

# Fieldwork Protocol

## Effects of land management on the Supply and Distribution of ecosystem services (ESuDis)

Roman Isaac<sup>1\*</sup>, Jana Kachler<sup>2,3,4\*</sup>, Berta Martín-López<sup>1</sup>, María R. Felipe-Lucia<sup>2,4</sup>

1 Social-Ecological Systems Institute, Leuphana University of Lüneburg, Lüneburg, Germany

2 Department of Ecosystem Services, Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany

3 Faculty of Biological Sciences, Friedrich-Schiller-University Jena, Jena, Germany

4 Department of Ecosystem Services, German Centre for Integrative Biodiversity Research (iDiv), Halle-Jena-Leipzig, Germany

Corresponding author: [isaac@leuphana.de](mailto:isaac@leuphana.de)

\*Shared first authorship

### 1. Project description

The ESuDis project is embedded in the Biodiversity Exploratories, a large scale and long-term project for functional biodiversity research funded by the German Research Council (DFG) (Fischer et al., 2010). It is based on the notion that nature's contributions to people (NCP) (Díaz et al., 2018), including ecosystem services (ES), are co-produced by an interplay of natural capital with anthropogenic capitals, such as human, social, physical and financial capital, following Palomo et al. (2016)'s definitions (see S1). The ESuDis project seeks to understand the different pathways by which anthropogenic and natural capitals are combined to sustainably co-produce NCP and contribute to the equitable distribution of these (see e.g. Bruley et al., 2021; Fischer and Eastwood, 2016; Lavorel et al., 2020; Palomo et al., 2016). In particular, we investigate how increasing land use intensity affects (i) the supply of multiple NCP (*scientific objective 1*), (ii) the preferences for those NCP across different stakeholders and multiple spatial scales, in terms of use and demand (*scientific objective 2*); and (iii) how that relates to the governance of NCP and both natural and anthropogenic capitals underpinning service supply (*scientific objective 3*).

We focus on the co-production of a range of NCP across forests and grasslands, including regulating, material and non-material NCP. We do so by using secondary data on land use intensities, ecosystem functions and NCP gathered within the Biodiversity Exploratories by several projects on 300 experimental plots in three case study sites. We pair this data with our own data gathered by employing several social science methods. Our methods include systematic literature reviews (scientific objectives 1 and 3), a policy document review and analysis (scientific objective 3) as well as interviews with relevant stakeholders in our case study sites (scientific objective 2). In this protocol we report on the design and conduction of the stakeholder interviews.

## 2. Case study sites

The sites are located in different federal states across Germany (see S2). They include the Biosphere Reserve Schorfheide-Chorin in Brandenburg, the landscape in and around the Hainich National Park in Thuringia, and the Biosphere Reserve Schwäbische-Alb in Baden-Württemberg. The three sites were initially chosen by the Biodiversity Exploratories as they vary in geography, topography, and land management practices (see Table 1) (Fischer et al., 2010).

Table 1: Case study sites' main characteristics. Table adapted from Fischer et al. (2010, p. 276)

	<b>Schorfheide-Chorin</b>	<b>Hainich-Dün</b>	<b>Schwäbische-Alb</b>
Location	NE Germany	Central Germany	SW Germany
Federal state	Brandenburg	Thuringia	Baden-Württemberg
Size	~1300 km <sup>2</sup>	~1300 km <sup>2</sup>	~422 km <sup>2</sup>
Human population density	23 km <sup>-1</sup>	116 km <sup>-1</sup>	258 km <sup>-1</sup>
Altitude a.s.l.	3–140 m	285–550 m	460–860 m
Annual mean temperature	8–8.5 °C	6.5–8 °C	6–7°C
Annual mean precipitation	500–600 mm	500–800 mm	700–1000 mm

## 3. Selection of respondents

Since our focal NCP are co-produced by humans in multiple ways, our research addresses different stakeholder groups. These include nature conservationists and administrative staff, foresters and forest owners, farmers and representatives of farmers' associations, as well as tourists and local people coming to the case study sites for recreational purposes (see Table 2).

Table 2: Number of interviews conducted within the case studies as of January 2022. Due Covid-19 restrictions during our fieldwork more interviews will be conducted for those numbers in bold.

<b>Stakeholder Group</b>	<b>Schorfheide-Chorin</b>	<b>Hainich-Dün</b>	<b>Schwäbische-Alb</b>
Forestry	16	10	10
Nature conservation	7	<b>1</b>	<b>2</b>
Grassland	<b>2</b>	<b>0</b>	14
Tourists/ local population	43	44	56

## **4. Ethics considerations**

Understanding stakeholder perspectives is vital when investigating human nature interactions in the co-production of NCP (Jericó-Daminello et al., 2021). Our research involves participants from the stakeholder groups described above. Working with humans implies specific care, awareness of local as well as the participants' individual circumstances and ethical reflections of one's methods before going into the field. It is thus important "that free, prior and informed consent is sought from participants. The research protocol must be approved by a research ethics council before research begins" as Vos et al. (2021, p. 126) point out. We did so by submitting a research protocol that included all interview questions as well as the data consent form to the research ethics council at Leuphana University Lüneburg, Germany. Prior to being interviewed participants signed a data consent form (see S3).

## **5. Research design: ranking and interviews**

To gather information about the stakeholders' perceptions of natural and anthropogenic capitals in NCP co-production and their governance, we follow a two-step approach. First, we conducted a ranking of eleven different NCP using laminated images and a whiteboard with magnets (see S.4). After explaining these NCP and ensuring that participants understood what was meant, we asked the participants to select five NCP that were particularly relevant to them individually (tourists and local population) or in their work context (agriculture, forestry, nature conservation, administration). The participants then ranked the selected NCP according to the importance to them with one being the most important and five being the least important (see S.5A). The participants could only assign one NCP per rank (1-5). The ranking of NCP already sparked conversations with some participants who openly reflected on why they would exclude or include certain NCP.

Second, this was followed by a set of questions adapted to the top ranked NCP (see S.5 B.1 for an example of the interview design adapted to the NCP "forage production" and "outdoor recreation") and participants profession. If they worked in forestry, agriculture, administration, or nature conservation they were asked an additional set of questions tailored at their respective background (see S.5 B.2 for an example adapted to "nature conservation"). This set included questions on relevant actors in the governance of their field of expertise and questions on their professional co-operation with other stakeholders.

The interview design comprised closed-ended questions to elicit quantitative information (e.g. fertiliser application per hectare per year) and open-ended questions to elicit qualitative information (e.g. perceptions of the study site) (Shackleton et al., 2021). These questions aimed at gathering info about

participant's perception on how anthropogenic capitals were involved in the co-production of their first ranked NCP and how formal and informal governance was related to this co-production. We also included a set of socio-demographic questions at the end of the interview (see S5 B.3)

## **6. Data collection and processing**

We conducted semi-structured interviews with experts (i.e. nature conservationists and administrative staff, foresters and forest owners, farmers and representatives of farmers' associations), tourists and local residents in all three study sites, either in person or online. Experts were purposively sampled and interviewed at their offices, homes, farms, or at huts in the forest. Tourists and residents were interviewed randomly at special sightseeing spots, picnic areas, parking lots and at the starting points of hiking trails.

We used *ArcGIS Survey123* version 3.12.277 by *Esri* and recorded online interviews using *Zoom H2N* recorders and an *Apple iPad* (8<sup>th</sup> generation). Open-ended questions were transcribed directly or using *NVivo* version 7 by *QSR International*, checking the transcripts for grammar, spelling and content errors. The clean version of the transcripts was coded in *MAXQDA* version 2022 by *Verbi GmbH*.

## Supplementary material

- S1. Definitions of the capital types involved in NCP co-production based on Palomo et al. 2016, Kachler et al. under review, Isaac et al. under review.
- S2. Case study sites
- S3. Data consent form
- S4. Ranking of nature's contributions to people
- S5. Interview design

## Disclosure statement

No potential conflict of interest was reported by the authors.

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## ORCID

Roman Isaac <https://orcid.org/0000-0002-0007-7433>

Jana Kachler <https://orcid.org/0000-0003-0536-2820>

María R. Felipe-Lucia <https://orcid.org/0000-0003-1915-8169>

Berta Martín-López <https://orcid.org/0000-0003-2622-0135>

## 7. Literature

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## 8. Supplementary Material

### S1. Definitions of the capital types involved in NCP co-production based on Palomo et al. 2016, Kachler et al. under review, Isaac et al. under review.

**Natural capital** comprises the stock of natural resources and ecosystem functions that independently or combined with anthropogenic capitals provide NCP.

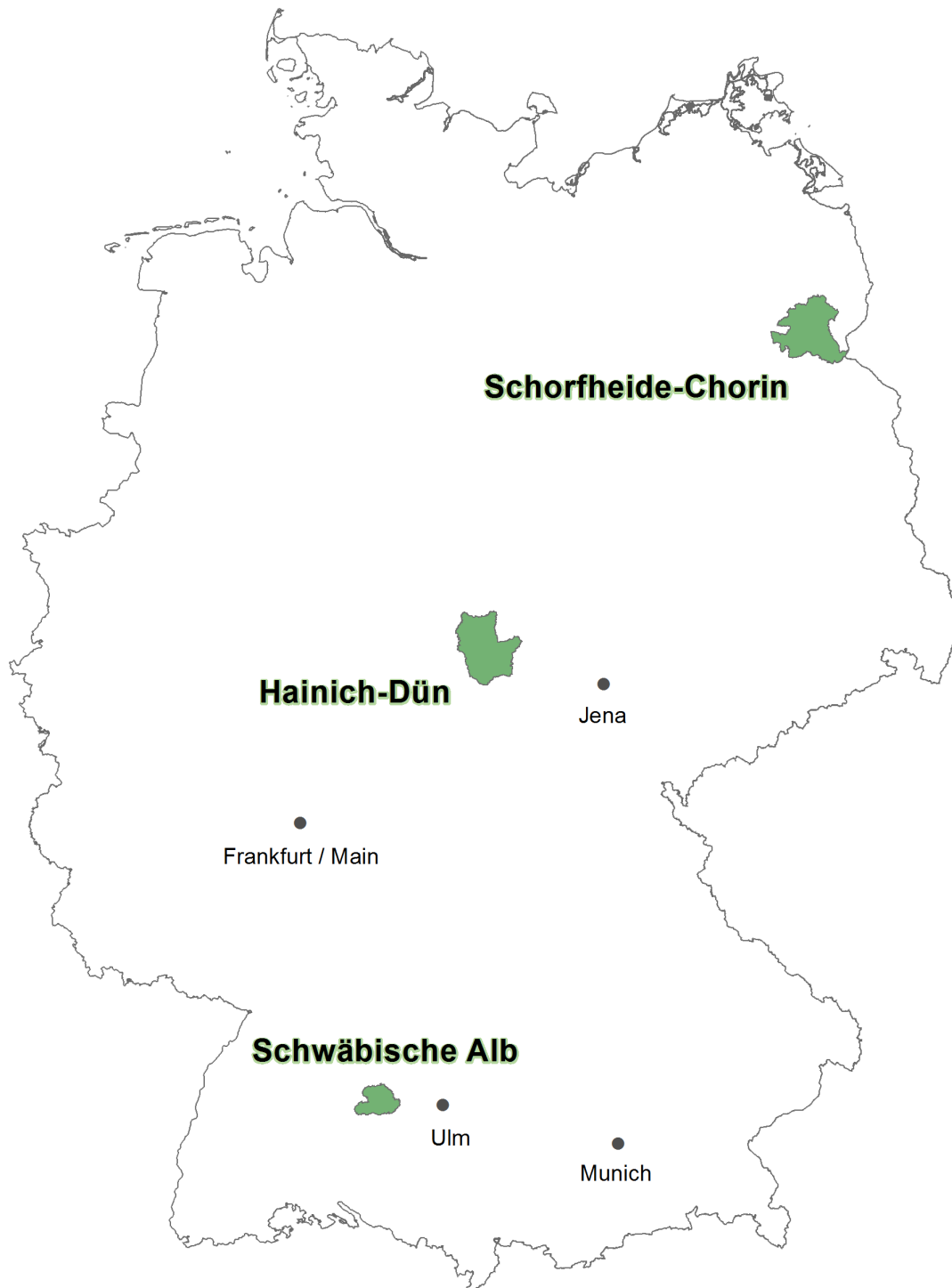
**Human capital** refers to people's capabilities including health, informal knowledge, formal knowledge, skills, motivation and labour that can yield a flow of NCP.

**Social capital** includes all intangible assets associated with interactions between people including formal and informal networks, trust, and formal and informal institutions required for enhancing the flow of NCP.

**Physical capital** refers to technological or manufactured assets that contribute to the flow of NCP.

**Financial capital** Virtual mechanisms in the form of savings, credits, and other monetary forms used for trading, maintaining or enhancing natural, human, social or physical capitals that contribute to the flow of NCP.

## S2. Case study sites



BEO 2018 (administrative boundary of Germany © GeoBasis-DE BKG 2017)

Figure 1: Biodiversity Exploratories' case study sites in Germany (Biodiversity Exploratories, 2018)



### **S3. Data consent form**

#### **Information on data handling**

This interview is fully anonymous, and the data obtained will be handled confidentially. The information you provide will only be used for scientific purposes. This research project is carried out by two PhD students, Jana Kachler at the Helmholtz Centre for Environmental Studies in Leipzig and Roman Isaac at Leuphana University in Lüneburg.

Besides, closed-ended questions in which you state your preferences, this interview also contains open-ended questions which will be recorded. The audio will be transcribed. The transcripts will be anonymised meaning that all references to individuals or organisations will be anonymised or deleted. No data linked to you personally will be recorded or stored. All data will be handled by researchers are legally obligated to keep this data anonymous. All data will be stored inaccessibly to third parties and deleted after project completion. You can withdraw your consent to the handling and storage of data you provided at any time.

#### **Data consent**

I hereby state that I voluntarily participate in this interview and consent to the use of the data I provide for scientific purposes only. I am fully aware that I can revoke this consent at any time. No disadvantages will arise for me by doing so. I am aware of my right for disclosure, correction, suspension, deletion and restriction in the handling of any data that I provided.

#### S4. Ranking of nature's contributions to people

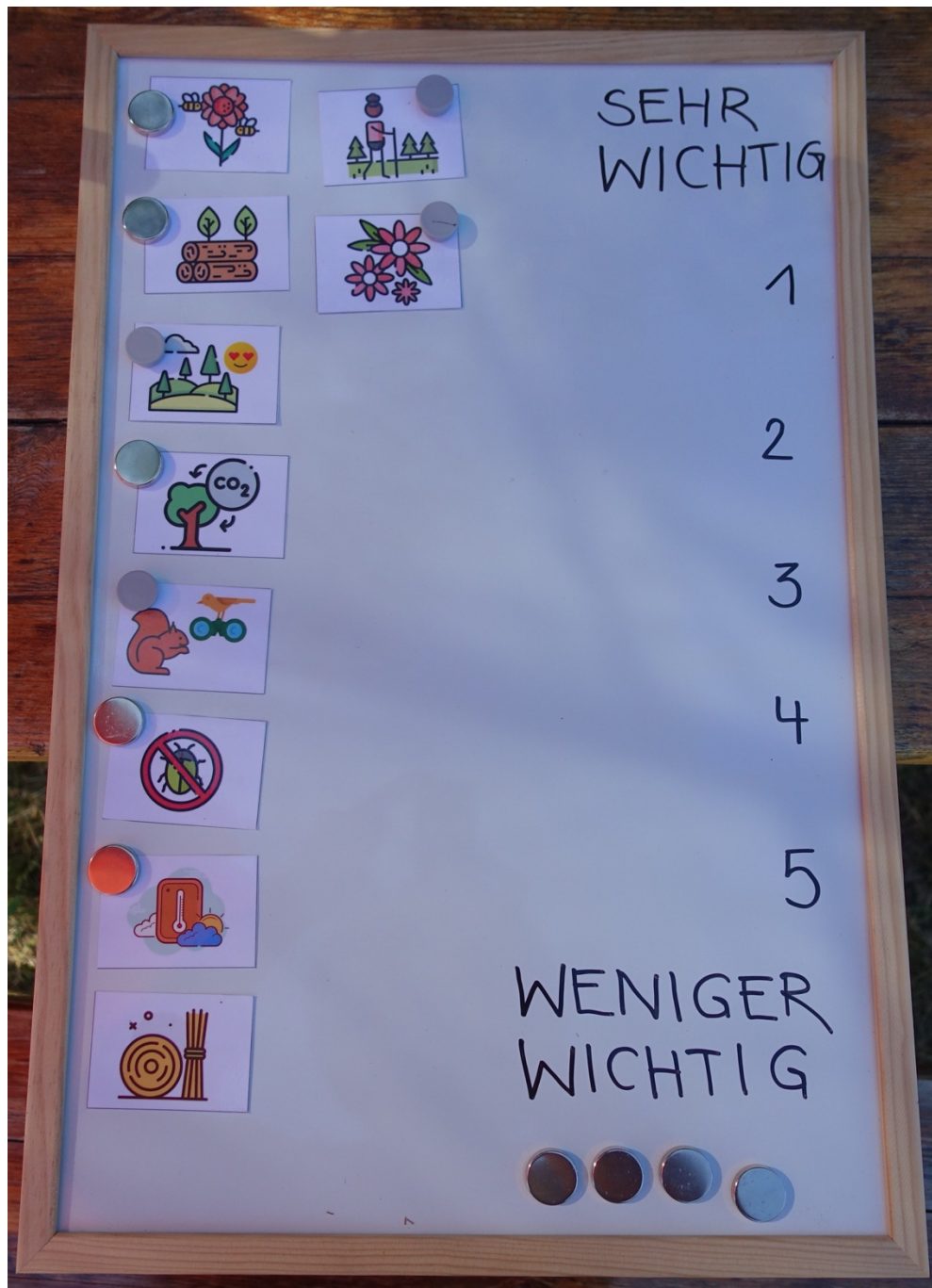


Figure 2: Nature's contributions to people (NCP) to be ranked from 1 (very important; "Sehr wichtig" in German) to 5 (less important; "weniger wichtig" in German). NCP from top left to bottom right: pollination, timber as a resource, landscape beauty, carbon sequestration, observation of birds and other wild animals, natural pest control, local temperature regulation/ microclimate, fodder production and grazing, outdoor recreation (e.g. hiking, biking etc.), observation of beautiful plants of cultural value

## S5. Interview design

### A. Ranking of nature's contributions to people

*“To begin I will now show you eleven different services of nature. Some of these services are recognisable with the naked eye, such as, for example, timber, forage, or the beauty of nature. Other services are activities that we can carry out in nature, for example, mushroom picking or exercising in nature like hiking, walking and swimming. Yet others are difficult to recognise but still there such as carbon storage or local climate regulation.*

*From your professional perspective [Only applies to experts.] and without rush, please think which of these services that nature provides, contribute more or less to your well-being. Then pick five services and rank these from most important to less important. Please do so by putting the service contributing most to your well-being at 1) and the one contributing the least out of these five at 5). There is no right or wrong in this exercise and ranking these services does not imply that other services are unimportant to you. Please take your*

*time.*

*[Explain the different NCP as shown in S4.] ”*

### B. Interview guide

#### B.1. Questions on the NCP ranked as most important

[Disclaimer: The following questions are exemplary for the NCP *forage production* and *outdoor recreation*. The whole interview is recorded, closed-ended questions are filled in using Survey123 by ArcGIS.]

#### *Fodder production*

1. Why is fodder production important for you?
2. Throughout the year, when is fodder production important to you? A) all year; B) depending on the season [Follow up on which season]; C) never; D) I wish not to answer
3. From your perspective, is fodder production sufficiently available in this region? A) yes, fully; B) yes, but threatened; C) no; D) I wish not to answer
4. Could you explain in detail why you think so?
5. If you use fodder, how do you obtain it? A) I do not use any fodder; B) I produce it myself on my own land; C) I buy the rights from someone to produce on their land; D) I exchange it with someone for something else; E) I get it for free; F) I wish not to answer
6. Do you fertilise the land you produce fodder on? A) yes; B) no
7. If so, how often do you fertilise the land?
8. With what and in which quantity do you fertilise the land? [Provide list of main fertilisers (organic and non-organic)]

9. Who owns the land used to produce fodder? [Provide list of owner types e.g. private person, state, company etc.]
10. From your point of view, is there any person or organisation that influences the possibility to produce fodder in this region? [Subsequently ask for more people or organisations]
11. Does this or any other person or organisation influence the use of machinery to produce fodder?
12. Do you receive any funding in form of subsidies to produce fodder?
13. If so, who administers these funds?

#### *Outdoor recreation*

1. Why is outdoor recreation important for you?
2. Throughout the year, when is outdoor recreation particularly important to you? A) all year; B) depending on the season [Follow up on which season]; C) never; D) I wish not to answer
3. From your perspective, are there enough opportunities in this region for outdoor recreation? A) yes, fully; B) yes, but threatened; C) no; D) I wish not to answer
4. Could you explain in detail why you think so?
5. If you engage in recreational activities outdoors what kind of equipment or infrastructure do you use and how often [Use Likert scale: always, often, sometimes, never, I wish not to answer]?  
A) public hiking trails B) cycle paths; C) info signs; D) picnic areas, huts; E) restaurants, bars, cafés; F) hotels, private accommodation, camp grounds, motels; G) tourist info; H) public transport; I) public parking; J) maps, GPS, navigation apps; I) outdoor equipment (e.g. waterproofs, hiking boots, binoculars etc.); my own vehicle (e.g. car, bicycle etc.); J) I wish not to answer; K) none of the above
6. Is there anything that would make you come to this region more often for recreational activities in the outdoors [Use Likert scale: always, often, sometimes, never, I wish not to answer]? A) improved public transport; B) better infrastructure (e.g. picnic areas, public toilets, hiking trails etc.); C) improved access for people with disabilities; D) improved access for families with small children
7. With whom do you normally engage in recreational activities in the outdoors? A) by myself; B) with my family and relatives; C) with friends; D) with colleagues; E) with club or group members; F) I wish not to answer; G) none of the above
8. I will now read out several statements to you. You can either fully agree, agree, disagree, or fully disagree or you may wish not to answer? A) I know this region well enough to engage in outdoor activities; B) I am knowledgeable enough to engage in outdoor activities; C) I am physically fit enough to engage in outdoor activities; D) I am motivated to engage in outdoor activities; E) I have the financial means to engage in outdoor activities (e.g. for transport or equipment)

9. Do you know or can think of any person or organisation that influences the opportunities for people to engage in recreational outdoor activities here in this region? Subsequently ask for more people or organisations]

## B.2 Questions based on the participant's background

[Disclaimer: Participants indicate their professional background. If they work in forestry, agriculture, or nature conservation, they are asked the following questions. If not, questions in B.3 follow. The following questions are exemplary for someone working in *nature conservation*.]

1. From your point of view, which person or organisation is relevant to nature conservation in this region? [Subsequently ask for more people or organisations]
2. From your point of view, which person or organisation actively influences nature conservation in this region? [Subsequently ask for more people or organisations]
3. If you are concerned regarding a nature conservation issue, who do you turn to or who do you ally with? [Subsequently ask for more people or organisations]
4. Is there anyone you would team up locally to get your self heard regarding a nature conservation issue? [Subsequently ask for more people or organisations]
5. Is there anyone you would like to team up with in the next five years regarding a nature conservation issue? [Subsequently ask for more people or organisations]
6. Are you a member of any nature conservation group? If yes, which ones?
7. If yes, do you feel represented by these groups?
8. Do you receive any funding for nature conservation projects?
9. If yes, for what?
10. If yes, by whom?
11. Do you think the funding you get is adequate?

## B.3 Socio demographic questions

1. Have you visited a formally protected area sometime last year?
2. Do you regularly consume organic or fair-trade products? A) always; B) sometimes; C) seldom; D) never
3. Do you normally recycle? A) always; B) sometimes; C) seldom; D) never
4. What is your highest education? [Give list of relevant forms of education]
5. What is your postcode?
6. What is your household income after tax? [Provide list with context dependent income groups and possibility to opt out of this question.]
7. Is there anything we have not talked about yet or any issues you would like to raise surrounding the topics we touched?