Directory of key methods most suitable for biodiversity decision-making contexts

Deliverable number: D2.1

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PLANET4B

BETTER DECISIONS FOR BIODIVERSITY AND PEOPLE

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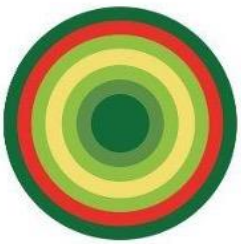

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Key deliverable information

Project acronym	**PLANET4B**
Project title	understanding Plural values, intersectionality, Leverage points, Attitudes, Norms, behaviour and social lEarning in Transformation for Biodiversity decision making
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Website	https://planet4b.eu/
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Deliverable number	**D2.1**
Deliverable title	Directory of key methods most suitable for biodiversity decision-making contexts
Task leader	Coventry University (CU)
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Status	Final

Deliverable description

Directory of: 1) transformative methods of experiential games for social learning, behavioural and institutional change, identifying the most suitable experiential games with specific focus on their applicability within the biodiversity domain; 2) framing and nudging experiments (e.g. various biases and heuristics and activation of social norms); 3) deliberative, creative and arts-based methods (e.g. competency groups, storytelling, deep mapping, nature-based meditation, photo exhibition); for triggering intrapersonal, interpersonal, and institutional change towards improved states of biodiversity.

Version	**Status**	**Date**	**Authors/Reviewers**
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List of abbreviations and acronyms

Acronym	Definition
CG	CzechGlobe – Global Change Research Institute of the Czech Academy of Sciences
CGE	Culture Goes Europe
CU	Coventry University
DC	DADIMA'S C.I.C.
ESSRG	Environmental Social Science Research Group
FiBL	Research Institute of Organic Agriculture
FUG	Forum Urban Gardening
IFZ	Interdisciplinary Research Centre for Technology, Work and Culture
MLU	Martin Luther University of Halle-Wittenberg
NINA	Norwegian Institute for Nature Research
OOF	Oslo og Omland Frilfutsråd
RU	Radboud University
UNIPI	University of Pisa

Table of Contents

Executive summary

- This report introduces a directory of key intervention methods most suitable for biodiversity decision making contexts.
- We used a targeted approach to the mapping of intervention methods, combining scoping the literature, expert input, and narrative review.
- The directory contains 100 intervention methods, organised across three main categories: experiential games; framing and nudging experiments; and creative, arts-based and deliberative methods.
- Prioritisation has been given to methods capable of triggering change at the 'deeper' levels of worldviews, values, beliefs, norms and attitudes.
- As an analytical accompaniment to the directory, we propose a Reflexivity-Contextualisation matrix. The matrix facilitates understanding of the contextualisation of interventions and how social transformations can occur in broader terms.

1 Introduction

While we have broad acknowledgement that there is need for transformative social change to address the ongoing and deepening biodiversity crisis (IPBES, 2019), there is little discussion on how to achieve such a change. The question addressed in this report is to what extent we can conceptualise and create a working directory of intervention methods for triggering social change at various intrapersonal, interpersonal, and institutional levels towards improved states of biodiversity.

There are several strands of literature that are particularly relevant for addressing this question and here we particularly focus on the scholarship around societal transformations and leverage points for interventions. Existing studies on transformative change generally focus on understanding what transformative change is and, for example, the potential of various leverage points in a (social-ecological) system to facilitate such change (Meadows, 1999; Abson et al., 2017; Angheloiu & Tennant, 2020; Davila et al., 2021; Leventon et al., 2021; Mupelele et al., 2021; Horcea-Milcu, 2022). One of the overall arguments in this literature in the last decades of research has been that change in deeper-level leverage points such as paradigms, mindsets, norms, and alike, have greater potential for transforming the system at more fundamental levels. In contrast, as the literature argues, change at more "shallow" levels, such as introducing technical measures, tax and incentive policies, without the internalisation of norms or without change in levers at deeper level, will not in the long term provide the sustainable forms of transformative change that are required.

At the same time, though, the question of social change is not new per se. There is a vast literature addressing many relevant questions of social change (see e.g. North, 2005; Williamson, 2000 for debates on broader understanding of various levels of social change), but often it is very fragmented across disciplines and practice. Applicable disciplines with relevant knowledge can hardly be listed in an exhaustive manner, yet some of the social sciences, humanities, as well as newer disciplinary areas at the interface of natural and social sciences, have been dealing with the questions of social change for a very long time. This is particularly relevant, for example, for behavioural sciences and psychology at the intrapersonal level of change (see e.g. Kahnemann & Tversky, 1979; Thaler & Sunstein, 2008), for anthropology,

sociology and human geography at the interpersonal level of change (see e.g. De Sardan, 2008; Sztompka, 1993; Cote & Nightingale, 2012), and for political sciences, economics, and law at the institutional level of change (see e.g. North, 2005 & Williamson, 2000); all of which also overlap and intersect. However, the biodiversity domain remains relatively new to these disciplines, especially at these detailed levels. This is so despite very adjacent domains such as climate change, environment, and nature, having received substantial attention in the last decades, including specifically in connection with the triggering of individual-to-institutional change.

The question, then, is how to take stock of the available knowledge on interventions, particularly at the deeper-transformative levels, capable of addressing the ongoing biodiversity crisis (Nielsen et al., 2021). Within PLANET4B, this question is relevant to much of the critical review work undertaken through Work Package 1 ('Understanding theories of decision making and intersectionality for a transdisciplinary framework of analysis'),[1] as it is to the opening task of Work Package 2: Task 2.1: Map transformative, deliberative and creative intervention methods for practice. It is the latter of these which this current deliverable reports upon. Specifically, the purpose of this report is to document the creation of a directory of intervention methods (hereafter referred to as the directory) suitable for application within a biodiversity decision-making context, at either an intrapersonal, interpersonal, or institutional level.

Notably, the term 'intervention method' is used in connection with the directory to refer to methods supportive of triggering a change. Classical interventions include regulatory (laws), market-based (policies with incentives, taxes), and advisory-voluntary (education, awareness raising, etc.) interventions. Interventions also include methods aimed at changing people's perception, understanding, attitude and/ or behaviour. Our focus, in compiling the directory, has been on identifying methods capable of intervening in this latter grouping. The rationale behind this focus is two-fold. Firstly, in accordance with existing literature on leverage points for intervening in a system (Meadows, 1999), it responds to the argument that interventions targeting such deeper-level leverage points have greater potential for transforming the system at more fundamental levels. Secondly, in accordance with the overall purpose of Work Package 2, the suite of methods included in the directory are intended to serve as a practical resource for (potential) direct use within Work Package 3 ('Learning communities for transformative change') and Work Package 4 ('Synthesizing transformative pathways and ensuring policy relevance'). As such, prioritisation has been given to identifying intervention methods which learning communities, such as those to be established in the PLANET4B consortium, have both the power and capability of operationalising. Accordingly, three main sets of methods are featured in the directory:

1. Transformative methods of experiential games for social learning, behavioural and institutional change
2. Framing and nudging experiments
3. Deliberative, creative and arts-based methods

The remainder of this report is structured as follows. Firstly, we document the approach taken to compiling a database which provides the foundation for the directory.

[1] See especially Deliverable 1.2, 1.3 and 1.4.

Secondly, we present the results arising from Task 2.1 – namely, the directory (included as Annex 1), together also with an accompanying summary descriptive and preliminary analysis, addressing the nature of the entries contained within the directory and their potential purpose for use within the context of the PLANET4B project. Thirdly, we reflect on the limitations of the directory as it currently stands. Fourthly, we conclude and outline the next steps in relation to the directory.

2 Targeted mapping of intervention methods

The directory (and accompanying database) has been compiled using a targeted approach to the mapping of intervention methods both inductively and deductively, combining scoping the literature, expert input, and narrative review where the focus was on targeted review and mapping of the variation of interventions from both theoretical and practical perspectives (Bryman, 2016; James et al., 2021).

In the case of expert input, we drew upon the rich transdisciplinary knowledge and expertise of consortium partners, including those with previous experience of directly applying individual intervention methods in relevant research contexts (i.e. orientated towards addressing issues of biodiversity, intersectionality, behaviour and/ or transformative change). For the review of existing literature (and also, the subsequent provision of example references within the directory), we have included both peer reviewed work and grey literature. The overall task has, though, been restricted to mapping of intervention methods which fall within the above stated three main method sets of PLANET4B (i.e. (experiential) games; behavioural framing/nudging experiments; deliberative, creative and arts-based intervention methods). The remainder of this section provides further methodological detail on the five main stages of this task: (1) Scoping review in accordance with consortium partner expertise; (2) multi-source targeted review; (3) supplementary literature review; (4) mapping workshops; (5) creation of directory.

2.1 Scoping of interventions in accordance with partner expertise (stage 1)

The objective for the first stage was to identify and record basic information on intervention methods with which one or more members of the consortium had existing experience of using. Although, as part of this stage, partners were asked to indicate the applicability of each proposed method to biodiversity decision-making contexts, they were also directed not to restrict themselves in this way.

Building on an introductory session for Work Package 2 held during the opening consortium meeting (December 2022), the Task 2.1 programme of work was initiated in January 2023, with all participating partners invited to attend an opening workshop at the beginning of February. During this workshop the various envisaged stages of work were first presented (by the task leads) and discussed in outline, with workshop attendees' more detailed attention then being directed towards the first stage of targeted review. In support of the latter, task partners were introduced to and asked to review an excel sheet ('Intervention method') which had been pre-formatted by the task leads (see Figure 1 below).

Following minor revision (namely, the addition of a column identifying the partner contributing each method entry) the excel file was agreed upon by all task partners. The partners were then given a two-week period (in immediate follow-on from the workshop) in which to insert methods into the file. Figure 1 (below) displays the guide instructions for inserting intervention methods, together with a list of categories against which data was gathered.

Instructions:

In the "intervention method" tab, please add:

- Additional methods to the "Intervention Method" tab that you DO NOT see yet in the table.
- If you added an additional method, please fill out the whole row.
- If you provided a new method and are aware of the relevant scientific article/grey literature (column H), you can already go to the "scientific article" tab and fill out the columns there.
- If you have an article for a method already listed add ONLY the article name to column H on the "method" tab, and fill out a new row on the "scientific article" tab.
- Please use N/A when the specific column is not relevant.

Data gathered:

1) Name of contributing partner [with experience of using method]
2) Name of intervention method
3) Type:
    - Experiential game
    - Nudging and framing experiment
    - Deliberative, creative, arts-based intervention
    - Other
4) Description (context, method elements, use, target group
5) Knowledge of previous use within a biodiversity context and/ or opinion on relevance for use within PLANET4B
6) Intersectionality consideration
7) Previous evidencing of impact
8) Any other comments

Figure 1. Instructions and data gathered during Stage 1 – scoping review of intervention methods. Source: Authors own work.

After the initial two-week period had passed task partners were directed to move on to assisting with the next stage of the process (see below).

2.2 Multi-source targeted review of intervention methods (stage 2)

The objective for the second stage was to undertake a targeted review of literature with the aim of identifying and completing a preliminary evaluation on the utility of the intervention methods identified during stage one. This stage was also further informed by the existing expertise and experience of participating partners in the use of individual nominated methods.

Following a series of three internal planning meetings between the task leads, a second formatted excel sheet ('targeted mapping') was added to the Task 2.1 excel file and distributed to all participating partners (March 2023), together with detailed instructions on how to complete this stage of the task. The instructions – which were accepted without revision by all partners – were as follows:

I. Begin by taking a moment to *critically reflect on the following two questions:*

A. What interventions have the highest transformative potential for societal change?

B. What factors serve to shape the extent to which an intervention method can trigger transformative change?

II. *Guided by your thoughts in response to the above questions, your own knowledge and experience, &/or review of the literature, please now identify between three and five intervention methods which you consider capable of contributing to a transformative change.*

- *In making your selection, please choose intervention methods which fall within the three main method sets of PLANET4B (i.e. (serious) games; behavioural nudging & framing; creative & deliberative methods).*
- *You may find it helpful to review the list of intervention methods previously identified by this group (see 'intervention method' sheet of the excel file) – although should you wish to select a method not yet listed on that tab, this is also fine).*
- *The methods you select do not need to be ones which you yourself have previous direct experience of (e.g. you may prefer to use this task as an opportunity to review the literature for a intervention method which is new to you but which you may like to apply within your associated PLANET4B case study), but if it is the case that you lack direct personal experience then please also add a note to this effect in the associated 'additional comments' column of the excel tab.*

III. *Using the 'Targeted mapping' sheet of the T2.1 excel file begin by adding your institutional name and a list of the intervention methods which you will be mapping.*

Select intervention methods which have not already been selected/ listed on this sheet by other Partners.

IV. *For each intervention method, supported by your own review of literature (including academic peer reviewed and other online resources) identify and enter into the spread sheet information* [see Figure 2 below] *on up to four articles addressing either all, some or one of the following article types (e.g. you may prefer to include four seminal articles only; or one seminal and three transformative change articles (etc)):*

- *A **seminal (or seed) paper** that introduces the description or discussion of an intervention method.*

  We define a seminal/ seed paper as an initial piece of evidence, a comprehensive guideline, &/ or a highly cited article that presents an important or influential idea within a particular discipline.

- *A more detailed example (if one is available) that presents an intervention method being used in a **biodiversity** context (not necessarily linked to a seminal paper).*

    If you use an abstract database (such as Scopus or Web of Science) it would be useful to include 'biodiversity OR wildlife OR nature OR conservation OR environment' in the search to ensure you capture evidence in which 'biodiversity' is implicit rather than explicit.
- *A more detailed example that presents an intervention method being used to bring about **transformative change** in any context (i.e. not limited to biodiversity).*
- *An example that presents an intervention method being used to **empower**/ enable a targeted set of participants (i.e. demonstrating potential to address the **intersectionality** dimension of PLANET4B.*

    If you use an abstract database (such as Scopus or Web of Science) in the case of widely cited methods (e.g. photovoice, exhibition) you may need to include as a search term a specific intersectional grouping (e.g. gender, women, disabled, minority, ethnic, youth) in order to return a narrower/ more targeted set of results

In addition to the above, should you wish to add any additional articles and/ or online resources about the intervention method (be they academic/peer reviewed, 'how to guides', reports, blogs or other) that you found to be inspirational or of great interest, or of relevance for Planet4B, please feel welcome to do so (in the final column of the excel sheet).

In the case of Step I of the above instructions, the purpose of asking the partners to begin by reflecting on the two opening questions was two-fold. Firstly it was to encourage them to select methods for review which they felt held clear potential for achieving transformative change (with the only limiting factors here being to choose from within the three main project method sets and to avoid selecting a method for which a review had already been completed by another partner); secondly it was to encourage them to think critically not only about the transformative power of a method, but also as an integral dimension of this, about the range of factors with potential to effect its level of impact and effectiveness in action. In addition to such aspects being important for the purposes of completing Task 2.1, this critical review of existing methods was also an opportunity for all task partners to further their own knowledge and expertise in preparation for the subsequent application of methods featured in the directory later in the project. It was also for this same logic that (as detailed in Step II above) partners were free to select from methods with which they had existing direct experience, methods identified during the first stage of the task (see above), methods which had not been included in the first stage of the task (e.g. for the fact that no partner had previous knowledge or experience of using it), and/ or methods for which they had no previous experience in using, but were nevertheless interested in critically considering in connection with the aims and objectives of PLANET4B.

Figure 2 (below) contains a list of all the database category headings which partners were requested to complete for each of their selected methods and corresponding (four) literature articles. In the case of the first six data categories partners were required to enter descriptive information only (as open text). For the seventh category, they were required to assign descriptives selected from fixed choice lists; in the case

of ‘degree of impact/ effectiveness’ and ‘practicality to implement’, this involved ranking their individual proposed methods as either ‘high, medium and low’. Whilst the reference point for completing the seventh data category was the accompanying cited literature article, it is acknowledged that these entries (together also with the overall selection of four reference articles) were subjective choices on the part of each individual partner. The same applies for the eighth data category in which, in addition to being informed by their targeted literature review selections, partners may also have drawn on any existing first-hand experience.

Data captured:

1) Project partner
2) Name of intervention method
3) Type of supporting article:
    - Seminal
    - Biodiversity
    - Transformative
    - Empowering
4) Article information noting the intervention method (authorship; date of publication; title; abstract; journal/ platform published; DOI/ weblink)
5) Article selection method (already known to researcher/ used to inform their existing work; systematic literature review)
6) Intervention method setting
    - Study context
    - Objective of using the intervention method
    - Target group involved
    - Time frame (time period intervention was used)
    - Specific tools/ resources needed for intervention methods
7) Type of (transformative) change
    - Outcome/ type of change
    - Level of change
        - Intrapersonal
        - Interpersonal
        - Institutional
    - Degree of Impact/ effectiveness
        - High
        - Medium
        - Low
    - Practicality to implement
        - High
        - Medium
        - Low
8) Assessment of overall applicability to PLANET4B
9) Any further comments
10) Any additional recommended resources

Figure 2. Data gathered during stage 2 – targeted mapping of intervention methods.

2.3 Identification of gaps and supplementary literature review (stage 3)

The objective for stage three was to both cross-check and, where required, fill any gaps in the coverage of intervention methods recorded in the database during Stages one and two. This was approached as follows:

- Firstly, the task leads completed stage 2 of the task for all the remaining intervention methods which had previously been identified by partners during stage one of the task, but not then selected and subjected to a targeted literature review during stage 2 of the task. In the case of these additions a note was also added into the database to this effect.
- Secondly, the task leads added additional intervention method entries to the 'targeted mapping' sheet of the database (i.e. exceeding the three to five entries per partner observed by the rest of partners) and completed the corresponding targeted reviews.

In the case of the deliberative, creative and arts-based methods these additions comprised of methods which were either (a) already known to the task leads (although in several cases they were not methods with which they have direct previous experience of using), or (b) which were identified during an additional supplementary snowballing literature review using the literature identified during stage 2 as our start set (Wnuk & Garrepalli, 2018).

To assess additional relevant behaviour science methods in relation to e.g. nudging, framing, social norms, emotions, two key review articles on the behavioural aspects and pro-environmental behaviour (Balmford et al., 2021; van Valkengoed et al., 2022) were assessed. These articles were the results of an online search on biodiversity or pro-environmental behaviour relevant keywords. These articles were deemed as the most relevant, gap-bridging documents because they provided an overview of relevant interventions in a systematic way.

For complimenting the list of games as an intervention method, several articles with review of games (narrative and systematic) were studied with the focus on games as an intervention method to facilitate social learning, both in abstract contexts (e.g. public goods game, common pool resources game, etc.), and in contexts that are adjacent to biodiversity domain (particularly, nature, environment, sustainability, water, land, forests, fisheries). Further, an additional search in Web of Science was conducted to make sure relevant articles particularly focusing on biodiversity were captured (with the search string [“game” (Topic) AND “biodiversity” (Topic) and “intervention” (All Fields)].

The supplementary review confirmed the comprehensiveness of the intervention methods listed within the database.

2.4 Key theories and (intensive) case study mapping workshops (stage 4)

In parallel to completing stage 3 (above), the contents of the database and final composition of the directory have also been shaped by information gained through involvement of the 2.1 task leads in two additional workshops. Namely, the first Task 1.4 workshop on 'key theories of behaviour, decision making and change' and, the

‘intensive case study (online) mapping workshops’ (which were jointly run by the leads for Task 2.1 and Task 3.1). Whilst the former included representation from all partners across two duplicate sessions (see Deliverable 1.4), the latter involved individual sessions with each pairing of intensive case study lead partners and associated lead research partners (namely: FUG and IFZ; OOF and NINA; CGE and MLU; FiBL; DC and CU). Further account of how these workshops contributed to shaping the directory are provided in section 3, below.

These workshop discussions further contributed to our collective understanding of the types of issues with which the intervention methods would need to support engagement. They also served to highlight particular target groups with which intervention methods would need to be aligned (including, e.g. children; physically disabled; ethnic minorities) and accordingly associated points of methodological complexity requiring specific consideration (e.g. limits in ability to read, write and/ or converse in the national language of the case study country; limits in types of terrain able to navigate (in case of outdoor methods) (etc)).

2.5 Report writing and creation of the directory (stage 5)

Stage 5 of this task involved compiling the directory and writing this associated deliverable report. Both activities were undertaken by the task leads, with peer review from one of the task partners (RU).

The directory (which is included as Annex 1) has been compiled using the following category headings:

- Name of intervention method
- Short description
- Purpose
- Example Reference
- Potential for transformative change (High/Medium/Low)
- Practicality (High/Medium/Low)
- Note

In compressing the original database categories to the above refined list, the intention is to make the directory accessible and attractive to a range of different users. As such, it was felt important to balance the number of individual method entries with the amount of information available on each. The aim for the directory, at this stage of the project at least, is that it acts as a simple first-point-of-reference resource, for use by academic and practitioner partners alike. The expectation is that all partners will begin by reviewing all individual method entries contained in the directory, before then making an assessment as to which methods and they would like to trial within their respective case studies. Further information on how this will be facilitated is included in the next steps section of this report (see 4.1, below).

3 Results: Compiling the directory of key intervention methods

3.1 Understanding the directory

The combined use, within PLANET4B, of the three main method sets (together also with a range of more traditional social science research methods) has the *potential* to make a combined contribution to both knowledge and action. That is, they are potentially capable of:

i) advancing our understanding of the diverse perceptions, awareness and meanings of biodiversity in current societal circulation, the resulting behaviours and motivations around biodiversity prioritisation, and also how they shape (or indeed fail to be accounted for within) biodiversity decision making. This includes better understanding the extent to which such variations can be mapped on to the intersectional characteristics and identities of individuals or whole groups in combination with the socio-political and environmental settings in which they live out their everyday lives; and,

ii) bringing about a (positive) change in the way in which biodiversity is perceived, understood, valued and behaved towards by individuals, groups and institutions. It is in this sense that they are also understood as generative and transformative.

Notably, however, throughout this results section we make repeated reference to the 'potential' utility of individual methods (and indeed whole method sets). What became clear from the targeted mapping process is that their ultimate effectiveness and suitability (i.e. the extent to which it is able to *both* advance scientific understanding and render a transformative change amongst participating individuals) will vary in accordance with the specific characteristics and context of each individual research setting. This includes the relational dynamics of study participants (in the case of group activities) and alongside the relational dynamics between study participants and research team. Other relevant factors capable of influencing their usability include, for example, time availability (on the part of research participants as well as researchers), demographic of targeted participants, size and socio-cultural composition of the group, availability of supporting resources, the skills and facilitation capabilities of the researchers, and even – in the case of outdoor interventions – the weather!

Nevertheless, the targeted mapping of intervention methods has still resulted in the identification of a considerable number and range of individual methods (also techniques and approaches) with the potential for contributing to transformative change at either an intra-personal, inter-personal or institutional level. This is particularly so for the deliberative, creative and arts-based methods set. The current collection featured in the directory (see Annex 1) includes altogether 100 methods which can be classified as:

- 29 experiential games methods;
- 11 nudging, framing, social norms, emotions relevant methods;
- 60 deliberative, creative and arts-based methods.

As noted earlier, in compiling the directory (and accompanying database), we have been especially interested in identifying intervention methods capable of triggering change at the deeper levels of the "lever" – worldviews, values, beliefs, norms, attitudes, etc. Furthermore, in accordance with the need for better understanding (and, in turn, acting upon) the relationship between biodiversity loss, intersectionality, plurality and behaviour change (IPBES, 2019), we have also sought to identify methods which give space and recognition to plural values and to the needs and voices of under-represented subjects. Such methods feature within the first (experiential games) and third (deliberative, creative and arts-based) of the three method sets.

To our knowledge this is the first directory of intervention methods specifically addressing the above-mentioned methods sets in the context of identifying methods suitable for application within a biodiversity decision-making context. Notably, however, as per the living nature of this resource, and also the likelihood that new methods will surface during the lifetime of PLANET4B, it is unlikely that the current version of the directory will prove to be definitive.

3.2 Preliminary mapping: introducing the Reflexivity-Contextualisation Matrix

As an accompaniment to the directory, we also take the opportunity to present some preliminary analysis of the range of methods featured in the directory. Whilst this analysis has primarily been undertaken for the purpose of supporting the internal transition to the next task of work package 2 (Task 2.2: Align methods to intersectional and biodiversity challenges of individual case studies), it is thought to also have wider (public and theoretical) value.

Building on own expertise of the authors (Falk et al., 2023; Franklin, 2022; Soliev et al., 2021; Zolyomi, 2022; Zolyomi et al., 2023) and literature on interventions and social change (e.g. Meadows, 1999; Williamson, 2000; North, 2005; Thaler et al., 2013; Cialdini & Jacobson, 2021; van Valkengoed et al., 2022; Janssen et al., 2023) we argue that understanding of transformative interventions most suitable for biodiversity decision-making contexts requires an understanding of 1) contextualisation of interventions and 2) how social transformations can occur in broader terms. We propose a Reflexivity-Contextualisation Matrix for facilitating such understanding. Figure 3 illustrates a continuum of interventions that range from interventions in abstract contexts or contexts that emphasise relationships in a society in general to interventions highly contextualised for biodiversity explicitly emphasising relationships around biodiversity, nature, environment on the ground. The assumption here (and of PLANET4B) is that most challenges related to the prioritisation of biodiversity in society (such as those rooted in intersectionality) in some ways stem from deeper and often non-biodiversity related social issues. This includes, for example, what values, traditions, customs prevail in a society, how these values shape how we govern ourselves and various issues as a society, and what the resulting power structures are, all of which can have defining implications on to what extent biodiversity is high on the societal agenda as an issue (see also Cikara et al. (2022) for debate on the need to integrate richer context in social psychological research). As such, abstract interventions, such as continuous discussions, deliberations, events that are meant to make us re-think the prevailing and more fundamental discourses in a society at a given time (gender, religion, ethnicity, race, age, culture, disability), can be relevant for

all representatives in a society and outcomes are more intangible. Highly contextualised interventions on the other hand aim to facilitate change with a very specific or close focus on biodiversity, nature, environment, with specific groups of stakeholders as participants in the decision-making processes, and often in specific locations. Here the interventions such as stakeholder workshops, joint scenario building activities, actions involving co-creation or co-transformation of space, citizen deliberations and alike, take place on the ground within the contexts where transformations are desired, and the outcomes are more tangible.

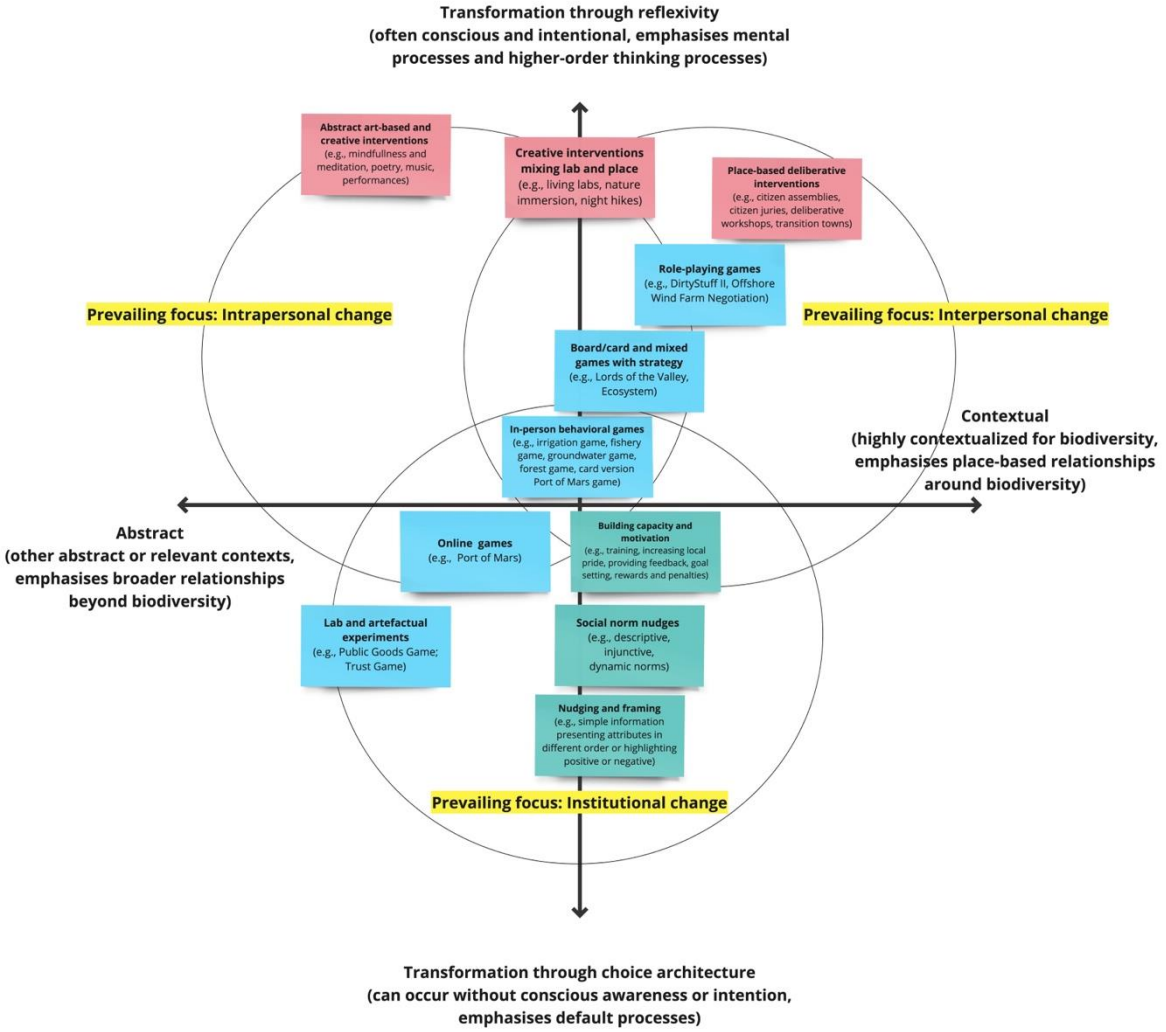

Figure 3. Reflexivity-Contextualisation Matrix for conceptualising transformative interventions focusing on games (blue), nudging and framing (green), and arts-based, creative, deliberative methods (red). Source: Authors' own work.

Finally, a further valuable aspect of thinking about transformative interventions using the contextualisation spectrum is that it provides signals in terms of the resources required for the interventions. Highly contextualised interventions tend to require more engagement on the ground at a specific location to ensure involvement of specific stakeholders and development of details that accurately represent the reality (e.g. if interventions take place in Halle about social transformations related to biodiversity

prioritisation in or through urban gardens, contextualised interventions will mean names, places, circumstances reflect the situation on the ground).

We further argue that transformations in a society can occur in a continuum between 1) change at deeper levels of social change where change is conscious and intentional and the focus is on mental processes and higher-order thinking, such as rethinking assumptions that are often taken for granted, engaging with the challenges, critical thinking, and problem solving; and 2) change at levels where change can occur without conscious awareness or intention – for example, in response to new default processes, such as a new regulation (or how it is presented) that might expand, restrict, reorganise available choices. Transformations through more reflexive, conscious, intentional change thus occur from the bottom up, in the sense that where individuals, groups or a society, develop deeper beliefs about what is valuable, they then begin to shape their behaviour and devise their institutional arrangements accordingly. Whilst transformations through choice architecture occur rather from the top down, in the sense that continuous external stimuli and carefully crafted default choices largely define the availability of choices and more importantly the likely choices integrating them into every-day life and on a mass scale.

This categorisation of transformative interventions helps us to make further sense of different groups of interventions in terms of their prevailing focus: intrapersonal, interpersonal, and institutional change. Highly abstract interventions with the purpose to trigger deeper reflections about issues at hand (not about specific people, places, or issues in particular) primarily focus on intrapersonal change. The more contextualised the interventions become (about certain people, certain places, certain issues) the more they centre around interpersonal change, where specific relationships between individuals, groups, communities take the prevalent focus. Interventions that focus on achieving transformations through changes in choice architecture, whether they are about certain people, places, issues or not, often focus on institutionalising the desired change, that is making certain actions a default choice formally or informally. We suggest this analytical approach for facilitating our understanding of transformative interventions conceptually and not as precise and exclusive categories. All these categories often overlap and intersect, and while distinction is useful for understanding and analysis, any selection of transformative interventions should consider various combinations of interventions.

3.3 Limitations

Certain limitations regarding this task should be considered. Our primary classification of methods (creative methods, serious games and nudges, framing, etc.) was applied as we considered these methods to be more suitable to induce changes in behaviour with a higher leverage factor, especially when used in mix with each other. Accordingly, in our directory certain, especially institutional level-relevant methods (e.g. policy-regulatory, market-based instruments) are not noted, as our scope was on the suitability to Work Package 3, which will mostly operates in a local/sector specific context. Our methodology was developed to capitalise on the expertise of the PLANET4B consortium in a systematic way. Further, the broader set of interventions (not only those listed in this directory) can be analysed through the introduced Reflexivity-Contextualisation Matrix. Both dimensions of the matrix, as well as the levels of change, can be applied to analysis of any interventions. Hence, although our

list of methods is primarily indicative to the knowledge of the partners and cannot be considered exhaustive, there is an important added value derived through iterative inductive process. Further, we chose this approach to enable and utilise entirely the diverse and transdisciplinary background and knowledge of the different organisations and their experts participating in the project. To counteract the potential biases of the consortium nevertheless, we did carry out additional searches ensuring that our database is as thorough as possible. We also want to reflect on the fact that we need further alignment of the other, simultaneously processed, deliverables (esp. D1.2 and D1.4 on theories) to ensure that methods of relevant theories are built into the directory. Concerning the richness of various methods and their multiple versions, probably thousands exist in various formats, which are not currently included in our directory. Nevertheless, we still consider our 100 methods as an ideal starting point to be further explored with the other Work Packages, and to additionally be honed and extended throughout the project.

4 Conclusion and outlook

With the contribution of over 50 experts, through a series of steps and reviews, we built a directory of 100 methods varying from horticulture workshop through serious games on global warming to campaigns to build local pride on biodiversity. This directory will serve as a basis for further discussion with PLANET4B case study leads, where partners can evaluate the suitability of the featured methods or method-mixes concerning the case studies' context. To ensure their usability and attractiveness, the directory will be further developed to be used in Work Package 5 and its educational materials. Upon completion of Work Package 2 (month 36) an extended version of the directory and the accompanying database will be shared as an Open Access resource within the PLANET4B repository. Whereas our primary aim was to work with the case study partners on further tailoring the methods to their needs and context, we consider the directory as a general resource for external users also. Further, through the Reflexivity-Contextualisation Matrix introduced here we aim to initiate a discussion on how we understand and select transformative interventions, both in theoretical and practical terms, beyond PLANET4B.

Our aim, going forwards, is to further optimise the coverage and utility of the directory. In so doing, it will be treated as a living resource to which we are able to add additional intervention methods where required. Initially, we will be guided in doing so by the further articulation of the eleven PLANET4B case studies. Over the course of the next six months each case will become more established. Within the support framework of Work Package 3 they will further clarify their aims and objectives, their associated individual programmes of work, their impact pathways, and the composition of their learning communities (intensive case studies)/ advisory boards (extensive case studies). This activity will, in turn, make it possible (and likely necessary) for us to further calibrate and evolve the content of the directory towards the respective characteristics, needs and intervention opportunities of each case. For this reason, it is important that the directory remains under active review. Keeping the directory under review is also important in accordance with our longer-term aim of maximising its wider scientific and practical value for use by a range of different stakeholders out-with and beyond the lifetime of this project.

In terms of practical steps to be taken in support of the above:

- Our immediate next step will be to circulate the directory to all consortium partners for review.
- In parallel to circulating the directory consortium partners will be invited to attend an expert group workshop. The purpose of the workshop will be to discuss – via both small group and plenary sessions – the relevance, utility and practicality of the intervention methods across the individual cases. This discussion will be further stimulated by the use of a series of simple mapping matrices (including that presented in section 3.2 above). The workshop will help us to establish such as: types of method for which there is greater or lesser demand within the cases; methods which may need to be adapted in accordance with the specificities of individual cases (e.g. biodiversity focus; intersectionality characteristics); and also any methodological intervention needs which are, as yet, unmet by the directory.
- In follow on from the workshop consortium partners will be updated on any revisions to the directory. This will be achieved both through targeted communications within individual case study leads, and also more broadly by Work Package 2 leads working closely with Work Package 3 leads (and all associated task leads). The continued close collaboration between these work packages will, in turn, ensure that the directory continues to act as a key supporting resource aligned to the (evolving) needs of the individual case studies.
- Over the course of the remainder of PLANET4B we will also endeavour to keep abreast of any intervention methods which emerge during the period. This will be achieved via targeted review of both peer reviewed and grey literature (including using keyword search terms and through snowballing reference review). It will also continue to be informed by the expert knowledge of the consortium partners.

References

Abson, D. J., Fischer, J., Leventon, J., Newig, J., Schomerus, T., Vilsmaier, U., ... & Lang, D. J. (2017). Leverage points for sustainability transformation. *Ambio, 46,* 30–39. https://doi.org/10.1007/s13280-016-0800-y.

Angheloiu, C. & Tennant, M. (2020). Urban futures: Systemic or system changing interventions? A literature review using Meadows' leverage points as analytical framework. *Cities, 104.* 102808. https://doi.org/10.1016/j.cities.2020.102808.

Balmford, A., Bradbury, R. B., Bauer, J. M., Broad, S., Burgess, G., Burgman, M., ... & Nielsen, K. S. (2021). Making more effective use of human behavioural science in conservation interventions. *Biological Conservation*, *261*, 109256. https://doi.org/10.1016/j.biocon.2021.109256.

Bryman, A. (2016). *Social Research Methods*. Oxford: Oxford University Press.

Cialdini, R. B. & Jacobson, R. P. (2021). Influences of social norms on climate change-related behaviors. *Current Opinion in Behavioral Sciences, 42*, 1–8. https://doi.org/10.1016/j.cobeha.2021.01.005.

Cikara, M., Martinez, J. E. & Lewis Jr, N. A. (2022). Moving beyond social categories by incorporating context in social psychological theory. *Nature Reviews Psychology, 1*(9), 537–549. https://doi.org/10.1038/s44159-022-00079-3.

Cote, M. & Nightingale, A. J. (2012). Resilience thinking meets social theory: situating social change in socio-ecological systems (SES) research. *Progress in Human Geography, 36*(4), 475–489. https://doi.org/10.1177/0309132511425708.

Davila, F., Plant, R. & Jacobs, B. (2021). Biodiversity revisited through systems thinking. *Environmental Conservation, 48*(1), 16–24. https://doi.org/10.1017/S0376892920000508.

De-Sardan, J. P. O. (2008). Anthropology and Development: Understanding Contemporary Social Change. Bloomsbury Publishing.

Falk, T., Zhang, W., Meinzen-Dick, R., Bartels, L., Sanil, R., Priyadarshini, P. & Soliev, I. (2023). Games for experiential learning: triggering collective changes in commons management. *Ecology and Society, 28*(1): 30. https://doi.org/10.5751/ES-13862-280130.

Franklin, A. (2022). *Co-creativity and Engaged Scholarship: Transformative Methods in Social Sustainability Research* (p. 559). Springer Nature.

Horcea-Milcu, A. I. (2022). Values as leverage points for sustainability transformation: Two pathways for transformation research. *Current Opinion in Environmental Sustainability, 57*, 101205. https://doi.org/10.1016/j.cosust.2022.101205.

IPBES (2019): Global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. E. S. Brondizio, J. Settele, S. Díaz, and H. T. Ngo (editors). IPBES secretariat, Bonn, Germany. 1148 pages. https://doi.org/10.5281/zenodo.3831673.

James, K. L., Randall, N. P. & Haddaway, N. R. (2016). A methodology for systematic mapping in environmental sciences. *Environmental Evidence, 5,* 1–13. https://doi.org/10.1186/s13750-016-0059-6.

Janssen, M. A., Falk, T., Meinzen-Dick, R. & Vollan, B. (2023). Using games for social learning to promote self-governance. *Current Opinion in Environmental Sustainability, 62,* 101289. https://doi.org/10.1016/j.cosust.2023.101289.

Kahneman, D. & Tversky A. (1979). Prospect theory: an analysis of decision under risk. *Econometrica, 47*(29), 263–292. https://doi.org/10.2307/1914185.

Leventon, J., Abson, D. J. & Lang, D. J. (2021). Leverage points for sustainability transformations: nine guiding questions for sustainability science and practice. *Sustainability Science, 16*, 721–726. https://doi.org/10.1007/s11625-021-00961-8.

Meadows, D.H. (1999). Leverage points: Places to intervene in a system. Hartland VT: The Sustainability Institute.

Mupepele, Anne-Christine, Helge Bruelheide, Carsten Brühl, Jens Dauber, Michaela Fenske, Annette Freibauer, Bärbel Gerowitt et al. (2021). Biodiversity in European agricultural landscapes: Transformative societal changes needed. *Trends in Ecology & Evolution, 36*(12), 1067–1070. https://doi.org/10.1016/j.tree.2021.08.014.

North, D. C. (2005). Understanding the Process of Economic Change. Princeton: Princeton University Press.

Soliev, I., Janssen, M. A., Theesfeld, I., Pritchard, C., Pirscher, F. & Lee, A. (2021). Channeling environmentalism into climate policy: An experimental study of Fridays for Future participants from Germany. *Environmental Research Letters, 16*(11), 114035. https://doi.org/10.1088/1748-9326/ac30f7.

Sztompka, P. (1993). The Sociology of Social Change. Wiley-Blackwell.

Thaler, R. H. & Sunstein, C. R. (2008). Nudge: Improving Decisions about Health, Wealth, and Happiness. Yale: Yale University Press.

Thaler, R. H., Sunstein, C. R. & Balz, J. P. (2013). Choice architecture. In: *The Behavioral Foundations of Public Policy*. E. Shafir (ed.). Princeton, NJ: Princeton University Press, chapter 25, pp. 428–439.

van Valkengoed, A. M., Abrahamse, W. & Steg, L. (2022). To select effective interventions for pro-environmental behaviour change, we need to consider determinants of behaviour. *Nature Human Behaviour*, *6,* 1482–1492. https://doi.org/10.1038/s41562-022-01473-w.

Williamson, O. E. (2000). The new institutional economics: taking stock, looking ahead. *Journal of Economic literature, 38*(3), 595–613. http://www.jstor.org/stable/2565421.

Wnuk, K. & Garrepalli, T. (2018). Knowledge management in software testing: a systematic snowball literature review. *e-Informatica Software Engineering Journal, 12*(1), 51–78. https://doi.org/10.5277/e-Inf180103.

Zolyomi, A. (2022). How to Make Policy-Makers Care about “Wicked Problems” such as Biodiversity Loss?—The Case of a Policy Campaign. In: *Co-Creativity and Engaged Scholarship*. A. Franklin (ed.). Cham: Palgrave Macmillan, p. 527.

Zolyomi, A., Franklin, A., Smith, B. & Soliev, I. (2023). Ecosystem services as the silver bullet? A systematic review of how ecosystem services assessments impact biodiversity prioritisation in policy. *Earth System Governance, 16*, 100178. https://doi.org/10.1016/j.esg.2023.100178.

Statement on data availability

The directory of methods is available in Annex 1 and the references cited in the directory in Annex 2.

Statement on ethics

This work used published material available on the Internet. No personal data were collected, so no ethical issues are apparent. The authors have no conflicts of interest to declare.

Annexes

Annex 1. Directory of intervention methods as of April 2023

Table A1. Directory of interventions suitable for application within a biodiversity decision making context. Source: Authors' own work. Note: categories and evaluative notes are based on subjective assessment of the authors derived from the expert inputs, relevant literature, and relative to other interventions, see the full report for details.

Category	Name of method	Short description	Potential suitability for biodiversity decision-making contexts	Reference	Potential for transformative change (High=H Medium=M Low=L)	Practicality (High=H Medium=M Low=L)
Creative and arts-based methods						
Modelling and mapping	**Deep mapping**	Deep mapping is a form of critical cartography which uses a collaborative and reflexive cycle of research, dialogue as well as visual and written analysis, to co-creatively capture alternative forms of sensing, relating to and representing space. Deep mapping can take a variety of forms, but commonly involves artful layering of multiple different dimensions and versions of a mapped space.	Deep maps capture the relational complexity of space, often with a purpose of increasing public awareness of what and whom are commonly excluded from more standard forms of mapping and in so doing, supporting social empowerment and/ or increasing awareness of the role of nature and biodiversity in the making of place.	Humphris et al. (2022)	L	M
	Mental maps (place based)	Participants are asked to draw maps of a specified location as a way of identifying subjective interpretations of space.	When used as part of a workshop or other group setting mental maps can support increased understanding on different meaning and uses of space by different social groupings (e.g. youth, elderly, ethnic minorities, women, disabled etc)	Götz and Holmen (2018)	L	H
	Digital sound maps	Digital sound mapping involves the tagging of georeferenced social media and audio data to a digital map.	Digital sound maps can be used as a tool for exploring relationships between sound, place, nature emotion and perception, with the results used to identify (e.g.) restorative spaces and/ or spaces with rich soundscapes of nature	Aiello et al. (2016)	L	M
	Participatory 3D modelling	A form of participatory system modelling involving 3D modelling of a particular place, its characteristics and features (and potentially also any associated activities, actors, or issues).	The value of a 3D modelling exercise is that while walking around the model, participants will trigger different memories or be able to gain a more tangible perspective of their land use.	Rambaldi (2010)	L	M

	Participatory System Mapping	A participatory system dynamics (qualitative) modelling approach in which participants jointly devise diagrams on a topical issue.	The systems mapping process fosters knowledge exchange and also supports the development of shared understanding plus policy recommendations on complex and dynamic issues	Lopes and Videira (2017)	L	M
	Actor mapping	Involves the visualisation of key stakeholders and the relationships between them.	Can be used as a design thinking tool, as a means of ensuring identification of all relevant actors (in connection with a particular issue, place, or process) and alongside for the purpose of analysing the relationships between them	Panke (2019)	L	H
	Journey maps	Visualisation of steps/ actions/ decisions taken by one or more actors over a specified period of time.	Can be used to illustrate key points in life history to date, or to illustrate steps undertaken/ to be taken to achieve a particular goal	Panke (2019)	L	H
Creative and participatory workshops	**Horticulture workshops**	Focused around practical gardening and plant cultivation tasks, horticultural workshops facilitate small groups of participants to engage in a social and therapeutic activities, either as a single session or series of sessions.	Horticulture workshops are commonly run as a restorative activity that promote well-being, social inclusion and practical know-how in an inclusive and accessible manner.	Bos et al. (2016)	L	H
	Scenario Workshops	Scenario workshops comprise of facilitated group discussion around one or more future scenarios in connection with an issue of relevance to all participants and in connection with which there is a high possibility of change. The scenarios may either be pre-formulated, or formulated co-creatively as part of the workshop itself. As a general rule scenarios being put forward to the participants should be designed such that they "have a temporal property rooted in the future and reference external forces in that context; scenarios should be possible and plausible while taking the proper form of a story or narrative description; and that scenarios exist in sets that are systematically prepared to coexist as meaningful alternatives to one another" (Spaniol and Rowland 2019:1).	Scenario workshops can be effective in encouraging participants to become aware of alternative, future orientated ways of addressing a problem and also the potential consequences of particular courses of action or inaction, over the short, medium and longer term; they can also be effective in motivating change	Slocum (2003)	L	H
	Art-making workshops	Creative workshops involve (e.g.) cutting, sticking, drawing, painting (etc) in combination with individual and group reflections.	Commonly designed to be accessible to a full range of participants, with no actual need for formal artistic skill, the workshops can be used for purposes of encouraging individual and collective reflection around a particular issues and/ or supporting the incorporation of a much richer and more diverse range of voices, experiences and perspectives in a research process	Vasudevan (2020)	M	H
	Collage making workshops	Collage making is 'the process of using fragments of found images or materials and gluing them to a flat surface to portray phenomena' (Butler-Kisber and Poldma 2010: 2); it can be used to create non-	Collage making is widely thought of as a therapeutic process which triggers memories and experiences; as such it is often used to facilitate individual and/ or collective discussion about	Butler-Kisber and Poldma (2010)	L	H

		linear visual representations in response to a specified issue, question or theme.	sensitive and controversial issues. Collages offer an alternative way for people to express themselves and thus serve as a rich visual source of data.			
	Cooking workshops	Cooking workshops involve participants collectively preparing, cooking and eating together whilst sharing stories, memories and personal experiences associated with particular meals or individual items of food.	The workshops can be used either as an opportunity to build trust and understanding amongst a group of individuals regardless of the research foci, or as a means of accessing visceral and embodied knowledge in connection with a particular food, health or dietary issue, belief or behaviour. Additional theatrical/performative dimensions can also be incorporated into the method with the intention of increasing the transformative impact on participants	Winham et al. (2014)	M	H
	Lego serious play	Participants are encouraged to design and build objects of their own choosing from a pile of lego, either in response to a set question, focal issue, or problem statement. The method commonly involves a series of construction rounds in a group setting.	Lego serious play can be used to encourage collective discussion around points of group tension or controversial issues. It is also often used (in either a group of one-to-one interview setting) to support participants sharing their experience, thoughts and feelings in connection with sensitive issues. Lego serious play uses and prompts creativity, reflection, imagination and problem solving through play. In urban settings, for example, young people can use the method to imitate the city they live in, and with limited resources and space, they can decide together to address biodiversity issues in the city.	Roos and Victor (2018)	L	M
Film making and audio	**Participatory video**	Participatory video is centred around enabling a group of participants (e.g. a community group; a youth group) to plan, design and making a short film about a subject of their choosing, working collaboratively with a researcher and/ or videographer. Recordings can be made using smart phones or more specialist film making equipment. As part of the process participants are also taught to create story boards and to become familiar with a range of basic digital editing techniques.	Can be used for a range of purposes, including drawing attention to an issue, showcasing an initiative or documenting an intervention, doing so in a way which (commonly) prioritises the viewpoints of the participants and also simultaneously upskills and empowers all participants	SOLINSA Project (2012)	M	M
	Documentary Film making	Production, sharing and show casing of a (often relatively short) documentary film, commonly with direct input from a videographer or film maker	Can be used to raise awareness and understanding of a full range of socio-cultural, environmental, economic and political issues, with target audiences ranging from policy makers, to industry, and to civil society	Fitzgerald and Lowe (2020)	M	M
	Podcasts	Production and sharing of digital audio 'podcast' recordings - of varying formats e.g. interview;	Often used with the aim of raising public awareness and/ or understanding in a format intended to be compatible with easy listening, high	Sage (n.d.)	M	H

		conversational; solo; and/ or types e.g. educational; storytelling	existing professional work loads and/ or busy everyday lives.			
	More-than-human audio recordings	Short digital audio recordings of the sound made by a particular species (e.g. a call or song of a bird) accompanied by a brief description of the characteristics of that species.	Aimed at increasing public awareness and appreciation for the existence of a species and our relationship to it	BBC (n.d.)	L	H
Cinema	**Movie screenings/ outdoor cinema**	Films tell stories, they touch and move their audience' (Harms et al 2022). Public film screenings can be targetted either towards whole place-based communities, or to specific local groups, and are often most effective when followed by dedicated time and space for formal and/or informal discussion (for example, accompanied by refreshments). In the case of (e.g.) biodiversity, wider environmental and/ or climate change themed content, where resources and regulations permit, holding the film screening in evocative outdoor locations can help to further catalyse its impact. An carefully selected outdoor location may also support an increase in audience attendance figures.	Public film screenings can create a perfect stimulus for promoting critical awareness, discussion and desire for change in connection with key issues.	Harms et al. (2022)	M	M
Living Labs	**Living Lab**	Stakeholders are brought together over a relatively extended time period (from months to years) solution-orientated generation of ideas, planning and action in a 'real life' setting. Multiple individual methods may be incorporated into any one living lab, with the range and type of methods being dependent upon in accordance with the challenge faced, the range and number of stakeholders involved, the resourcing of the living lab and its participants, whether it is primarily physical or virtual in arrangement, and the issue/ challenge with which it is engaging.	Living labs are a methodological approach for supporting multi-actor collaboration (co-creation processes) and as an experimental 'space' for intervention; commonly referred to as an open innovation system, they can either be place-based, or organised virtually, and have as their focus a particular societal issue or challenge (e.g. addressing biodiversity loss).	Hossain et al. (2019)	H	L
Social movements	**Transition Towns**	Long term place-based citizen led transition movement addressing multiple dimensions of sustainable production & consumption/ behaviour and practice at a local level (e.g. food, energy, housing, transport, biodiversity, education, health & wellbeing), including via the establishment of a wide range of transformative and inclusive community initiatives.	Transition Towns movements promote citizen empowerment, education, awareness raising and grass roots led collaborative action for change .	Feola and Nunes (2014)	H	L
Action research and action learning	**Systemic Action Research**	Systemic action research offers a research and learning architecture for engaging large (and dynamic fluctuating) numbers of participants 'in multiple parallel and interlocking inquiry	Aims at identifying and acting upon the systemic properties of complex real-world issues	Burns (2014)	M	M

		processes, across a system where issues are interconnected' (Burns 2014).				
	Reflective Learning Methodology	A participatory action-learning methodology which incorporates, through a series of dynamic and interactive stages: i) reflection workshops to both co-identify research questions and participatory methods to be used during associated field research, and to review and monitoring the results of the fieldwork, and ii) corresponding field based co-production of knowledge between researchers/ research participants.	The method is aimed at encouraging continuous collective reflection between a range of stakeholders, and also at intentionally producing results which are of value for policy, practice and science.	Moschitz and Home (2014)	M	M
Art and craft based visual communiation	**Zines**	Involves the Do-It-Yourself creation (either by an individual or by a group) of a handmade publication to convey information about a specific issue and/ or study results with emphasis on use of visual image and story telling; can incorporate hand writing, calligraphic writing, drawings, photos, collage (etc).	Supports wider engagement with issues and enhanced accessibility of research results	Velasco et al. (2020)	L	H
	Drawing/ thematic drawing	As with draw and write/ draw, write and tell, drawing is a very inclusive method suitable for use with a wide range of participants and often especially popular for use with children, where there may be a risk of illiteracy amongst participants and/ or where participants have limited ability to converse in the language of the researcher.	Drawings help to convey how something (e.g. an issue, place, environment, object or subject(s)) is perceived by an individual and the process of inviting (especially vulnerable) individuals to participate through the mode of drawing can both empower and encourage self reflection. Notably though, where drawings are analysed without any accompanying written/ oral narrative by the participant, considerable care must be taken in how they are interpreted.	Young and Barrett (2001)	L	H
	Seasonal mapping/ calendars	Calendars are constructed either by the participants themselves during a facilitated session, or by professional artists. Where professional artists are involved, they can be asked to use information separately gained from participants by researchers and/ or create visual representations whilst directly in accompaniment with research participants (e.g. during a creative workshop).	Seasonal calendars can used to capture, display, educate and generally communicate about biodiversity knowledge and associated human-nature relations in an evocative and accessible manner.	McKemey et al. (2020)	L	H
Visceral, imersive, experiential and mobile methods	**Earth walking (outdoor education)**	The earth walking method can be undertaken in a wide range of outdoor settings (including some outdoor urban settings), and for a duration of either a single day, or up to three days together with night camping. In order to achieve a transformative impact amongst participants there needs to be a strong group dynamic, expert facilitation, and also ideally a dedicated 'debriefing' session in follow on from the 'earth walk'.	Outdoor Education methods such as 'earth walking' are characterised by a strong connection with the natural environment. This is achieved by: teaching *about* environment, *through* the environment (e.g. by using its elements as educational tools) and *in* the environment (by being outdoors rather than indoors). In the specific case of Earth Walking the method is used to stimulate active learning about Human Evolution	Outdoor Academy (2018)	L	M

			and Human Impact, especially in terms of the impact of humans (and human decision making) on the environment and how to protect biodiversity.			
	Nature immersion	Nature immersion activities are centred around facilitating small groups of participants spending time outdoors, experiencing nature. This can take the form of facilitated day sessions and/ or longer facilitated residentials and retreats.	Aimed at stimulating a greater awareness as well as a more caring and appreciative relationship with nature, whilst also promoting human health & wellbeing;	Lim et al. (2020)	M	M
	Workshops in nature	Workshops held outdoors in natural settings/ sites of green space (e.g. gardens) to discover biodiversity relevant habitat elements and learn about their maintenance by a local/ resident and/ or scientific expert, with opportunity for peer-to-peer consulting by providing the space for participants (e.g. gardeners) to meet and exchange.	Workshops in nature help to increase participants' awareness, knowledge and appreciation of local flora and fauna as well as the multiple roles and values of biodiversity more broadly	Priebe et al. (2022)	M	H
	A night hike (experiential learning)	Incorporating the use of an expert guide and facilitator the night hike method is used to teach participants about the environment, *through* environment (by using its elements as educational tools) and *in* the environment (by emphasising outdoor activities over indoor ones). The method requires preparation (including route planning) and establishment of a collaborative group dynamic. Often used with young people (18-30), a perfect place for a night hike is a forest, but equally night hikes can also been undertaken in urban settings.	Often used as a form of outdoor education, emphasis is given through this method to promoting experiential learning and greater appreciation of the roles of nature.	Outdoor Academy (2018)	L	M
	Walk and talk/ mobile interviews	A mobile semi- or unstructured interview method which can be of varying length and either digitally recorded, or written up subsequently in field notes. The interview may undertaken with a single individual or small group of participants. In arranging the interview attention needs to be given to any mobility needs of either the participant or researcher and also the location (e.g. safety, background noise, accessibility) and length of the planned route.	Mobile interviews are often used for the purpose of better understanding complex relationships between people and outdoor spaces/places in either urban or rural settings, including stakeholder know-how and lived experiences within such settings. They can also be used to engage respondents in discussion of sensitive issues in a less confrontational manner than may be associated with a more static face-to-face interview arrangement	Bardsley et al. (2019)	L	H
	Excursions/ Field trips	Excursions/ field trips offer a different approach to learning about something than teaching theories. They are based on the premise that the subject of study/ interest (e.g. nature) needs to be experienced directly. The excursion can be a half or full day or involve a residential stay. Commonly they are organised for small or large groups and include a facilitator and/ or expert guide.	Seeing and learning about examples, initiatives, and content firsthand can contribute to deeper understanding, broaden horizons, foster teamwork, and contribute to personal development. In addition, they can increase one's own motivation for dealing with the content of one's own projects;	Rickinson et al. (2004)	L	M

	Stigmergic gardening	People (known or anonymous) are invited by signals (e.g. signs with pictograms or placed tools) to perform tasks within a garden, e.g. planting, watering but also harvesting. Gardening can also refer to the care of green public spaces.	Stigmergic gardening can be used to promote engagement with nature, the development of new skills, reflection and also increased self-confidence	Heylighen (2015)	L	H
	Mindfulness and mediation based intervention	Guided individual and/ or group based sessions facilitating participants' deep, embodied and open-minded awareness of the present-moment.	Mindfulness and mediation encourage curiosity, reflexivity, openness, calmness and relational connectivity; increases capacity to cope with stressful and challenging situations and environments	Schuman-Oliver et al. (2020)	L	H
	Yoga as research method	Yoga classes are provided to small groups of research participants in either an indoor or outdoor settings. Care must be taken to ensure that the yoga exercises are suitable (and prior risk assessed) in accordance with the characteristics of research participants. As an intervention method yoga classes are ideally accompanied by other complimentary forms of research method supportive of encouraging reflection and dialogue with (and amongst) research participants.	Can be used to explore and raise consciousness around the role of the body, haptic senses, and also sense of self in connection with how meanings and understandings are constructed and experienced. Can also be used as a method for building trust between researchers and research participants.	Buckingham and Degen (2012)	L	H
	Poetry walk	Poetry can be used as a medium for bringing together and stimulating 'sensations, emotions, insights, reflections, imaginations, descriptions, and affects' (Paiva 2020). Typically a poetry walk will follow a pre-planned route, with intervals of poetry reading in set locations. The poetry may either be provided by the facilitating researcher, or by participants themselves. Whilst moving along a walk between poetry readings participants can either be encouraged to reflect individually in silence, or through dialogue with other walk participants. A poetry walk is sometimes also accompanied by a final summative reflection session, facilitated by the researcher.	Poetry walks can be used to encourage multi-sensory engagement with a diverse range of issues, environments and subjects/ objects. They can also be used stimulate a greater awareness, appreciation or sense of connection with the point of focus and in turn encourage a change of mindset.	Paiva (2020)	L	H
	Soundwalk	Soundwalks are guided walks which take place outdoors and during which attention is directly towards observation of multiple different sounds. The sounds can either be naturally occurring or they can be pre-recorded and played back to participants at set points along a route. Often the route to be taken is pre-planned by the organiser, and so too the time of day for the activity to take place. In some cases participants may be asked to repeat a route at different times of the day (or even, during different weathers and seasons) for the purpose of exploring variations in	In directing our attention towards soundscapes, soundwalks attend to the embodied and multisensory ways in which humans experience and perceive environments. Findings from soundwalk studies provide further evidence for the potential variation in how environments are perceived and experienced by individuals in accordance with their individual life histories and intersectional characteristics. The results are sometimes shared in the form of a sensory map.	Young Jeon et al. (2013)	L	H

		soundscapes. Soundwalks are limited to either small groups or individual participants, with accompanying researchers also assisting in noting the locations of observed sounds.				
Story telling and visual narrative	**Vignettes**	Vignettes can include short stories, scenarios or case examples. They can be presented to individual participants or to small groups, with the participants given time to first read (or listen to) and reflect on the vignette before responding. In the case of small groups they can also be used to encouraged group discussion and reflection. They can be employed at various stages in a research process, and are often used in combination with other research methods (e.g. interviews, focus group, participatory workshops).	Vignettes can be used in support of eliciting a range of responses, including (e.g.) opinions, beliefs, attitudes, wider commentary, and/ or self-reflection on what a participant may themselves have done in a similar circumstance. They also serve as a supportive means of addressing sensitive issues with research participants.	Barter and Renold (1999)	L	H
	Story telling	As a research method storytelling can take multiple forms, including oral, written, visual (e.g. story boarding), role play and theatrical enactment; artefacts can also be enlisted to support and enrich storytelling both on the part of the participant story teller and also how it is received by a target audience. The story teller can be either a professional facilitator/ story teller, or a volunteer from within the group of participants. Story telling sessions often include a number of different stories (and potentially also, a number of different story tellers).	Story telling can be highly effective and evocative as a way of encouraging participants to gain new knowledge, awareness, appreciation and/or interest in a wide range of issues. Story telling can also be a very inclusive and accessible method for communicating information, suitable for use with a diverse range of participants.	Wright et al. (2012)	L	H
	Story boarding	This method can either be used as a stand alone form of story telling by one or more participants, or it can be used as an integral part of participatory video and film making. A series of picture scenes are used to tell the story, commonly with hand drawn images and where required brief accompanying annotations.	Story boarding supports the visualisation of a narrative, including for the purposes of developing a film. It is an accessible method which can be used with a diverse range of both participants and audiences. It can be used to convey a story or key message in a more engaging manner. The process of creating a story board also supports group based collaboration and planning.	Claverie et al. (2016)	L	H
	Comics	Comics can be used to engage people of all ages and backgrounds. Reading them or making them tends to entertain everyone involved in the process. They can be created in either a single or a series of sessions and do not require any specific prior skills on the part of participants. Because comics are familiar to most people from childhood onwards, with basic facilitation participants will usually be able to easily understand what they	The use of a narrative form such as a comic can foster participant's interest, promote discussion in connection with issues which participants may not have previously engaged, and help them to retain learning. Readily shared between peers and accessible to a very wide range of audiences regardless of age, language, education level (etc), they can also be a valuable educational resource.	Friesen et al. (2018)	L	H

		have been tasked with completing and how to proceed.				
	Photo voice	Photovoice commonly involves research participants being tasked firstly with taking a series of photos, of their own choosing, in connection with a particular brief, issue and/ or place; and then secondly, providing a short description of what an image depicts for them, together with an explanation of why it matters to them and thus why they were minded to take the photograph. The latter can either be secured by way of asking the participants to provide accompanying written descriptions for each of their photographs, or through oral discussion of the photographs with them during a follow-on research interview. The outputs from photovoice exercises are sometimes also publicly displayed in the form of an exhibition.	Photo voice encourages critical reflection and can prove empowering for participants. It provides enhanced understanding on individual perceptions and/ or relationships within particular objects, landscapes, events or issues. It can also be an effective means of directing attention towards those whose voices, experiences and viewpoints are otherwise seldom heard and appreciated in connection with a particular issue (e.g. youth, minority ethnic).	Wang and Burris (1997)	L	H
	Creative voice	Creative voice has been developed as an adaption and extension of photovoice. In addition to using photography as a medium for representing spaces, items, objects, subjects and associated issues of meaning to individuals, participants are also able to draw on other mediums of artistic expression at their own discretion	Creative voice (alike photovoice) aims to encourage critical reflection and can prove empowering for participants, giving recognition to their viewpoints and knowledge. It provides enhanced understanding on individual perceptions and/ or relationships within particular objects, landscapes, events or issues. It can also be an effective means of directing attention towards those whose voices, experiences, knowledge and viewpoints are otherwise seldom heard and appreciated in connection with a particular issue (e.g. youth, minority ethnic).	Rivera Lopez et al. (2018)	L	H
	Photo diaries	Similar to photovoice, photo diaries commonly involve participants documenting particular aspects of their everyday life through a combination of visual image and short accompanying written narrative. Participants are asked to complete diaries for a set duration (e.g. 1 week, 1 month) or at particular time points (e.g. a day or week during each season of the year)	Photo diaries can be used to encourage critical reflection on the part of participants whilst also providing researchers with enhanced understanding and insight into the encounters and experiences which make up the everyday lives of individuals, how they are perceived and received. Where participants are willing for extracts from their photo diaries to be publicly shared the method (alike photovoice) can also be an effective means of directing attention towards those whose voices, experiences, viewpoints and everyday lives are otherwise seldom heard and appreciated in connection with a particular issue (e.g. youth, minority ethnic).	Young and Barrett (2001)	L	H
	Draw and write/ draw, write and tell	Draw and write/ draw, write and tell exercises can take various forms, but commonly involve participants drawing an image about and/ or in	The method encourages reflective thought on the part of the participant, including in connection with sensitive issues. The resulting image, together	Angell et al. (2015)	L	H

		response to a specific issue or question. The method can be used in combination with a semi- or unstructured interview. The method is particularly popular in research with children.	with any accompanying narrative, supports deeper understanding of how an issue is perceived, understood and engaged with by an individual (or, where applicable, a group of participants), as well as providing the participant(s) with a way of communicating this.			
	Sandboxing	Selecting from with a range of different miniature objects and figurines made available to them, an individual research participant is asked to place the objects in relation to one another in a box of sand in order to create a 3D scene in response to, or representation of, a particular posed question, issue or place. Having completed the task they are then asked to narrate and explain the scene to the researcher.	Sandboxing can be especially useful for engaging individuals (including minors) in the discussion of sensitive issues. They offer individuals alternative ways of expressing themselves whilst also supporting further self-reflection on the part of the individual. For the researcher they assist in developing a deeper understanding of how an issue or place is experienced, what it represents, and what it means to that individual.	Mannay et al. (2017)	L	H
	Body-map story telling	A small group of participants are guided to begin by drawing an outline of their bodies in a pose that represents their feelings of spending time in a particular setting (in the case of PLANET4B, for example, a biodiverse nature setting). They are then encouraged to add such as key words, symbols and shapes representing feelings that render them in-place or out-of-place in that space. Each participant is then invited to explain the meaning of their body map, incorporating as they do so, story telling narratives providing examples of their own past experiences and/ or those of their family and friends. The session ends with a group discussion about what interventions, and by whom, would contribute to establishing a more inclusive, empowering and/ or meaningful embodied relationship for all.	Promotes multi-sensory reflection and reflexivity around the diversity of ways in which nature and green space are engaged with by a range of individuals. Effective also as a means of directing attention towards those whose voices, embodied experiences, knowledge and viewpoints are otherwise seldom heard, understood or appreciated .	Sweet and Ortiz Escalante (2015)	L	H
Exhibition	**Photo exhibition**	A curated collection of photos are placed on public display. The location, space and layout of an exhibitions can prove crucial in achieving the desired impact and attracting a particular visitor demographic. Exhibitions can be held either indoors (e.g. a dedicated exhibition venue, a town hall or a public library), or outdoors (e.g. an urban park or public throughfare. Depending on the nature of the associated research study, photographs on display may be either professional commissions or the result of a participatory photographic method (e.g. photovoice). The images are often displayed together with short passages of text description	Exhibitions are commonly held with the aim of raising public consciousness and/ or prompting discussion and reflection in connection with a specific issue. The images on display can also be effective in increasing public concern and/ or self-identification with an issue which may otherwise be perceived as of scant relevance, or receive little attention within their everyday lives.	Cherdymova et al. (2018)	M	M

		aimed at offering context without restricting interpretation or emotional perception.				
	Interactive/ Research-as-object exhibition	Interactive and research-as-object exhibitions involve three-dimensional presentation and expression of key messages and research findings.	Interactive/ research-as-object exhibitions can be used to provoke thought and encourage public engagement with research. In this context exhibitions can also serve as provocative sites of knowledge co-creation. With skilful curation and careful selection of an inclusive and inviting physical setting, they can stimulate imagination and make a lasting impression on their visitors.	De Waegemaeker et al. (2021)	M	M
Theatre, drama and role play	**Drama/ community theatre**	Participants are asked to engage collaboratively in drama-based exercises during the course of a single or series of sessions. In creating theatre collectively, they are required to draw on both on their own experiences and viewpoints, and at the same time are exposed and required to engage with those of others through theatrical means.	For the participants especially, but also for the viewer (where performed to a wider audience) theatrical drama methods create a space for developing greater understanding, appreciation and dialogue around the significance and impact of an issue on a particular place and/ or group of individuals. The method can be employed to engage with marginalised groups in a way that draws out a range of issues. Drama can encourage people to talk, reflect and think about their lives in diverse ways. Drama can also increase participants' confidence and may serve as a way of indirectly addressing issues.	McKenna (2014)	L	M
	Role play	A facilitated group session in which either scripted or unscripted roles are assigned and/ or selected by participants. Commonly they include a concluding period of reflective discussion.	Role play is often used with the aim of stimulating a group to experience and test out contrasting positions, arguments and viewpoints in connection with a set issue/ scenario/ problem, in a playful setting. Within transformative learning theory role play has been identified as capable of contributing to transformative change by way of directly widening and influencing the perspective of participants.	Chen and Martin (2015)	L	H
	Nature role-play	Nature role-play can be drawn upon in a range of different ways and formats. One such example is the nature role-play game developed by members of URBNANCE (https://urbnance.ioer.info/en/). Run as a single creative workshop session, having first taken on the identities of non-human form of nature, participants are then asked to imagine a positive vision of a 'sister city' in which humans live in partnership with nature. Specifically, in this game, they are challenged with addressing: 'firstly, how can we give autonomous "voices" to non-human nature? And secondly, how can we better perceive and meet her needs, collaborating in a positive sense instead of controlling?' (Harms	Nature role-play is aimed at 'developing positive visions and imaginaries in which humans live in partnership with nature' (Harms 2022). Such activity supports participants in developing a much greater appreciation, awareness and empathy towards nature in all its biodiverse forms. It simultaneously often encourages participants to develop imaginaries of alternative ways of living with nature which allow all (human and non-human) to flourish.	Harms (2022)	L	H

		2022). These questions are addressed, through nature role-play, over a series of rounds. Each round is further supported with a range of prompts aimed at encouraging participants to further identify with and take on gaze of their selected (or allocated) non-human nature form.				
Participatory Evaluation	**Circle of Change**	A qualitative tool used either singularly or iteratively with participants to record their perceptions about how they feel an activity has encouraged and/or supported them to make or want to make changes in their behaviour. The method is adapted from the Reflective Cycle developed by Graham Gibbs in 1988 to give structure to learning from experience.	Encourages self-reflection and also sharing of outcomes, including as a means of validating the impact of an intervention.	Brown and Brady (2020)	M	H
Deliberative methods						
Methods with explicit deliberative emphasis	**Citizen Assemblies**	Participants meet (physically and/ or virtually) on a number of occasions over the course of a week or longer, during which they hear presentations from a range of experts (in response to set questions and/ or a focal issue), representing all sides of an argument; expert presentations are regularly interspersed with small group and also plenary discussion by participants; the final stage involves collaborative writing and/ or agreement on a report setting out participant view points, recommendations and key findings; citizen assemblies can accommodate a large number of participants (e.g. c.100).	Citizen assemblies give recognition to the everyday expert knowledge of civil society (regardless of the presence/ absence of participant's professional position or academic qualification). They are commonly organised with the aim of incorporating wide ranging socio-demographic representation as a means of bringing into play both a depth and breadth of knowledges and world views.	Dryzek et al.(2020)	M	M
	Citizen deliberations/ Deliberative workshops	Deliberative workshops can be organised in a format similar to a focus group. To aid a sufficient depth of discussion and promote input from all participants, groups are usually limited to c.8-15 members and the may take place in either a single or series of sessions. During the session a semi-structured approach to facilitation is commonly used, with participants being asked to share their views, experience and knowledge in connection with a specific issue or sets of questions. Invitations to attend can also be extended to relevant 'expert' guest speakers.	Deliberative workshops usually include a commitment, on the part of the organisers, to convey the results to a target stakeholder group (e.g. policy makers) with the aim that such evidence will trigger action or change. In facilitating deliberation and knowledge exchange between groups of citizens they also serve the purpose of prompting awareness and appreciation of a range of different viewpoints, experiences and sources of (citizen) knowledge.	Myant and Urquhart (2009)	M	M
	Most Significant Change technique	Most significant change is a dialogical story-based technique which aims at achieving a summative participatory evaluation of the outcomes of a particular policy, programme or other form of real world intervention.	Most significant change technique can aid the identification of key policy/ programme/ intervention outcomes and support open deliberation as to their value and significance.	McDonald et al. (2009a)	M	H

	Design Thinking/ Participatory Design	A problem solving approach which commonly begins with (facilitated) identification of key questions/ challenges, followed by a mix of individual and collective analysis (potentially incorporating a range of story telling, visualisation, discussion and team work formats).	Participatory design thinking is aimed at supporting both the process and mindset required to collaboratively identify solutions to 'wicked' problems (i.e. complex problems evoking multiple interpretations and for which there exists no quick fix or single solution). It promotes increased awareness, creativity, innovation and reflexivity amongst participating stakeholders.	de Mendonca et al. (2019)	M	M
	Citizen juries	Based on the model of a criminal jury, citizen juries requires the recruitment of a small group of participants (where possible with representation from a range of different socio-cultural groups) who, across a number of sessions, are tasked with hearing and collectively reflecting upon evidence given by a series of invited expert speakers in connection with a focal issue, before reaching their own independent verdict.	Citizen juries raise awareness of the value and importance of citizen participation in public decision making. They provide an insight into how citizen viewpoints on a particular issue, as well as how public opinion is formed and informed in connection with a range of different evidence sources.	Aldred and Jacobs (2000)	M	M
	Consensus conference	A consensus conference follows a structured conference style format, through which c. 12-15 individually selected participants are invited to present their viewpoint, listen to the presentations of all other attendees, and engage in (facilitated) small group discussion. Conferences commonly take-place over one or more full days	Consensus conferences are used to promote citizen deliberation conducive of reaching consensus on solutions, points of action, pathways to change and (where applicable) associated policy levers, in connection with a controversial of topical issue.	McDonald et al. (2009b)	M	M
	Competency groups	An inclusive group-based method for co-producing knowledge between multiple expert stakeholders (including those in a professional capacity and those with non-certified expertise). Individual sessions take the form of focus group style group discussions, with or without external input from guest speakers. Requires multiple sessions of discussion over a medium time period (e.g. 6-12 months)	Can be used to foster collaborative action to overcome societal and environmental challenges; intended to achieve change rather than be merely a 'talking shop'.	Landström et al. (2011)	M	M
	T-Labs (Transformation Labs)	Informed by a systems modelling approach, T-Labs are comprised of stakeholders ('innovators') with an declared interest in bringing about change in connection with a particular issue and also some degree of power or capacity to deliver the change in practice (or through policy). As part of the T-Lab process, activities are undertaken by the group aimed at building their capacity to bring about change. This includes the collaborative development of a 'change strategy' and an associated review a of range of different potential solutions to the challenge being addressed. T-labs require expert facilitation, background research,	T-Labs are intended to produce social innovations and in so doing 'guide transformations in social-ecological systems towards sustainability' (Pathways network 2018:7). Supported by the development of a 'change strategy' T-Labs are used to co-creatively identify change interventions and to build momentum for action. Although they require a willingness on the part of participating stakeholders for bringing about change, they can be used to address and resolve disagreements on what type of changes should be introduced and how to do so. T-labs 'create a space to think about	Network (2018)	M	M

		intentional selection of (a limited number of) participants, and iterative cycles of reflection and reporting of results/ progress against an original challenge, between individual workshops. They commonly last from one to three days.	transformation in a new way' (Pathways network 2018:9).			
Experiential games						
Lab and artefactual experiments	**Public goods game**	The Public Goods Game is an experimental economic game that examines cooperative behaviour and the provision of public goods. In this game, participants are given a sum of money and must decide how much to contribute to a common pool. The contributed amount is multiplied by a factor and then evenly distributed among all participants, regardless of their individual contributions. The game tests individuals' willingness to cooperate and contribute to a collective benefit versus maximizing their own personal gains.	A public goods game can be contextualised as a biodiversity game or a debriefing session after the abstract public goods game can focus on parallels with biodiversity.	Games for Sustainability (2017a)	L	H
	Common pool resource game	The Common Pool Resource Game is an experimental game that simulates the management of shared resources, such as forests or fisheries. Participants are given the opportunity to extract resources from a common pool, with each extraction depleting the resource to some extent. However, there is a risk of resource collapse if participants collectively extract beyond the sustainable level, highlighting the challenges of balancing individual self-interest with the long-term preservation of shared resources.	A common pool resource game can be contextualised as a biodiversity game or debriefing session after the abstract common pool resources game can focus on parallels with biodiversity.	Games for Sustainability (2017b)	L	H
	Games of cooperation, coordination, and conflict	In this set of games two-player games on cooperation and coordination are framed in a natural resource management context. This set of games demonstrate how small changes in payoff structure affect the social dilemma and expected outcomes.	Games of cooperation, coordination, and conflict can be contextualised for biodiversity (but exact payoff matrix might be difficult to develop) or debriefing session after the abstract game can focus on parallels with biodiversity.	Games for Sustainability (2017c)	L	H
	Trust game	The Trust Game is an experimental game that explores trust and cooperation between individuals. In this game, one participant, known as the "trustor," is given an initial endowment and has the option to send some or all of it to another participant, known as the "trustee." The amount sent is multiplied by a factor, and the trustee can then decide how much to return to the trustor. The game examines the trustor's willingness to take a risk by sending money and the trustee's trustworthiness in returning a portion of the	The game can be framed in a biodiversity context (for example, for agricultural production) and debriefing can be used for parallels after an abstract game.	Games for Sustainability (2017d)	L	H

		received amount, thus reflecting dynamics of trust and reciprocity in social interactions.				
	Coase bargaining (negotiations game)	The Coase Bargaining game is an economic game that simulates a bargaining situation to analyse the allocation of resources between two parties. In this game, participants negotiate over the distribution of a fixed amount of resources, with each player having a different initial claim. They can make offers and counteroffers to reach an agreement, but if no agreement is reached, the resources are lost. The game allows researchers to study the bargaining process, strategic decision-making, and the factors that influence the final outcome of resource allocation.	The game can be framed in a biodiversity context (for example, for agricultural production) and debriefing can be used for parallels after an abstract game.	Games for Sustainability (2017e)	L	H
Artefactual and framed field experiments	**Dam maintenance game**	This game is based on a public goods game, where players jointly contribute to a water harvesting infrastructure from which everyone receives benefits.	The dam maintenance game could be contextualised for biodiversity.	ICRISAT et al. (2022a)	M	M
	Channel irrigation game	In this game players decide on water use while facing water scarcity. They chose to grow water efficient or water consumptive crops while available water is only sufficient if every player grows the water efficient crop.	The game can be either re-framed for biodiversity or debriefing sessions can focus on parallels with biodiversity.	ICRISAT et al. (2022b)	M	M
	Surface water game	This game is based on a common pool resource game where players can decide on contributing to a water harvesting structure. Water harvesting structure makes water available for the group. Water appropriation decisions are framed as the choice of crops with different water efficiencies.	This game combines decisions on harvesting from a resource and investing in infrastructure. A similar set of mechanics could be explored for biodiversity, and whether that is possible at all.	ICRISAT et al. (2022c)	M	M
	Pastoralism game	In this game participants have to decide how much livestock to put in different locations.	The game can be either re-framed for biodiversity or debriefing sessions can focus on parallels with biodiversity.	Games for Sustainability (2017f)	M	M
	Fisheries game	In this game participants have to decide where to fish and how much to fish.	The game can be applicable to the biodiversity domain for facilitating the cognitive, normative, relational learning in relation to an environmental common pool resource dilemma - revealing, experiencing, and overcoming potential conflicts between individual decisions and interests of the broader group. Debriefing sessions will be key for reflecting on lessons and parallels to relevant real-life situations.	Games for Sustainability (2017g) Castillo et al. (2011)	M	M
	Forests game	In this game participants harvest from a renewable resource representing trees in a forest.	The game can be applicable to the biodiversity domain for facilitating the cognitive, normative, relational learning in relation to an environmental common pool resource dilemma - revealing,	Games for Sustainability (2017h)	M	M

			experiencing, and overcoming potential conflicts between individual decisions and interests of the broader group. Debriefing sessions will be key for reflecting on lessons and parallels to relevant real-life situations.	Janssen et al. (2013)		
	Groundwater game	In this game participants make decisions about which crop to plant where crops require different amounts of water.	The game can be applicable to the biodiversity domain for facilitating the cognitive, normative, relational learning in relation to an environmental common pool resource dilemma - revealing, experiencing, and overcoming potential conflicts between individual decisions and interests of the broader group. Debriefing sessions will be key for reflecting on lessons and parallels to relevant real-life situations.	IFPRI et al. (2022) Meinzen-Dick et al. (2018)	M	M
	Irrigation game	In this game participants make decisions to invest in the irrigation system maintenance and to extract water for irrigating their individual plots.	The game can be applicable to the biodiversity domain for facilitating the cognitive, normative, relational learning in relation to an environmental common pool resource dilemma - revealing, experiencing, and overcoming potential conflicts between individual decisions and interests of the broader group. Debriefing sessions will be key for reflecting on lessons and parallels to relevant real-life situations.	Games for Sustainability (2017i) Janssen et al. (2012)	M	M
Role playing games	**Coastal Flooding in Shoreham**	"Coastal Flooding in Shoreham" is a role-playing simulation game developed by the Program on Negotiation at Harvard Law School. The game aims to help participants understand the complexities and challenges associated with coastal flooding and climate change risks. Players take on the roles of various stakeholders, such as local residents, government officials, and environmental activists, and must collaborate to address the impacts of coastal flooding, make decisions, and negotiate strategies for adaptation and risk management. The game encourages participants to explore different perspectives, engage in problem-solving discussions, and develop skills in negotiation, collaboration, and decision-making in the context of climate change and its effects on coastal communities.	The game can be applicable to the biodiversity domain for facilitating the understanding and negotiation skills in the context of responding to an uncertainty as a community comprised of heterogenous actors. The games focuses on developing agreements in a community to adapt to potential climate change risks - such as flooding. In this sense, debriefing could focus on 1) the links between the climate risk and biodiversity loss, 2) biodiversity loss and potential consequences thereof could be integrated as part of the problem to be tackled in the game by amplifying the conservation narrative already in the game.	Harvard Law School (n.d.a)	H	M
	DirtyStuff II	Six-person, multi-issue facilitated negotiation among industry, environmental, consumer/community, labour, and government	The game can be applicable to the biodiversity domain directly as DirtyStuff is depicted also as a potential environmental hazard and an environmental representative participates in the	Harvard Law School (n.d.b)	H	M

		representatives to develop single-text regulation of toxic industrial by-product.	game to make sure more stringent regulations are agreed in the final document. The game is also useful for facilitating the understanding of unwritten nuances in negotiations, but also for developing skills of constructive techniques in a multi-issue multi-party negotiation. Debriefing can include reflections on measuring impact on biodiversity, negotiating while dealing with uncertainty, social processes between parties with diverse interests.			
	Offshore Wind Farm Negotiation	Eight-party nonscorable negotiation among commercial, environmental, and governmental stakeholders over a controversial proposal to develop offshore wind farms. The game is centred around techniques for creating value in spite of differences; joint fact-finding in the face of disputed scientific information; dealing with scientific and technical uncertainty through an adaptive management approach.	The game can be applicable to the biodiversity domain directly as one of the key concerns in the game is the impact of the Offshore Wind Farm on marine life and environment. The game is a negotiation of a development project in a society that reveals different values, needs, interests, and practices rule making. Debriefing can include reflections on plural values of a development project, prioritisation challenges and opportunities in such a multi-interest setting.	Harvard Law School (n.d.c)	H	M
	Federal Lands Management I	Facilitated multi-party negotiation over the appropriate decision-making process for a federal land management dispute. Some key learning outcomes of the game focus on understanding the decision rule for the negotiations, how scientific and technical disagreements are handled and the time frame for the negotiations.	Land management disputes can be of direct relevance for biodiversity. The game can be adapted with more prominent role given to biodiversity. Debriefing can focus on parallels with biodiversity.	Harvard Law School (n.d.d)	H	M
Board/card and mixed games with strategy	**MineSet**	The MineSet is a strategy board game, where players take the role of logging and mining companies, securing rights, developing infrastructure, extracting timber and interacting with local communities. With the development of human activities, forests are fragmented and opened and eventually transform into landscapes with crops, infrastructures and trees. Players can cooperate to sustainably manage the forest resources and the landscape.	The game seems to be adaptable for biodiversity contexts, and can be directly relevant already as it focuses on land use change and its possible consequences.	Garcia and Speelman (2017) Garcia et al. (2022)	H	M
	Settlers of Catan: Oil Springs	"Settlers of Catan: Oil Springs" is an expansion for the popular board game "Settlers of Catan." In this expansion, players enter a new era of industrialization as they explore and exploit the newfound resource of oil. They must strategically gather and manage oil resources, establish trade routes, and compete with other players to control the valuable oil fields, introducing an additional	One of the well-known board games has a variation focused on oil as a resource. In principle it was developed to address climate change, yet could be useful for initiating a discussion on biodiversity.	Fjællingsdal and Klöckner (2020)	M	H

		layer of complexity and decision-making to the original game.				
	Evolution Climate	"Evolution: Climate" is a strategic board game that simulates the impact of climate change on the ecosystem. Players take on the role of different species and adapt their traits to survive in a changing environment. They must manage their population size, gather food, and navigate the effects of temperature, food availability, and other factors to succeed in this dynamic and challenging game of adaptation and survival. "Evolution: Climate" is a highly interactive and challenging game that requires players to think ahead, adapt to changing conditions, and balance risk and reward.	This game has more natural sciences focus and could facilitate understanding of biodiversity. It could be also useful to link biodiversity with climate change.	Crapuchettes (2014) Crappuchettes (2016) Fjællingsdal and Klöckner (2020)	L	H
	Global Warming	Global Warming is a card-based strategy game where the players score “happiness points” by providing a variety of goods to the public, in turn influencing the environment. In order to provide these goods, oil needs to be gathered and used. The player with the highest amount of happiness points wins the game, unless there is too much pollution. If this is the case, the player with least pollution is the winner. The overall level of pollution as well as each individual player’s level of pollution is shown as separate markers on the game map, and if these markers move past certain points, bad things will happen to the game’s ecology as well as the players themselves.	Focuses on the incentives and potential consequences of free-ride. Parallels to biodiversity could be discussed in debriefing.	Bucak (2011) Fjællingsdal and Klöckner (2020)	L	M
	Keep Cool	"Keep Cool" is a cooperative board game designed to raise awareness about climate change and promote sustainable actions. Players work together to reduce carbon emissions and keep the planet's temperature from rising. By making strategic decisions, managing resources, and implementing mitigation measures, players aim to balance economic development with environmental conservation to ensure a sustainable future for all.	This game focuses on climate, but illustrates the importance of cooperation, which could be similarly relevant to biodiversity. Yet, an alternative for temperature as an indicator for climate change could be discussed for the biodiversity context.	Eisenack and Petschel-Held (2004) Fjællingsdal and Klöckner (2020)	M	H
	Ecosystem	"Ecosystem" is a card-drafting game where players shape and evolve their own unique ecological systems. Players compete to create diverse and balanced ecosystems by strategically placing animal and plant species, managing limited resources, and adapting to the ever-changing environment. The game combines	This is a game that facilitates learning of how species need interconnections.	Simpson (2019)	M	H

		elements of strategy, resource management, and ecosystem dynamics, offering an immersive experience that highlights the delicate balance of nature and the impact of player decisions on the overall ecosystem.				
	Ecosystem: Coral Reef	A card-drafting game of marine competition. Players choose, pass, and arrange cards representing a diversity of organisms found in the Great Barrier Reef, including coral, clownfish, sea turtles, and sharks.	This is a game that facilitates learning of how species need interconnections, with particular focus on marine ecosystems.	Simpson (2022)	L	H
	Lords of the Valley	The Lords of the Valley is a professional role-play simulation game that takes place in the valley of the river exposed to unexpected droughts and floods. Players assume the roles of farmers-businessmen, public officials, banker, and NGO's worker. They attempt to achieve their own goals, facing many challenges arising from the decisions of their co-players and the unpredictability of the environment.	Biodiversity is a byproduct of other activities and provides significant feedback on productivity of the agricultural production. Still, it is represented by only one variable. The game promotes biodiversity just not explore it as a concept.	CRS (2018)	M	H
	Habitat Puzzle Game	This is a children activity - with the goal to achieve all essential connections and have the maximum number of connections with the other groups "species". This is expressed in a scoring point system. The winner is the group with the highest score.	This is a game that facilitates learning of how species need interconnections.	ESA Climate Office (2021)	L	H
	Landopoly	In this game designed for students, players develop their land-use decision-making skills. Through the various choices posed in the game, students are asked to consider both economic and environmental well-being in making land-use decisions.	This game can be used to discuss the effects of land-use decision-making on the environment, including biodiversity.	Aldren (n.d.)	L	M
Online games	**Port of Mars**	"Port of Mars" is an online educational game developed by Arizona State University. It is set in a future Martian colony and challenges players to manage resources and make decisions to ensure the colony's survival and prosperity. The game incorporates elements of strategy, sustainability, and problem-solving, providing players with an interactive and immersive experience of what it might be like to live and thrive on Mars.	Can be played with specific focus on uncertainty that features prominently in the game and debriefing could focus on parallels with biodiversity.	Port of Mars Janssen et al. (2020)	M	H
	The Law of the Jungle: The Game of Social Rules	A role-player game (RPG) in which the player must uncover the forces causing destruction of a tropical forest.	Can be played individually, directly addresses the questions of biodiversity and the social-political challenges associated with conservation.	The Social Rules Project (n.d.)	M	M

Nudging and framing						
Choice architecture	**Framing (surveys or experiments)**	Presenting information and choices in a way that highlights the positive or negative aspects of the same decision, leading to changes in their relative attractiveness. The relative attractiveness and the positive or negative aspects of a choice can be altered to meet a specific group of people and decision makers.	Different decisions will be made if the loss or if the gain is highlighted of the same equation underlining the preference of avoiding risks. In terms of using framing in the environmental/biodiversity context, loss aversion (e.g. loss of environmental common goods) can be capitalised on to trigger behaviour change.	Homar and Cvelbar (2021)	M	H
	Nudging	A nudge may be defined as 'a function of (i) any attempt at influencing people's judgment, choice or behaviour in a predictable way (ii) that is motivated because of cognitive boundaries, biases, routines, and habits in individual and social decision-making posing barriers for people to perform rationally in their own self-declared interests, and which (iii) works by making use of those boundaries, biases, routines, and habits as integral parts of such attempts' (Hansen PG, 2015). Nudges are subtle intervention that consider psychological biases which are usually simple and cost-effective.	Nudges can be built in 1) affecting the physical micro-environment (e.g. providing vegetarian options only or having them as a first choice), 2) macro-environment (e.g. decreasing public transport prices while increasing parking prices), 3) institutional (e.g. providing renewable energy default options for costumers).	Hansen et al. (2021) Balmford et al. (2021)	M	H
	Choice experiments	Choice experiments, also known as discrete choice experiments or stated preference methods, are a research technique used to understand individuals' preferences and decision-making processes. In choice experiments, participants are presented with a series of hypothetical scenarios or choice sets, each consisting of different alternatives with varying attributes.	Choice experiments are widely used in various fields such as marketing, transportation, environmental economics, and healthcare. They provide valuable insights into consumer behaviour, policy evaluation, product design, and market demand. The results of choice experiments can inform decision-making, resource allocation, and the development of tailored strategies to meet consumer preferences.	Mariel et al. (2021)	M	H
	Behavioural experiments	Behavioural experiments allow researchers to explore and test hypotheses about human behaviour in different situations, both theoretical and literal. Participants are randomly assigned to different groups (called treatments), which only differ with regard to the specific condition the experimenter would like to test. This 'control' over the different situations allows the researcher to establish a causal relationship between the observed behaviour and the specific condition (D. Friedman, S. Sunder, 1994).	In the context of sustainability research, controlled behavioural experiments have been mostly used to identify factors associated with effective collective action around critical natural resources (T. Lindahl et al, 2021). These types of experiments can help establish specifically which factor resulted in more pro-environmental behaviour.	Chaigneau and Schill (2022)	H	M
Buidling capacity and motivation	**Training/providing information and**	Information provision can help accumulate knowledge and can build capacities as well as motivation to nurture new types of behaviour.	Information could be about raising awareness (e.g. about biodiversity loss), details of current undesired behaviour impacts (e.g. impacts of car use on air pollution) or instructions about	Balmford et al. (2021)	L	H

	behavioural support		performing a new behaviour (e.g. how to build a biodiversity-friendly garden). Information provision can also take many forms ranging from awareness campaigns through physical training in nature.			
	Pledging (Communicating social norms and commitment)	Social norms define what we normally do (or we think we do) and are the foundation of our society, culture and social interactions. When pledging to act on a pro-environmental way, we will want to be consistent with our choices and we are more likely act on it. This behaviour is further enabled by peers and an environment that supports the given behaviour (e.g. if our friends are vegetarian, user bikes instead of cars, etc.)	Enabling pledging, making a private or public commitment (e.g. using bikes instead of cars, or no-meat Mondays) will help us be consistent with our belief system if we want to act on a pro-environmental ways. According to literature, with sufficient background information, we are more likely to pledge to pro-environmental behaviour.	Balmford et al. (2021)	M	H
	Increasing local pride of biodiversity	Social norms define what we normally do (or we think we do) and are the foundation of our society, culture and social interactions. When local pride of a given area or species is supported and shared by the relevant community, behaviour change is more likely to be triggered also thanks to various positive emotions.	Increasing local pride by highlighting the ecological values and importance of nearby sites and species followed by related awareness raising campaigns are important tool to increase support and result in pro-environmental behaviour.	Balmford et al. (2021)	M	M
	Providing feedback on performance	Outcome efficacy is how we consider our behaviour contributing to a certain target/behaviour. Providing information about concrete measurable results of behaviour can induce behaviour change (e.g. comparing monthly spending on meat, energy use) if we consider it important for our personal norms to perform better.	Setting a system to measure pro-environmental behaviour and enable people to track their contribution/performance even in a competing scheme (e.g. games on who can save more energy) can nudge people for pro-environmental behaviour. Displaying e.g. the community performance can also help enable certain behaviours (e.g. showing the average energy consumption).	van Valkengoed et al. (2022)	M	H
	Goal setting	Built on personal efficacy and performance, we can set specific goals to achieve (e.g. no. of kms to bike/walk per month instead of car use) triggering pro-environmental behaviour.	Setting goals to enable public and private commitments (e.g. planting x no. of trees by 2025) will set a framework of our behaviour to perform better for a specific environmental goal.	van Valkengoed et al. (2022)	M	H
	Rewards	Concrete (financial) benefits (e.g. you have discounts at the local cafe if you bring your own container for take-away) can trigger behaviour change.	Certain rewards or reward system can be introduced e.g. for those using the public transports or participating in certain activities (e.g. garbage collection).	van Valkengoed et al. (2022)	L	H
	Penalties	Concrete (financial) disadvantages (e.g. the price of plastic bags instead of free bags) can trigger behaviour change.	Certain penalties can be introduced to impact pro-environmental behaviour (e.g. increased taxes on harmful subsidies)	van Valkengoed et al. (2022)	H	L

Annex 2. References cited in the directory

Aiello, L. M., Schifanella, R., Quercia, D., & Aletta, F. (2016). Chatty maps: constructing sound maps of urban areas from social media data. *Royal Society Open Science, 3*(3), 150690. https://royalsocietypublishing.org/doi/pdf/10.1098/rsos.150690.

Aldred, J., & Jacobs, M. (2000). Citizens and wetlands: evaluating the Ely citizens' jury. *Ecological Economics, 34*(2), 217–232. https://doi.org/10.1016/S0921-8009(00)00159-2.

Aldren, J.D., (n.d.). Landopoly: A decision-making game. http://jareddahlaldern.net/lessons/Landopoly.pdf accessed date 25 April 2023.

Angell, C., Alexander, J., & Hunt, J. A. (2015). 'Draw, write and tell': A literature review and methodological development on the 'draw and write'research method. *Journal of Early Childhood Research, 13*(1), 17–28. https://doi.org/10.1177/1476718X14538592.

Balmford, A., Bradbury, R. B., Bauer, J. M., Broad, S., Burgess, G., Burgman, M., ... & Nielsen, K. S. (2021). Making more effective use of human behavioural science in conservation interventions. *Biological Conservation, 261,* 109256. https:/doi.org/10.1016/j.biocon.2021.109256.

Bardsley, D. K., Palazzo, E., & Stringer, R. (2019). What should we conserve? Farmer narratives on biodiversity values in the McLaren Vale, South Australia. *Land Use Policy, 83,* 594–605. https://doi.org/10.1016/j.landusepol.2019.02.036.

Barter, C. & Renold, E. (1999). The Use of Vignettes in Qualitative Research. URL: https://sru.soc.surrey.ac.uk/SRU25.html accessed date 25 April 2023.

BBC (n.D.). Tweet of the Day. URL: https://www.bbc.co.uk/sounds/brand/b01s6xyk.

Bos, E., Brown, G., Parsons, J., Brady, G., & Halliday, J. (2016). Supporting rehabilitation: A pilot study exploring the role of community and land based models. Key findings report, Coventry University, Coventry. https://www.researchgate.net/publication/308415082_Supporting_Rehabilitation_a_pilot_study_exploring_the_role_of_community_and_land_based_models#fullTextFileContent accessed date 25 April 2023.

Brown, G., & Brady, G. (2020). Collaborative research: Working together to deliver land-based prison initiatives. *Methodological Innovations, 13*(2), 2059799120927333. https://journals.sagepub.com/doi/10.1177/2059799120927333.

Bucak, S. D. (2011). Global WarmIng. Mücke Spiele. Board game.

Buckingham, S., & Degen, M. (2012). Sensing our way: Using yoga as a research method. *The Senses and Society*, 7(3), 329–344. https://doi.org/10.2752/174589312X13394219653644.

Burns, D. (2014). Systemic action research: Changing system dynamics to support sustainable change. *Action Research, 12*(1), 3–18. https://doi.org/10.1177/1476750313513910.

Butler-Kisber, L., & Poldma, T. (2010). The power of visual approaches in qualitative inquiry: The use of collage making and concept mapping in experiential research. *Journal of Research Practice, 6*(2), M18–M18. http://jrp.icaap.org/index.php/jrp/article/view/197/196.

Castillo, D., Bousquet, F., Janssen, M. A., Worrapimphong, K., & Cardenas, J. C. (2011). Context matters to explain field experiments: results from Colombian and Thai fishing villages. *Ecological Economics, 70*(9), 1609–1620.

Centre for Systems Solutions (CRS) (2018). Lords of the Valley. A professional role-play simulation game. URL: https://lordsofthevalley.socialsimulations.org/ accessed date 25 April 2023.

Chaigneau, T., & Schill, C. (2022). Environmental behaviours within ecological and social limits: integrating well-being with behavioural research for sustainability. *Current Opinion in Environmental Sustainability, 57,* 101201. https://doi.org/10.1016/j.cosust.2022.101201.

Chen, J. C., & Martin, A. R. (2015). Role-play simulations as a transformative methodology in environmental education. *Journal of Transformative Education, 13*(1), 85–102. https://doi.org/10.1177/1541344614560196.

Cherdymova, E. I., Vorobyeva, K. I., Romashkova, O. V., Mashkin, N. A., Grigoriev, S. M., Romanchenko, L. N., ... & Bayanova, A. R. (2018). Photo exhibition influence on student environmental consciousness formation. *Ekoloji, 27*(106), 1271–1278. http://www.ekolojidergisi.com/article/photo-exhibition-influence-on-student-environmental-consciousness-formation-5412.

Claverie, T., Heard, R., O'Connor, J., & Sabatino, J. (2016). Animating biodiversity (Doctoral dissertation, Worcester Polytechnic Institute). https://core.ac.uk/download/pdf/212984778.pdf accessed date 25 April 2023.

Crapuchettes, D. (2014). EvolutIon. North Star Games. Board game. https://boardgamegeek.com/board-game/155703/evolution accessed date 25 April 2023.

Crapuchettes, D. (2016). EvolutIon: ClImate. North Star Games. Board game. https://boardgamegeek.com/boardgame/182134/evolution-climate accessed date 25 April 2023.

de Mendonça, M. C., Trauer, E., de Sousa, R. P. L., & Costa, E. (2019). Interdisciplinarity, design thinking, and innovation in public spaces: A teaching experience in Florianpolis. *Journal on Innovation and Sustainability RISUS*, 10(2), 86–97. https://revistas.pucsp.br/risus/article/view/39953.

De Waegemaeker, J., Franklin, A., Bandakova, T. (2021).Spaces of Possibility! Exhibition Catalogue. 7–11 June 2021, Brussels (Belgium). https://recoms.eu/sites/default/files/exhibition-catalogue-link.pdf accessed date 25 April 2023.

Dryzek, J. S., Nicol, D., Niemeyer, S., Pemberton, S., Curato, N., Bächtiger, A., ... & Vergne, A. (2020). Global citizen deliberation on genome editing. *Science, 369*(6510), 1435–1437. https://doi.org/10.1126/science.abb5931

Eisenack, K., & petschel-Held, G. (2004). KeeP Cool. Spieltrieb. Board game.

Esa Climate Office (2021). Education Group Game. Habitat Puzzle Game. Biodiversity habitat and climate change. https://climate.esa.int/media/documents/Biodiversity_and_Habitat_Game.pdf accessed date 25 April 2023.

Feola, G., & Nunes, R. (2014). Success and failure of grassroots innovations for addressing climate change: The case of the Transition Movement. *Global Environmental Change, 24,* 232–250. https://doi.org/10.1016/j.gloenvcha.2013.11.011.

Fitzgerald, A., & Lowe, M. (2020). Acknowledging documentary filmmaking as not only an output but a research process: A case for quality research practice. *International Journal of Qualitative Methods, 19,* 1609406920957462. https://doi.org/10.1177/1609406920957462.

Fjællingsdal, K. S., & Klöckner, C. A. (2020). Green across the board: Board games as tools for dialogue and simplified environmental communication. *Simulation & Gaming, 51*(5), 632–652. https://doi.org/10.1177/1046878120925133.

Friesen, J., Van Stan, J. T., & Elleuche, S. (2018). Communicating science through comics: a method. *Publications, 6*(3), 38. https://doi.org/10.3390/publications6030038.

Games for Sustainability (2017a). Public Goods Game Practitioner's Manual, www.gamesforsustainability.org, accessed date April 25 2023. https://gamesforsustainability.org/wp-content/uploads/2019/03/PublicGood.pdf accessed date 25 April 2023.

Games for Sustainability (2017b). Common Pool Resource Game Practitioner's Manual, www.gamesforsustainability.org, accessed date April 25 2023. https://gamesforsustainability.org/wp-content/uploads/2019/03/CommonPoolResources.pdf.

Games for Sustainability (2017c). Games of Cooperation, Coordination and Conflict, Practitioner's Manual, www.gamesforsustainability.org, accessed date April 25 2023. https://gamesforsustainability.org/wp-content/uploads/2019/03/CooperationCoordinationConflict.pdf.

Games for Sustainability (2017d). Trust Game, Practitioner's Manual, www.gamesforsustainability.org, accessed date April 25 2023. https://gamesforsustainability.org/wp-content/uploads/2019/03/TrustGame.pdf.

Games for Sustainability (2017e). Negotiation Game, Practitioner's Manual, www.gamesforsustainability.org, accessed date April 25 2023. https://gamesforsustainability.org/wp-content/uploads/2019/03/Coase-Bargaining.pdf.

Games for Sustainability (2017f). Pastoralism Game Practitioner's Manual, www.gamesforsustainability.org, accessed date 25 April 2023. https://gamesforsustainability.org/Pastoralism_Game_Manual.pdf.

Games for Sustainability (2017g). Fishery Game Practitioner's Manual, www.gamesforsustainability.org, accessed date 25 April 2023. https://gamesforsustainability.org/Fishery_Game_Manual.pdf.

Games for Sustainability (2017h). Forestry Game Practitioner's Manual, www.gamesforsustainability.org, accessed date 25 April 2023. https://gamesforsustainability.org/Forestry_Game_Manual.pdf.

Games for Sustainability (2017i). Irrigation Game Practitioner's Manual, www.gamesforsustainability.org, accessed date 25 April 2023. https://gamesforsustainability.org/Irrigation_Game_Manual.pdf.

Garcia, C., & Speelman, E. N. (2017). Landscape approaches, wicked problems and role playing games. ForDev Working Paper 01. Department of Environmental Systems Science, Swiss Federal Institute of Technology (ETH), Zurich, Switzerland. https://www.researchgate.net/profile/Claude-Garcia/publication/320170969_Landscape_Approaches_Wicked_Problems_and_Role_Playing_Games/links/59d26d02aca2721f4369ac08/Landscape-

Approaches-Wicked-Problems-and-Role-Playing-Games.pdf accessed date 25 April 2023.

Garcia, C. A., Savilaakso, S., Verburg, R. W., Stoudmann, N., Fernbach, P., Sloman, S. A., ... & Waeber, P. O. (2022). Strategy games to improve environmental policymaking. *Nature Sustainability, 5*(6), 464–471. DOI: https://doi.org/10.1038/s41893-022-00881-0.

Götz, N., & Holmén, J. (2018). Introduction to the theme issue:"Mental maps: geographical and historical perspectives". *Journal of Cultural Geography, 35*(2), 157–161. https://doi.org/10.1080/08873631.2018.1426953.

Hansen, P. G., Schilling, M., & Malthesen, M. S. (2021). Nudging healthy and sustainable food choices: three randomized controlled field experiments using a vegetarian lunch-default as a normative signal. *Journal of Public Health, 43*(2), 392–397. https://doi.org/10.1093/pubmed/fdz154.

Harms, P., Muller, S., Killinger, A., & Artmann, M. (2022). Moving from crisis to resonance: A summer cinema Urbnance Blog https://urbnance.ioer.info/en/blog/blog-essay10/ accessed date 25 April 2023.

Harms, P. (2022) Lending nature our voice - role play in search of partnerships with nature Urbnance Blog https://urbnance.ioer.info/en/blog/blog-essay11/ accessed date 25 April 2023.

Harvard Law School (n.D.a). Coastal Flooding in Shoreham Responding to Climate Change Risks. https://www.pon.harvard.edu/shop/coastal-flooding-in-shoreham-responding-to-climate-change-risks/ accessed date 25 April 2023.

Harvard Law School (n.D.b). DirtyStuff II. https://www.pon.harvard.edu/shop/dirtystuff-ii/ accessed date 25 April 2023.

Harvard Law School (n.D.c). Offshore Wind Farm Negotiation. https://www.pon.harvard.edu/shop/offshore-wind-farm-negotiation/ accessed date 25 April 2023.

Harvard Law school (n.D.d). Federal Lands Management I Matching the Process to the Situation. https://www.pon.harvard.edu/shop/federal-lands-management-i-matching-the-process-to-the-situation/.

Heylighen, F. (2015). Stigmergy as a Universal Coordination Mechanism: components, varieties and applications. Human Stigmergy: Theoretical Developments and New Applications; Springer: New York, NY, USA. http://dx.doi.org/10.13140/RG.2.1.4479.5044.

Homar, A. R., & Cvelbar, L. K. (2021). The effects of framing on environmental decisions: A systematic literature review. *Ecological Economics, 183,* 106950. https://doi.org/10.1016/j.ecolecon.2021.106950.

Hossain, M., Leminen, S., & Westerlund, M. (2019). A systematic review of living lab literature. *Journal of Cleaner Production, 213,* 976–988. https://doi.org/10.1016/j.jclepro.2018.12.257.

Humphris, I., Horlings, L. G., & Biggs, I. (2022). 'Getting Deep into Things': Deep Mapping in a 'Vacant'Landscape. *Co-Creativity and Engaged Scholarship: Transformative Methods in Social Sustainability Research*, 357–390. https://link.springer.com/chapter/10.1007/978-3-030-84248-2_12.

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Foundation for Ecological Security (FES), and International Food Policy Research Institute (IFPRI). (2022a). Dam Maintenance Game Manual. ICRISAT and FES,

India; IFPRI, USA, www.gamesforsustainability.org, accessed date 25 April 2023. https://gamesforsustainability.org/wp-content/uploads/2022/06/Dam_Maintenance_Game_Manual_08042022.pdf.

ICRISAT, FES, & IFPRI (2022b). Channel Irrigation Game Manual. ICRISAT and FES, India; IFPRI, USA, www.gamesforsustainability.org, accessed date 25 April 2023. https://gamesforsustainability.org/wp-content/uploads/2022/06/Channel_irrigation_Game_Manual_08042022.pdf.

ICRISAT, FES, & IFPRI (2022c). Surface Water Game Manual. ICRISAT and FES, India, www.gamesforsustainability.org, accessed date 25 April 2023. https://gamesforsustainability.org/wp-content/uploads/2022/06/Surface_Water_Game_Manual_08042022.pdf.

IFPRI, FES, ICRISAT, & Arizona State University (ASU) (2022). Groundwater Game Practitioner's Manual, version 2. IFPRI and ASU, USA; ICRISAT and FES, India, www.gamesforsustainability.org, accessed date 25 April 2023.

Janssen, M. A., Bousquet, F., Cardenas, J. C., Castillo, D., & Worrapimphong, K. (2013). Breaking the elected rules in a field experiment on forestry resources. *Ecological Economics, 90,* 132–139.

Janssen, M. A., Bousquet, F., Cardenas, J. C., Castillo, D., & Worrapimphong, K. (2012). Field experiments on irrigation dilemmas. *Agricultural Systems,* 109, 65–75.

Janssen, M. A., Gharavi, L., & Yichao, M. (2020). Keeping up shared infrastructure on a Port of Mars: An experimental study. *International Journal of the Commons, 14*(1). https://doi.org/10.5334/ijc.1017.

Landström, C., Whatmore, S. J., Lane, S. N., Odoni, N. A., Ward, N., & Bradley, S. (2011). Coproducing flood risk knowledge: redistributing expertise in critical 'participatory modelling'. Environment and Planning A, 43(7), 1617–1633. https://journals.sagepub.com/doi/abs/10.1068/a43482?journalCode=epna.

Lim, P. Y., Dillon, D., & Chew, P. K. (2020). A guide to nature immersion: Psychological and physiological benefits. *International Journal of Environmental Research and Public Health, 17*(16), 5989. https://doi.org/10.3390/ijerph17165989.

Lopes, R., & Videira, N. (2017). Modelling feedback processes underpinning management of ecosystem services: The role of participatory systems mapping. *Ecosystem Services, 28,* 28–42. https://doi.org/10.1016/j.ecoser.2017.09.012.

Mannay, D., Staples, E., & Edwards, V. (2017). Visual methodologies, sand and psychoanalysis: employing creative participatory techniques to explore the educational experiences of mature students and children in care. *Visual Studies, 32*(4), 345–358. https://www.tandfonline.com/doi/pdf/10.1080/1472586X.2017.1363636.

Mariel, P., Hoyos, D., Meyerhoff, J., Czajkowski, M., Dekker, T., Glenk, K., ... & Thiene, M. (2021). *Environmental valuation with discrete choice experiments: Guidance on design, implementation and data analysis* (p. 129). Springer Nature.

McDonald, D., Bammer, G., & Deane, P. (2009a). Chapter 2. Using the dialogue methods in this book. In: *Research Integration Using Dialogue Methods*. ANU Press. URL: https://www.jstor.org/stable/pdf/j.ctt24hb0t.6.pdf?refreqid=excelsior%3A4aeb75472ff1b7c06743189a605d711f&ab_segments=&origin=&initiator=&acceptTC=1 accessed date 25 April 2023.

McDonald, D., Bammer, G., & Deane, P. (2009b). Chapter 3. Dialogue methods for understanding a problem broadly: integrating judgments. In: *Research Integration Using Dialogue Methods*. ANU Press. URL: https://www.jstor.org/stable/j.ctt24hb0t.7 accessed date 25 April 2023.

McKemey, M., Ens, E., Rangers, Y. M., Costello, O., & Reid, N. (2020). Indigenous knowledge and seasonal calendar inform adaptive savanna burning in northern Australia. *Sustainability, 12*(3), 995. DOI: https://www.mdpi.com/2071-1050/12/3/995.

McKenna, J. (2014). Creating community theatre for social change. *Studies in Theatre and Performance, 34*(1), 84–89. https://doi.org/10.1080/14682761.2013.875721.

Meinzen-Dick, R., Janssen, M. A., Kandikuppa, S., Chaturvedi, R., Rao, K., & Theis, S. (2018). Playing games to save water: Collective action games for groundwater management in Andhra Pradesh, India. *World Development, 107,* 40–53.

Moschitz, H., & Home, R. (2014). The challenges of innovation for sustainable agriculture and rural development: Integrating local actions into European policies with the Reflective Learning Methodology. *Action Research, 12*(4), 392–409. https://doi.org/10.1177/1476750314539356.

Myant, K. & Urquhart, G. (2009). Scottisch Government social research group social science methods series. Guide 1: Deliberative Methods. https://www.gov.scot/binaries/content/documents/govscot/publications/advice-and-guidance/2009/12/social-research-methods-guides/documents/deliberative-methods/deliberative-methods/govscot%3Adocument/Deliberative%2BMethods.pdf accessed date 25 April 2023.

Network, P. (2018). T-Labs: A Practical Guide—Using Transformation Labs (T-Labs) for Innovation in Social-Ecological Systems. STEPS Centre: Brighton, UK. https://steps-centre.org/publication/t-labs-practical-guide/ accessed date 25 April 2023.

Outdoor Academy (2018). Outdoor Education: from theory to practice. https://issuu.com/iairs/docs/outdooreducation_from_theory_to_pra accessed date 25 April 2023.

Paiva, D. (2020). Poetry as a resonant method for multi-sensory research. *Emotion, Space and Society, 34*, 100655. https://doi.org/10.1016/j.emospa.2020.100655.

Panke, S. (2019). Design thinking in education: Perspectives, opportunities and challenges. *Open Education Studies, 1*(1), 281–306. https://www.degruyter.com/document/doi/10.1515/edu-2019-0022/html accessed date 25 April 2023.

Priebe, J., Reimerson, E., Hallberg-Sramek, I., Sténs, A., Sandström, C., & Mårald, E. (2022). Transformative change in context—stakeholders' understandings of leverage at the forest–climate nexus. Sustainability Science, 17(5), 1921–1938. DOI: https://link.springer.com/article/10.1007/s11625-022-01090-6.

Rambaldi, G. (2010). Participatory Three-dimensional Modelling: Guiding Principles and Applications, 2010 edition. CTA, Wageningen, the Netherlands. https://www.weadapt.org/sites/weadapt.org/files/2017/november/p3dm_english_web.pdf accessed date 25 April 2023.

Rickinson, M., Dillon, J., Teamey, K., Morris, M., Choi, M. Y., Sanders, D. & Benefield, P. (2004) A Review of Research on Outdoor Learning, Preston Montford, Shropshire: Field Studies Council.

https://www.yumpu.com/en/document/view/44220526/a-review-of-research-on-outdoor-learning-field-studies-council accessed date 25 April 2023.

Rivera Lopez, F., Wickson, F., & Hausner, V. H. (2018). Finding CreativeVoice: applying arts-based research in the context of biodiversity conservation. *Sustainability, 10*(6), 1778. https://www.mdpi.com/2071-1050/10/6/1778.

Roos, J., & Victor, B. (2018). How it all began: the origins of LEGO® Serious Play®. *International Journal of Management and Applied Research, 5*(4), 326-343. https://www.researchgate.net/profile/Johan-Roos/publication/330773459_How_It_All_Began_The_Origins_Of_LEGOR_Serious_PlayR/links/5c7c1d5392851c695052038b/How-It-All-Began-The-Origins-Of-LEGOR-Serious-PlayR.pdf accessed date 25 April 2023.

Sage (n.d.). Research and Academic Podcasting. https://www.methodspace.com/blog/research-and-academic-podcasting.

Schuman-Olivier, Z., Trombka, M., Lovas, D. A., Brewer, J. A., Vago, D. R., Gawande, R., ... & Fulwiler, C. (2020). Mindfulness and behavior change. *Harvard Review of Psychiatry* https://journals.lww.com/hrpjournal/fulltext/2020/11000/mindfulness_and_behavior_change.3.aspx.

Simpson, M. (2019). Ecosystem. Card-drafting game. Genius Games. https://boardgamegeek.com/boardgame/271519/ecosystem/credits accessed date 25 April 2023.

Simpson, M. (2022). Ecosystem: Coral Reefs. Card-drafting game. Genius Games. https://boardgamegeek.com/boardgame/359406/ecosystem-coral-reef/credits accessed date 25 April 2023.

Slocum, N. (2003). Participatory Methods Toolkit. A practitioner's manual. https://archive.unu.edu/hq/library/Collection/PDF_files/CRIS/PMT.pdf accessed date 25 April 2023.

SOLINSA Project (2012). SOLINSA. https://www.youtube.com/watch?v=CT_XQcjuH8c accessed date 25 April 2023.

Spaniol, M. J., & Rowland, N. J. (2019). Defining scenario. *Futures & Foresight Science*, *1*(1), e3. https://onlinelibrary.wiley.com/doi/epdf/10.1002/ffo2.3?src=getftr.

Sweet, E. L., & Ortiz Escalante, S. (2015). Bringing bodies into planning: Visceral methods, fear and gender violence. *Urban Studies, 52*(10), 1826–1845. https://journals.sagepub.com/doi/10.1177/0042098014541157.

The Social Rules Project (n.d.). Law of the Jungle: The Game of Social Rules. http://www.rulechangers.org/?page_id=1214 accessed date 25 April 2023.

van Valkengoed, A. M., Abrahamse, W., & Steg, L. (2022). To select effective interventions for pro-environmental behaviour change, we need to consider determinants of behaviour. *Nature Human Behaviour*, 1–11. https://doi.org/10.1038/s41562-022-01473-w.

Vasudevan, R. (2020). The potentials and pitfalls of 'art in research'methodologies: Foregrounding memory and emotion in planning research. *Planning Theory & Practice, 21*(1), 58–75. https://www.tandfonline.com/doi/full/10.1080/14649357.2019.1699595.

Velasco, G., Faria, C., & Walenta, J. (2020). Imagining environmental justice “Across the street”: Zine-making as creative feminist geographic method. *GeoHumanities, 6*(2), 347–370. https://doi.org/10.1080/2373566X.2020.1814161.

Wang, C., & Burris, M. A. (1997). Photovoice: Concept, methodology, and use for participatory needs assessment. *Health Education & Behavior, 24*(3), 369–387. https://pubmed.ncbi.nlm.nih.gov/9158980/.

Winham, D. M., Szkupinski Quiroga, S., Underiner, T. L., Etheridge Woodson, S., & Todd, M. A. (2014). Integration of theatre activities in cooking workshops improves healthy eating attitudes among ethnically diverse adolescents: A pilot study. *ICAN: Infant, Child, & Adolescent Nutrition, 6*(2), 99–108. https://doi.org/10.1177/1941406413520323.

Wright, S., Lloyd, K., Suchet-Pearson, S., Burarrwanga, L., Tofa, M., & Country, B. (2012). Telling stories in, through and with Country: engaging with Indigenous and more-than-human methodologies at Bawaka, NE Australia. *Journal of Cultural Geography, 29*(1), 39–60. https://doi.org/10.1080/08873631.2012.646890.

Yong Jeon, J., Young Hong, J., & Jik Lee, P. (2013). Soundwalk approach to identify urban soundscapes individually. *The Journal of the Acoustical Society of America, 134*(1), 803–812. https://doi.org/10.1121/1.4807801.

Young, L., & Barrett, H. (2001). Adapting visual methods: action research with Kampala street children. *Area, 33*(2), 141–152. https://rgs-ibg.onlinelibrary.wiley.com/doi/epdf/10.1111/1475-4762.00017.