by broadening responsibility beyond shareholder interests (for example, instituting rules that preclude biodiversity loss throughout value chains). Similarly, reforming and complementing macroeconomic indicators (for example, GDP) to include values that encompass social and ecological well-being could change both the design and intent of the economic system. In the context of IPLC, institutional reforms to secure territorial property rights and recognize the rights of natural entities (for example, rivers) have demonstrated potential to be highly transformative. Similarly, embracing rights-based approaches would legitimize many IPLC's customary rules that already recognize and embed diverse values and valuation in their conservation decisions. All such institutional changes across sectors would alter predominant societal rules to better ensure recognition for diverse worldviews and broad values of nature. In turn, these actions could support broader reforms towards co-management regimes and foster further institutional changes throughout political and economic systems, helping to overcome current resistance to the worldviews and values held by IPLC.
4. Shifting societal norms and goals, mobilizing sustainability-aligned values and shifting development models: Whereas the first three leverage points act on largely existing values, the fourth one involves modifying underlying social norms and goals to reflect the links between justice and sustainability. Examples of fundamental changes in social norms include how a society views 'progress' or a 'good life' in terms of relationships with nature. These tasks are complex, but inherently transformative. They accompany many institutional reforms contemplated in the previous leverage point (for example, changing macroeconomic indicators of 'progress' beyond GDP) and could powerfully go beyond the goal of some sectors to continue increasing material and energy consumption in already affluent societies. Whereas environmental responsibility norms can be nurtured throughout the lever (see corresponding figure), strategies for wider socialization can aid larger-scale sustainability outcomes. For instance, empowering civil society's role through new participative fora such as citizen assemblies could be a way to form new shared values or surface latent sustainability-aligned values, fostering a counter-force to dominant ways of conceiving the values of nature and shifting current hegemonic societal norms through more open dialogue.

Supplementary Figure 1. Codebook used to code interview transcriptions (mostly answers to the questions *How do you think ValPar.CH can contribute to the Swiss Biodiversity Strategy?* and *How do you think ValPar.CH can contribute to improve biodiversity in Switzerland?*). Source: own elaboration based on Belcher et al. (2020).