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Measuring and managing sustainability impacts of tourism from a subnational perspective

Faculty of Sustainability
Leuphana University Lüneburg

Doctor of Economic, Social and Political Sciences

– Dr. rer. pol. –

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Born on 21st January 1982 in Gera

Submitted on: 22.09.2023

Thesis defense on: 15.01.2024

First supervisor and reviewer: Prof. Dr. David J. Abson

Second reviewer: Prof. Dr. Henrik von Wehrden

Third reviewer: Prof. Dr. Wolfgang Strasdas

The individual items in the cumulative thesis are published as follows:

Balas, M., Abson, D. (2022). Characterising and identifying gaps in sustainability assessments of tourism - a review. Tourism Management Perspectives. 43, 101004 https://doi.org/10.1016/j.tmp.2022.101004

Gössling, S., Balas, M., Mayer, M., Sun, Y.-Y. (2023). A review of tourism and climate change mitigation: The scales, scopes, stakeholders and strategies of carbon management. Tourism Management. 95, 104681 https://doi.org/10.1016/j.tourman.2022.104681

Balas, M., Mayer, M. The challenge of climate change and net zero emissions for destinations. In Pillmayer, M., Hansen, M., Karl, M. Tourism destination development: A geographic perspective on destination management and tourist demand. De Gruyter Tourism Studies

Balas, M., Dmytrów, K., Mayer, M., Zbaraszewski, W. (2022). Economic impact analysis of tourism in protected areas of the Pomerania region. In: Zbaraszewski, W., Balas, M., Dmytrów, K., Majewska, A., Mayer, M., Steingrube, W. (2022). Socio-economic research in protected areas of the Euroregion Pomerania: Visitor satisfaction, economic impacts and park–people relationships. Poznań: Bogucki Wydawnictwo Naukowe.

Mayer, M., Balas, M., Dmytrów, K., Zbaraszewski, W. (2022). Analysis of park–people relationships. In: Zbaraszewski, W., Balas, M., Dmytrów, K., Majewska, A., Mayer, M., Steingrube, W. (2022). Socio-economic research in protected areas of the Euroregion Pomerania: Visitor satisfaction, economic impacts and park–people relationships. Poznań: Bogucki Wydawnictwo Naukowe.

Year of publication: 2024

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Dedicated to
my Fantastic Four
& my Superwoman.

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Preface

This dissertation is presented as a series of manuscripts. The chapters additional to this framework paper (Chapter I) are designed to be stand-alone articles and book chapters intended for scientific publication. Due to formal requirements, stylistic differences (e.g., differences in formatting requirements) are possible among the articles. All chapters and appendices, expect Chapter IV, have been published and the content has not been changed. Chapter IV has been submitted as a book chapter to an international publisher (DeGruyter Publishing) and is therefore formatted in a similar style to the framework paper. References to each corresponding journal and the contributing co-authors are presented on the title page of each chapter or in the Appendix. The style used for citing literature in the text and for the references sections at the end of each chapter and appendix respects the formatting requirements of the corresponding journal and publisher where the respective manuscript was published or submitted to. Chapter I uses the APA reference formatting style.

Abstract

The emergence of sustainability as a guiding principle for tourism development came along with needs to introduce instruments that can monitor the actual impacts of tourism. Sustainability assessments in tourism (SAT) have gained popularity in recent years with a range of measurement schemes being introduced for national and subnational tourism destinations. With the help of sustainability indicators these schemes intend to guide decision-makers in making better evidence-informed decisions and to improve the overall sustainability performance of tourism. Yet, sustainability assessments have hardly led to changes in organisational or management structures in tourism in the last years.

With this dissertation I aim to contribute to a deeper understanding of the implementation and performance of sustainability assessments, by linking transformative needs of tourism with necessary assessment approaches that can serve as effective instruments for a shift towards a more sustainable tourism development. Thus, the research is part of recent efforts to establish profound and effective measurement approaches for sustainable tourism.

I employ a mixed-methods approach combining qualitative, quantitative, set-theoretic, and review methods, with the aim of maximising the validity of results. First, I explore the general progress and current state of research on sustainability assessments in tourism, with the intention to identify patterns, key elements and research gaps within assessment approaches This is followed by subsequent detailed analyses that examine specific environmental and socio-economic sustainability issues with the aim of providing conceptual, methodological and empirical solutions for assessing them in detail.

My dissertation highlights that concrete assessment tools are needed for evidence-informed decision-making and the establishment of effective actions in destination management. The findings indicate that assessments will be more successful in terms of serving as tools for decision-making, if they tackle main drivers of change and encourage management or policymakers to take decisions that affect multiple sustainability issues. It also reviews different concepts and accounting principles and rises awareness of a cautious selection of methods and measurement approaches, as this may affect overall results. The thesis empirically evaluates and applies different measurement approaches in specific destinations, with the help of quantitative and qualitative data collection methodologies. In general, my thesis provides further clarification about key environmental and socio-economic measurement methodologies, which supports ongoing debates about sustainability impacts of tourism. Thus, the research contributes to knowledge, frameworks, methodologies and practical application for tourism governance and tourism sustainability science.

Keywords: sustainable tourism assessments, indicators, tourism impacts, sustainability transformation

Chapter I

Measuring and managing sustainability impacts of tourism from a subnational perspective

1. Introduction

Human activities nowadays shape environmental and societal developments across the globe. How social and natural systems evolve and remain in a balanced state has been part of scientific debates for many years (Ellis et al., 2018; Crutzen, 2006; Waters et al., 2016). Incidences such as the Covid-19 pandemic reveal the tightly coupled relationship between nature and people worldwide, creating strong forces on politics, communities, the economy and humanity's attitudes towards natural systems in general (Hall, Scott & Gössling, 2020).

In a broader sense, system dynamics that are conveyed through 'disturbances' such as pandemics can influence several temporal and spatial scales: "What happens at one scale, can influence or even drive what's happening at other scales" (Walker & Salt, 2006). Cross-scale interactions are common in complex systems and describe the interdependence between different levels of a system (Cash et al., 2006). As long as transfers from one level to another are maintained, it is possible to alter interactions within the levels themselves, without the system losing its integrity or failing.

Tourism can be perceived as a complex system that continuously withstands external influences on different levels and is embedded in a wider socio-economic and social-ecological environment (Espiner, Orchiston & Higham, 2017). It is one of the world's major economic sectors, being the third-largest export category, contributing around 7% of global trade and being a supporter of one in 10 jobs worldwide (UNWTO, 2022). The capability of adaptation, learning and innovative thinking has been a main subject of modern tourism management in the last few decades (Fabry & Zeghni, 2019), with sustainability being a concept for the proactive management and planning of destinations, in order to increase the persistence and adaptability of tourism stakeholders in times of external disturbances (Bramwell et al., 2017).

When considering tourism as an economic activity, the need to adopt a sustainable approach is aggravated by its multi-sectoral nature and its dependence on social-ecological systems, in terms of intact destination environments and communities (White et al., 2006). It may be put in a way that "tourism, which degrades any elements of host communities, threatens its own future" (Manning, 1999). Hardin's (1968) 'Tragedy of the Commons' concept is inherent in tourism, as tourists tend to be attracted to the more vulnerable and sensitive areas, which in turn creates a strong management responsibility that lies with many different stakeholders.

There is a growing awareness that tourism destinations need novel strategies to cope with long-term future challenges (Luthe & Wyss, 2014). This awareness has increased rapidly in the last few years, and calls for a more sustainable and resilient form of tourism have become omnipresent in both the literature (Prayag, 2020) and the industry itself (UNWTO, 2021).

Globally, tourism is the only economic sector explicitly anchored in three targets of the Sustainable Development Goals (UNWTO, 2017b). The primary focus falls on target 12b, which emphasises sustainable consumption and production patterns in tourism and the continuous monitoring of sustainable associated practices (UNWTO & UNDP, 2017). Due to the spatial characteristics of tourism activities (Bieger & Beritelli, 2013), many tourism-related sustainability aspects are mainly relevant within sub-national contexts (UNWTO, 2017b; INRouTe, 2017). A range of ecological as well as socio-cultural tourism impacts are a result of the temporal and spatial activities of tourists (e.g., overcrowding).

The need to assess the environmental and socio-cultural impacts of tourism at the global, national and regional level is regularly highlighted in publications (Rasoolimanesh et al., 2020; Epler Wood et al., 2019; Torres-Delgado & Palomeque, 2014), and overall, there is a general agreement about the lack of integration of sustainability indicators into actual tourism policy and planning (Asmelash & Kumar, 2019; Vila, Costa & Rovira, 2010). At present, data about tourism impacts on the required regional spatial and temporal scales barely exist or require very complex data collection methods, especially if they are supposed to be connected to national tourism development objectives (Batista e Silva et al., 2018).

Current necessities to develop transformative strategies in tourism, in combination with the actual challenge of quantitatively assessing major tourism impacts, create a certain orientation gap in terms of defining key elements that are able to generate changes in the tourism model without destabilising the overall system. Recent publications indicate that new tourism models will at least need to provide solutions for low-carbon tourism development while maintaining local incomes and employment benefits and assuring positive community sentiments towards tourism (Gössling & Higham, 2021; Scott, Hall, & Gössling 2019; Sharpley & Telfer, 2015; Schilcher, 2007).

This dissertation aims to link transformative needs of tourism with necessary approaches that assess elements of sustainable tourism development on the subnational level, with a special focus on protected areas, the most prevalent of which are the most attractive and the most vulnerable destinations. The thesis was partly developed as part of two larger research projects: (1) “REGE – Cross-border cooperation between universities and large-scale protected areas in the Pomerania Euroregion” and (2) “Enhancement of sustainable tourism: Determining the share of sustainable tourism in value generation in Germany and strengthening cooperation with and between important stakeholders”.

The first project aimed at working out common methodologies for collecting, analysing and evaluating data on the social and economic impacts of large-scale protected areas. The goal of the second project was to develop a practical system for measuring the sustainability of national tourism in Germany. My thesis is integrated into sections of both projects and concentrates on advancing the measurement of tourism impacts in the fields of climate mitigation, socio-economic valuation and local perceptions of tourism development. The central focus of this thesis is to support project findings by capturing essential elements of tourism transformation with scientific sound conceptual approaches, and showcasing sustainable pathways for the future development of subnational tourism.

Moreover, this thesis aims to further explore theoretical work on climate change management in tourism, as it is the most demanding current challenge for the industry. Here, I emphasise on climate accounting, but also examine future development projections in terms of climate mitigation and adaptation, including related implications for future tourism development. In this scientific endeavour, I am motivated by the desire to comprehend the specific spectrum of the climate crisis in tourism as an ideal example of transformative change.

The overall personal motivation of this thesis is to provide solutions for tourism researchers and regional destination managers, in order to help them cope with transformative challenges, supported by evidence-based information allowing for the application of sustainable economic practices. Hence, this thesis is an attempt to bridge the gap between practical approaches to and the scientific demands of sustainability developments in tourism.

The main aim of this dissertation is to enhance ongoing debates about sustainability measurements in tourism, by exploring assessment implications of different scales and by focusing on the environmental and socio-economic impacts of subnational tourism.

Specifically, the thesis investigates the subject from different scales of abstraction and with a mix of methods and concepts (see Fig. 1), focusing on the following five major research topics.

First, I explore the general progress and current state of research on sustainability assessments in tourism, with the intention to identify patterns and research gaps within assessment approaches (*Chapter II*, Review paper).

Second, I specifically address the evolution of climate change mitigation in tourism, by providing a conceptual framework for mitigation dimensions, including a particular emphasis on emission inventory comprehensiveness, emission allocation principles on different scales, clearly defined responsibilities for decarbonisation and the identification of significant mitigation strategies (*Chapter III*, Review and Conceptual paper).

Third, this leads to a more detailed discussion about carbon and climate risks that arise from the need for transformative changes in terms of climate mitigation and adaption strategies for subnational tourism destinations (*Chapter IV*, Conceptual paper).

Fourth, I explore the need for robust economic impact analyses of tourism as a source of local economic value creation, by providing a particular example of implementing methodological approaches for economic impact assessments in two protected areas of the Pomerania region (*Chapter V*, Empirical paper).

Lastly, I intend to elaborate on general local interactions within regional contexts that lead to specific community sentiments towards (tourism) development, by implementing an empirical analysis of park-people relationships in fourteen protected areas in the Pomerania region, based on an explanatory framework representing the attitudes and behaviour of local people in relation to protected areas (*Chapter VI*, Empirical paper).

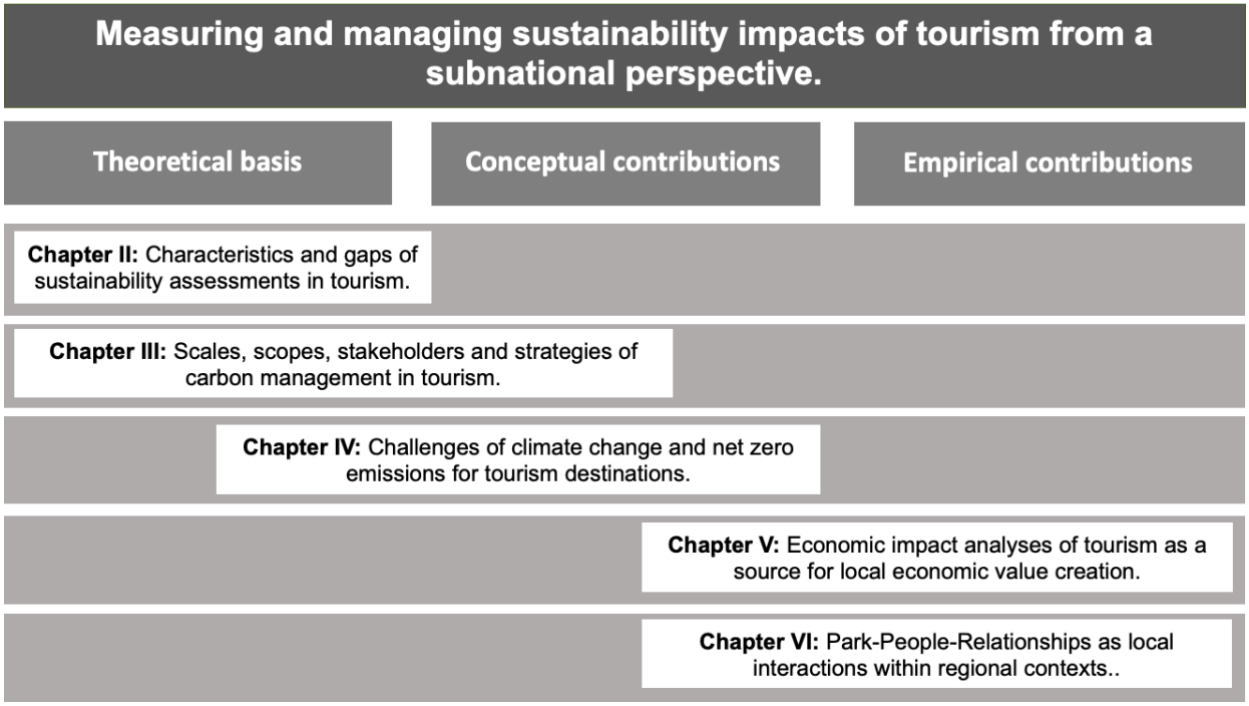

Figure 1: Relationship between papers and their contribution to the thesis' objectives.

This chapter summarises the introduced research topics, and the next section underpins the further conceptual and theoretical background for this dissertation, followed by the methods implemented herein. The third section summarises the main results and limitations of the research, by introducing the five main publications as well as six further supplementary publications that relate to the subject. Subsequently, I reflect on how the insights from this thesis contribute to the literature and to the practical application of sustainable tourism development.

2. Conceptual and methodological background

This thesis is largely linked to theories of interaction between human activities and the environment that acknowledge the creation of knowledge as the interplay between different concepts and which are relative to each experience. Thus, the theoretical approach of this thesis is based on a multi-paradigmatic philosophy of disciplines as an interface between social, economic and natural sciences. This mainly involves the situational application of both qualitative-constructivist research approaches and quantitative hypothesis-based analytical procedures. All presented papers include application-oriented research related to sustainability economics, with a specific focus on issues of transition, systems understanding and resilience management, as well as global environmental and resource economics.

2.1 Transition as an orientation towards the long-term future

The work presented herein relates to the idea that the global environment is constantly changing, with different scales across time and space but with certain connections through global physical and social processes (Hall, 2010; Meyer & Turner, 1995). Often described as

transition and/or *transformation*, global change involves interconnections that reinforce each other but take place in different contexts, such as technology, the economy, institutions, societal structures and individual behaviour (Rotmans, Van Asselt & Kemp, 2001). The setting of multiple causalities and co-evolution between independent developments relates to the general concept of human-environmental systems (Forbes et al., 2009; Berkes et al., 2003; Gunderson & Holling, 2002) and emphasises the relationships and interactions between social and natural components, which plays a critical role in sustainability economics (Baumgärtner & Quaas, 2009). In this setting, the thesis refers to modern sociotechnical structures as the main drivers of human development (Geels et al., 2017). Such structures are an efficient mix of technologies, infrastructures, productive units, regulations and individual practices that deliver societal functions, as in the case here, namely tourism as mainly being an activity of personal mobility. Sociotechnical structures have been well established throughout consumptive processes and serve as widely accepted instruments for economies. Nevertheless, they also come with destructive processes (Boivin et al., 2016), specifically long-term changes to the physical environment that can be harmful to species (Laland et al., 2014), and issues of social justice in terms of socioeconomic and cultural dependencies (Jonas, 2016). The original sustainable development concept aims to reduce these impacts while maintaining long-term economic productivity (Hopwood, Mellor, O'Brien, 2005) and therefore inherits the demand for transition and global change towards a desirable future for humankind (WCED, 1987). The main notions of sustainability have been recognised for decades in international policymaking Jonas, 2016; Hall, 2011), with many firms, individuals and governments claiming to develop and implement sustainable practices. However, criticism about missing outcomes and achievements has increased steadily (Sterman, 2012; Rees, 2012), with a main emphasis on rebound effects, trade-offs and general boundaries due to system complexities (Rees, 1992; Weinstein, 2013). A growing number of authors have therefore pledged for a stronger integration of systems thinking in sustainability concepts, with the aim of broadening perspectives and creating a new knowledge base that engages actions on multiple scales and over successive generations (Sterman, 2012; Westley et al., 2011).

2.2 Systems understanding and resilience management

The second research philosophy I stress in my research is the identification of specific system-level parameters that act as potential drivers for change. It is a typical notion of sustainability to create, test and maintain adaptive capabilities and opportunities for the future (Holling et al., 2002). By understanding complex systems such as tourism, i.e., as a combination of elements nested in a hierarchy across time and space, it is possible to generate combinations of system elements (e.g., innovations or experimental measures) that can be tested over longer periods without automatically triggering cascading instabilities of the whole, due to the stabilising nature of the overall nested hierarchies. This potential is highlighted in the transformative resilience concept, which places emphasis on identifying patterns that eliminate traditional path dependencies and create newly defined stabilities (Berkes et al., 2003). Central elements for new paths in tourism (and other economic activities) are the establishment of regional economies towards a steady-state equilibrium, in line with planetary boundaries, and strengthening individual and local structures of self-determination (Gössling & Higham, 2020; Espiner et al., 2017; Hall,

2009 & 2011). However, as straightforward as this might sound, actual application is just as challenging. Tourism policy, tourism studies and assessment frameworks still perceive the notion of sustainability mostly as being 'environmental', and the idea of development is often seen as 'economic' and to a certain extent 'social', with the concept of sustainable development aiming to bring about reconciliation between ecological (sustainability) interests and economic (development) paths (Scott, Hall & Gössling, 2019; Hall, 2010; Sachs, 1993). This rather isolative perception interferes with the idea of systems thinking and transformative resilience. Therefore, my research elaborates on quantifiable parameters in tourism for potential new paths that trigger dynamic tourism development processes and help establish an enhanced understanding of destination management as a strength-based approach in dealing with crises and change. In this sense, such variables intend to build a bridge between systemic and normative approaches to sustainable tourism development.

2.3 Environmental economics in tourism

Tourism as an economic activity is associated with environmental impacts on a global scale, and increasingly as a relevant factor for global resource depletion (Lenzen et al., 2018; Lew, 2009; Hall, 2005, 2008, 2010; Gössling, 2002). Thus, as this dissertation's research deals with tourism impacts, it inherently also touches upon the discipline of environmental economics, with an emphasis on natural resource allocation. Resource depletion and pollution has been a focal point of environmental economics since the 1960s (Beder, 2011), especially in relation to the integration of environmental values into cost-benefit analyses and internalising the costs of environmental and ecological degradation into price calculations (Hanley, Shogren & White, 2019). As tourism is an economic activity that involves people travelling to national or international destinations, along with expenditures in different locations and services produced domestically and internationally, the allocation of environmental impacts is challenging on scales below the global. The geographical phenomenon of tourism as a cross-sectoral economic activity that occurs across time and space, creates economic and environmental effects that are produced at every stage of a journey, with the environmental impacts often not being correctly allocated (Hall, 2005). Several analyses of tourism and environmental effects demonstrate that by only focusing on what occurs at a specific site, rather than over an entire trip, will likely lead to a substantial underestimation of the overall environmental impacts of tourism activities (Hall, 2010). Therefore, parts of this thesis deal with the issue of allocating environmental impacts, using an environmental economics allocation perspective.

2.4 Methodological approach

Any investigation of sustainability impacts for tourism as a complex system requires an interdisciplinary approach that can tackle economic, social and environmental disciplines. Therefore, I employed a wide range of conceptual, methodological and empirical approaches to help capture the specific aim of my thesis. In general, it involved desk research and, both, qualitative as well as quantitative methods for data collection and analysis, along with an attempt to maintain some form of balance between them (see Fig. 1). For the empirical papers, I contributed to data collection through several types of questionnaires and surveys. These were

accompanied by more than 14,000 structured interviews in 15 regions, using different types of distribution channels such as personal, telephone and online interviews, depending on the type of questionnaire, the required sample size and the target group. In addition, we used secondary data sources to conduct regional economic impact analyses by means of an input-output model, applied to tourism in a protected area. As qualitative methods, I mainly conducted thematic analyses (Chapters II, III and IV) and operationalised predefined variables through coding for further analyses. Quantitative methods included a range of descriptive statistics (all chapters), multivariate methods such as a hierarchical cluster analysis (Chapter II) and chi-square, p-value and Cramer's V tests (Chapter VI). All methods were applied in an explorative manner or by using predefined conceptual approaches, so that they would fit into the overall analysis.

The following section specifies in further detail the methods used for each paper, as the approaches vary substantially and need to be put into the corresponding context of the paper.

3. Research paper summary

This section provides an overview of the five papers making up the main body of this thesis and six further publications that expand on the overarching aim of the dissertation (see Appendix I-VI for a full list and summaries of these publications). For each main paper I provide a review of the envisaged research objectives, explain the specific methodological approaches and present key results. Further, I summarise the main limitations and possible further conclusions of each research. The publications in the appendix will be shortly summarised to provide further background knowledge and additional substantiation of the thesis. This will then lead to a general synthesis in section 4.

3.1 Paper 1: Characterising and identifying gaps in sustainability assessments of tourism – a review

In the paper *Characterising and identifying gaps in sustainability assessments of tourism – a review*, we aimed to examine the main development stages, general progress and the current state of research on sustainability assessments in tourism (SAT). We identified and characterised a range of different approaches used to assess sustainability in tourism, examined similarities and differences between these approaches by presenting different types of assessments and critically discussed the findings in relation to research on SAT, with a particular focus on suggesting improvements for each of the introduced assessment stages.

For the analysis, I performed a systematic semi-quantitative literature review of 81 peer-reviewed publications conducting empirical research on SAT. The review was based on an extensive search string, followed by title and abstract screening, as well as eligibility screening, to condense the relevant literature. The review process was guided by an evaluation scheme of variables covering all of the main stages in developing SAT, which helped to code the variables into multinomial and binary categories for the analysis. At first, a main descriptive analysis was applied, followed by an agglomerative hierarchical cluster analysis, to identify groups of publications that applied similar overall assessment approaches and to provide clear distinctions with other types of assessments.

We identified five SAT clusters: (1) new frameworks that develop indicator sets and assessment methodologies, (2) case studies that apply existing indicator sets or frameworks to specific areas, (3) system-based approaches that contextualise existing indicator work on sustainability in tourism and develop new perspectives and (4) indices assessments that compare destination sustainability through the use of composite indicators.

In general, our review revealed a wide range of assessment approaches, not only portraying ongoing academic reflection on the constantly evolving character of sustainability concepts (Pulido-Fernandez, Sanchez-Rivero, & Lopez-Sanchez, 2011), but also creating an environment of increased complexity, due to seemingly endless choices for sustainability assessments. In addition, most of the empirical work was carried out as one-time assessments, thereby negating the necessity to continuously monitor sustainability impacts. The divide between theoretical demands on assessments and actual practical applications was also confirmed through our analysis, as we determined that only a minority of assessments included tourism stakeholder involvement. Our results regarding the measurability of tourism-specific sustainability issues coincide with the findings of Font et al. (2021), who stress the general point that sustainability indicators in tourism are still mostly used as a diagnostic tool for DMOs but hardly lead to actual changes in organisational or management structures. Accordingly, if indicators could indeed enable evidence-based decisions, the collected data would need to directly present tourism-specific areas of concern and also be clearly related thereto. A main deficiency that we identified, was the missing connection between indicators and sustainability targets, which has also been stated in other studies (Blancas, et al., 2011). In relation to the identified assessment clusters, we confirmed that all of them are confronted with similar challenges regarding the process involved in indicator development and measurability. Our analysis suggests that more research is needed on how existing frameworks and assessment approaches could be better contextualised, so that the vast amount of already generated data can be better put into different contexts and be used for target-oriented decision-making.

The structured and systematic approach we pursue in this paper comes with a few limitations. First, we focused solely on empirical and peer-reviewed work on sustainability assessments, thereby potentially excluding a range of studies that were undertaken in applied contexts or by institutional efforts. Thus, missing the contextualisation of assessments and a lack of stakeholder integration might be tackled in frameworks with a stronger practical focus. Indeed, recent publications by Crabolu (2021) and Crabolu, Font & Miller (2023) point out that well-organised participatory processes included in developing assessment frameworks lead to stakeholder buy-ins, active engagement and even to direct policy change. However, they also highlight the need to ‘translate’ and to facilitate the complexity of indicator development processes. Another limitation is certainly the difficulty involved in grasping all of the existing concepts and assessment approaches. Within the 81 analysed papers, we identified 28 different theoretical concepts that were used to set up sustainability indicators. This heterogeneity of approaches would need a deeper understanding to analyse their suitability for sustainability assessments, which was not possible within this paper. Finally, the identification of assessment clusters was based on a limited number of variables that not only showcased important differences in their approaches to sustainability assessments, but also only provided a limited depth of informative value. Thus, it

would be helpful to apply these clusters to other studies and reviews – and thus to improve the overall eligibility of these approaches.

3.2 Paper 2: A review of tourism and climate change mitigation: The scales, scopes, stakeholders and strategies of carbon management

The paper *A review of tourism and climate change mitigation: The scales, scopes, stakeholders and strategies of carbon management* picks up on an outcome from the first paper, namely the need for sustainability assessments to provide tourism-specific, reliable and continuous data that fit to the user's needs and are based on internationally recognised standards. This demand is applied to the case of carbon management in tourism, i.e., one of the most pressing challenges of the sector (Gössling, 2011) and a main leverage parameter for the overall transition of destination management models (Gössling & Higham, 2020). Thus, the paper does not solely deal with carbon accounting but rather explores general interrelated and interdependent dimensions for effective carbon management in tourism. Based on literature about climate change mitigation, we introduce the S4C model of carbon management in tourism, which considers four key elements of decarbonisation: scale, scope, stakeholder and strategy. We elaborate on emission inventory comprehensiveness, allocation principles on different scales, clearly defined responsibilities for decarbonisation and the identification of significant mitigation strategies to implement effective carbon management. Based on the S4C model, we develop mitigation trajectories for specific tourism segments and provide recommendations to advance net-zero goals.

Methodologically, we conducted a thematic and systematic literature review that aimed to advance the state-of-the-art understanding of the different dimensions of carbon management. We separated the review into two parts: For the dimensions scope and scale, we performed a semi-quantitative review, whereas we did a qualitative evaluation for the stakeholder and strategy dimensions. This approach was chosen as a learning point from the first paper, in order to gain more in-depth information on specific aspects of the topic. As a considerable number of papers have already dealt with the complexities of the scopes and scales of carbon management in tourism, we favoured a more structured review. We chose a similar approach as presented for Paper 1, using an evaluation scheme to analyse a total of 62 scientific papers. The qualitative analysis focused on an account of developments about the topic over the past 25 years and included grey literature such as studies by the industry itself. The evaluation mainly followed an expert-based approach, to better contextualise existing complexities and objectives of individual reports.

The paper contains a rich variety of findings. First, we identified that greenhouse gas (GHG) emissions from tourism are analysed on all levels on which mitigation can be implemented and monitored, i.e., global-, national-, destination (sub-national)- or business-level. A wide range of assessment approaches mostly follow the purpose of investigation, such as understanding tourism relevant GHG emissions on a geographical scale as an economic system, as a combination of specific subsectors (accommodation etc.) or as specific tourism products. Measurements on the business level represent the most common approach and often follow internationally established frameworks and standards (UNWTO, 2023; Becken & Bobes, 2016).

Our findings verify that GHG accounting enables destinations to map and evaluate different development paths for the required extent of GHG reductions. There are four elements to the scope dimension: the subsectors to be included, such as accommodation, transport or shopping; the visitor segments to be considered, such as domestic, inbound and outbound tourism; the extent of the supply chain being evaluated (direct and indirect emissions at the destination level) and the type of emissions included, namely CO_2, other long-lived GHGs and non-CO_2 warming from air transport. Ultimately, allocation principles and data availability guide the decision to include certain components.

The analysis highlights that GHG emissions arise from a range of different tourism service providers at a destination. Calculations can be based on either visitor volumes and activities connected with information on specific tourism sub-sectors (bottom-up) or (larger-scale) destinations calculating emissions using environmental accounting methods that identify emissions along the chains of production and distribution (top-down).

Our findings reveal that information about tourism specific emissions is specifically relevant for destination management. As a baseline, it enables the setup of tailor-made GHG reduction targets and implementation strategies for different segments within the destination, which allows for an evidence-based climate management approach. Later, tourism-related carbon accounting will help monitoring progress and failure to adjust GHG management. It also enables comparisons with both national tourism emissions and other economic sectors. Furthermore, emission intensities can be mapped, i.e., setting emissions in relation to value added, which is of importance for regional/national climate action plans and green growth strategies.

In addition to accounting levels and elements of emission measurements, it is also important to assign responsibilities for carbon management (stakeholders). Responsibilities in destinations may be assigned to multiple stakeholders like businesses, consumers and policymakers. However, the question is still open in terms of whether destinations are responsible for transport emissions. In addition, there is currently limited evidence on climate governance in tourism contexts, specifically not in terms of a measurable decline in absolute emissions (Becken et al., 2020; OECD & UNEP, 2011). In addition, a potential barrier to clearly assigned responsibilities is seen in the form of industry's persistent greenwashing efforts, combined with misleading information provided to customers and missing sustainability targets, particular within the transport sector (Guix, Olle, & Font, 2022; Aurand et al., 2018; Patterson, 2000).

Destinations need to develop strategies to guide tourism on a net zero emission trajectory by 2050 or even earlier. This will require technological innovations, transition policies and changes in consumer behaviour. Given the lack of evidence relating to decarbonisation through tourism industry initiatives, governance will determine the success of mitigation initiatives. Here, our analysis shows that mainly regulatory and market-based policies will contribute to significant emission cuts, albeit voluntary policies are relevant in supporting social norm change (Gössling & Dolnicar, 2022; Gössling & Lyle, 2021). As some policies have a greater potential for emission reductions than others, it will be necessary to prioritise measures on the basis of impact assessments of specific tourism segments. Our findings show that several instruments have already been recommended by various studies, considering, amongst other subjects, the avoid, reduce and substitute hierarchy, albeit with a remaining lack of implementation (Peeters & Eijgelaar, 2014; Peeters & Landre, 2011).

The very extensive approach of this paper also leads to some limitations. Using a combined method for the review, especially in regard of the expert-based approach, leaves room for a subjective and indicative argumentation, due to the complexity of the issue and the profound knowledge of the topic by the authors. However, it allowed evaluations and illustrations that have not been introduced previously in publications, such as a comprehensive overview of tourism-relevant carbon inventory principles, the presentation of options for carbon emission allocation principles, an estimation of mitigation potentials for tourism-specific subsectors or proposals relating to tourism decarbonisation. Correspondingly, the analysis excluded very specific studies of carbon management investigations in tourism, such as scenario studies using methodologies such as National Environmental Kuznets Curves, as this is an exhaustive field of research itself (Sun, Gössling & Zhou, 2022). Other research questions related to the topic also could not be covered in further detail. For example, it would have been very useful to elaborate more on the distribution of responsibilities for emission reductions between different tourism stakeholders and the consequences in terms of formulating common industry-specific goals. Also, barriers to businesses and destinations estimating emissions need further exploration, in particular to provide additional guidance on facilitating comparable calculation methodologies to implement common assessment frameworks. Finally, the paper focused on mitigation, leaving out the necessity for climate adaptation, which comes with further demands and risks, as highlighted in the following paper.

3.3 Paper 3: The challenge of climate change and net zero emissions for destinations

The paper *The challenge of climate change and net zero emissions for destinations* directly picks up on elements and shortcomings from the previous paper and focuses on the specific challenges facing subnational destinations in terms of simultaneously cutting emissions at a radical pace (carbon risk) and preparing for the impacts of climate change (climate risk). The paper provides a conceptual basis for the complex relations between climate and carbon risk for destinations and exemplifies these challenges (but also opportunities) through two case studies.

Methodologically, we conducted desk research and used the results of the systematic literature review from the previous paper, albeit slightly adapting the variables to gain further insights into the relationships between climate mitigation and adaptation. In addition, we used unpublished results from previous fieldworks for the presented case studies, in order to provide additional insights into the topic.

A main result of the paper is a practice-based contextualisation of carbon and climate risks for tourism destinations. Both risks are not equally distributed geographically and will influence supply, demand and competitiveness of destinations at all spatial levels in highly different ways and to varying magnitudes (Scott & Gössling, 2022). Destinations are need to find solutions that maintain economic returns and employment at a stable level while also supporting concise and effective decarbonisation efforts. Altogether, such approaches are highly interlinked with overall destination resilience (Gössling & Higham, 2020). Measures to be taken in terms of mitigation include encouraging longer stays with constant value added features but with fewer arrivals (Gössling et al., 2018), less air travel by marketing domestic locations and demarketing long-haul markets (Gössling et al., 2015) and reducing leakages by regulating international intermediaries.

We also discuss the variety of different terminologies for mitigation and the related misinterpretation that might follow the use of specific claims such as ‘climate neutrality’.

Destinations are clearly impacted by climate change and, at the same time, destination management has a responsibility to mitigate GHG emissions caused by tourism activities (WTTC, 2021; Ma & Kirilenko, 2020; Scott et al., 2016). Nevertheless, both aspects are most often disproportionate, i.e., even if a destination did reach net-zero, it would not be relieved from negative climate change impacts. This could discourage decision-makers/stakeholders from taking action, as mitigation efforts at the destination level might be perceived as a market disadvantage and responsibility might be demanded to be taken elsewhere. This underlines the foundations of global warming as a common-pool resource problem (Ostrom, 2008). Still, adaptation to changing external developments is not new to destinations, as they continuously adapt to changing demand trends, competitors’ offers, new technologies and legal frameworks (Saarinen, 2004). This calls for an adaptive destination management approach (Hartman, 2023) that also needs to integrate risk management, including climate and carbon risks.

Climate change mitigation and the adaptation of tourism on the subnational level will need to be perceived as part of a holistic destination development that considers individual circumstances regarding natural surroundings, general infrastructure, tourism offers and demand structures. Destinations focusing on either mitigation or adaptation in their destination management plans might be confronted with conflicts of interests or even hampered efforts due limited capacity and resources. Therefore, we recommend integrating both carbon and climate risks into a holistic climate action strategy that takes into account mitigation and adaptation perspectives, integrates different stakeholder needs, including supply chain elements, and provides overall guidance for necessary steps that optimally serve both mitigation and adaptation, or at least minimise conflicting outcomes.

Our practical approach naturally comes with limitations. First and foremost, the paper is targeted at a wider, non-scientific audience with a strong applied focus. Therefore, sections such as the discussion are intentionally kept short, and other parts that have a stronger application base are more detailed. Parts of a wider discourse on most of the findings within the broader academic literature were implemented in the previous paper. Another limitation is that there is not currently a great deal of scientific literature on the net-zero transition challenge for destinations on the sub-national level. Thus, we had to focus on a limited number of sources, which in turn might have led to some indicative argumentation. We aimed to minimise this risk by also including a range of non-academic literature as well as specific case studies, to bridge the gap further between scientific approaches and practical implementation.

3.4 Paper 4: Economic impact analysis of tourism in protected areas of the Pomerania region

In the paper *Economic impact analysis of tourism in protected areas of the Pomerania region*, we specify the need to assess economic value creation by tourism in a destination as a main field of sustainability assessments (see Chapter II) and explore two ways of estimating economic impacts in the specific case of protected areas (PA) in Germany and Poland. As existing methodological approaches for economic impact analyses in protected areas are usually very

costly and need advanced scientific expertise, our aim was to adapt existing estimation approaches, with the intention of creating a more affordable and applicable method, especially for structurally weak and peripheral areas such as the Pomerania Euroregion, where no standard method for estimating the economic impact of PA tourism has yet been established.

PAs are ideal study cases for tourism impact assessments, as they are perceived as highly attractive regions for tourists and are often dependent on tourism incomes (Spenceley et al. 2021). At the same time, they are vulnerable areas that are designated for protection and not primarily for visitation (Bushell & Bricker, 2016). The economic valuation of PA tourism has become a prominent field of research, with countries such as the USA and Finland setting up national economic impact monitoring systems (Huhtala et al., 2010) and a range of publications arguing for the implementation of such analyses (Job et al., 2021; Mayer & Stoll-Kleemann, 2016; Pascual et al., 2010; Job, 2008; Flückiger, 2000; Hornback & Eagles, 1999; Rommel, 1998). This is because they provide an argument for the contested valuation of PAs' public goods, they close information gaps and support objectifying debates, they justify the provision of public budgets, their results can be used for self-evaluation and benchmarking internal and external communication, and they contribute to improving the attitudes of local people towards PAs with assumed positive consequences for nature protection outcomes (see also Chapter VI). Overall, economic impact analyses elaborate on the net effects of policies that bring tourism revenues into the PA region that would otherwise not occur, or policies that keep revenues in a PA region that would otherwise be lost. In this way, they are part of the tangible, direct and non-consumptive use values of a PA (Mayer, 2013).

For the empirical study, we applied two different methods. For the German case – the Biosphere Reserve Schorfheide-Chorin – I used the method introduced for biosphere reserves by Job et al. (2013). The aim was to gain a profound understanding of this method and to identify potential adaptations for an optimised methodology applicable to the Pomerania region. Collecting data for estimating visitor numbers and expenditure is crucial to the analysis. In order to determine such data, 7,100 short interviews relating to visitor counts, as well as 1,171 longer face-to-face interviews, were systematically conducted in the Biosphere Reserve at ten predefined locations over a period of 12 months in 2020 and 2021. All surveys were inserted electronically via mobile phones with an app that allowed for them to be conducted offline. A detailed description of the steps for this approach is presented in Chapter V.

For the Polish case – the Wolin National Park – we applied a regionalised input-output (I/O) model based on the classic I/O analysis by Leontief (1936), using cross-industry location quotients for the regionalisation of internationally defined tourism-characteristic industries (Arnegger, 2014; UNSD, 2010). I/O-tables for Poland were derived from the OECD, and average wages for each industry were taken from the Polish National Statistical Office. As the assessment relied on tourism demand data (visitor days and visitor expenditures) to create tourism-specific results, it was necessary to obtain further data from a total of 1,440 face-to-face interviews conducted over 17 separate days during one year (for the visitor expenditure data), and the use of seven automatic visitor counters (for the visitor days) during the same period.

The results of our study showed that both implemented methods have their justifications and that there are quite a few ways of facilitating the approaches. Overall, any estimation of the economic impacts of tourism relies on information about visitor flows and expenditure, as well as regional

multipliers for the included tourism segments. Such data can be obtained through statistically-based visitor counting and surveys throughout the year, which remains a costly exercise, even when the I/O-model is applied. An opportunity to reduce the cost of visitor counting lies in the use of automatic counting devices, which allowed us to obtain data from the Wolin National Park throughout the year, instead of acquiring information for selected days on which visitors were counted, as was the case for the German approach. At the same time, data from automatic counters was used not only for estimating economic impacts, but also for the ongoing monitoring of tourist flows. However, such counters need manual calibration, and data needs to be corrected with a certain factor, as Staab et al. (2021) also highlight. If there are no automatic counters, visitor days can alternatively be estimated empirically by a combination of sampling and secondary data (e.g., overnight statistics from the PA municipalities).

To acquire information about visitor expenditure, we propose using a standardised survey template with a modular structure, which has also been suggested in the literature as a possible solution (Spenceley et al., 2021). Such a survey would be minimal, as the primary objective would be to estimate the structure of expenditure. Additional questions may be clustered into modules and then used on an as-needed basis, which would help reduce costs due to reaching the desired sample size in a shorter time.

Another required element for estimating economic tourism impacts is regional multipliers. As a pilot, we additionally developed a questionnaire to measure value-added ratios and tested it in the Wolin National Park region and the Biosphere Reserve Schorfheide-Chorin (see Appendix VI). The survey in the Polish region included a group of twenty randomly selected enterprises among micro-, small- and medium-sized enterprises. As a result, respondents indicated that the data was too confidential to share, and the vast majority refused to answer the questions. Therefore, the pilot study failed to provide any basis for estimating the value-added ratios. In contrast, in the German Biosphere Reserve, we engaged 120 tourism businesses across all business types within the tourism sector and were able to gain profound knowledge that would be suitable for estimating value-added ratios. We concluded that the regionalised input-output method is the preferred option in the Polish case, as it makes use of widely available national input-output tables to estimate the multiplier effects of PA tourism, instead of using value-added ratios, which are obviously very difficult to obtain for Polish PA regions. As a next step, the regionalised input-output approach could also be applied in the future to additional protected areas in Germany, which would allow for comparing both approaches in more detail and assessing the comparability of these results.

Using such a data-driven and empirical approach, as done in this paper, inherently produces some obstacles. In general, as we experienced in the two cases, there are different perspectives, views and equipment available to conduct such empirical studies within certain protected areas. Thus, implementation of the impact analyses depends highly on the participation and cooperation of a range of stakeholders, including protected area managers, researchers, interviewers, etc. This of course needs a strong coordinative approach with a high degree of professionalism but will always come with minor mistakes and flaws with the research design, especially during data collection and analysis. In addition, the presented approach could not be tested to its full extent, primarily because of the numerous restrictions imposed during the Covid-19 pandemic in 2020 and 2021, which caused a range of necessary alterations, especially for on-site interviews.

Further details are explained in Chapter V. Even though this study led to some important outcomes for approaches to regional economic impacts of PA tourism that can be applied beyond Polish and German PAs, research needs to continue, in order to devise a more affordable approach that still allows internationally comparable results, as proposed in Spencely et al. (2021).

3.5 Paper 5: Analysis of park-people relationships

The final main paper of this thesis, namely *Analysis of park-people relationships* focuses on human interactions in protected areas surroundings. Even though this paper is not directly connected to tourism, it is still indirectly linked to impacts in a subnational context, as tourism is a crucial element of socio-economic development in a PA (Hanley & Barbier, 2009) and can be important in fostering a positive attitude towards PA, especially in regions with high tourism intensity (Mayer and Stoll-Kleemann, 2016). Nevertheless, this paper aimed to provide a more generalist approach, in which tourism is one of a number of influencing factors in people's attitudes to regional development, amongst others (Job et al., 2021).

The aim of this paper is to apply empirically a proposed conceptual framework that tries to understand the behaviour of local people towards protected areas and which is inspired by Ajzen's (2005) theory of planned behaviour, based on the theory of psychological reactance, the theory of social identity, the theory of communication behaviour, the theory of symbolic interaction (Stern, 2008; Schenk et al., 2007; Stoll, 1999) and the explanatory approach of the German Advisory Council on the Environment (SRU, 2002) for a lack of support for nature conservation. The work intends to fill an existing gap, as no general model has yet been developed to explain every interaction between protected areas and the people living in or around them despite a large body of literature talking about park-people relationships (PPR) (Schenk et al., 2007).

For the empirical analysis, we conducted extensive quantitative surveys with inhabitants of fourteen PAs in the German and Polish Pomerania region. This region was chosen because it covers a variety of different PAs in a cross-border rural area and has been characterised by dynamic socio-economic changes in the last few decades that have caused a general population decline and a weaker economy, albeit increasing tourist attractiveness, with some locations being traditional and well-known tourism destinations. The analysis covered the environs of six national parks (three in Poland and three in Germany), seven landscape parks (all of them in Poland) and one biosphere reserve (in Germany). The surveys were conducted using the CATI approach (computer-assisted telephone interviewing, using the random digit dialling method) to achieve a representative sample size in a cost-efficient manner. For every PA, between 385 and 400 completed questionnaires were collected to ensure a high statistical confidence level. In total, our sample consisted of 5,547 cases, and the survey took place between July 2019 and January 2020 and at three parks from September to October 2020. To improve the representativeness of the results, we weighted the data based on location-specific quotas for gender and age. The conception of the questionnaire was inspired by the goal of developing a survey instrument based on existing PPR studies to ensure comparability, which covered the theoretically identified influencing factors of the conceptual framework, namely communication, trust, economic situation, reactance and environmental worldview. For the analysis, we implemented descriptive

statistics and combined the dependent variables of the framework with several independent variables, covering most of the influencing factors on PPR, to showcase their relationships. We mainly used different Likert-type scales, mostly ranging from 1 to 5. As the dataset contained nominal- or ordinal-scaled data, we used Cramer's V association coefficient as a statistical method to distinguish the strength of the association for each value ([0.0; 0.1] – no association, [0.1; 0.3] – weak association, [0.3; 0.6] – moderate association, [0.6; 1.0] – strong association) (Cleff, 2019), followed by p-value significance tests. This allowed us to make statements on the strength and significance of the variable relationships.

The overall results of the empirical study are consistent with comparable studies, such as Job et al. (2019, 2021) or Allendorf (2020). Residents of nearby PAs are mostly in favour of the protected area and do not perceive any constraints associated with living in such a region. Also, attitudes towards PAs become more positive over time, as people get used to the regulations and become more convinced of the positive effects. Again, such developments were confirmed by comparable studies. The results of our PPR studies also underline the relevance of the proposed conceptual framework. It became evident that the variables *communication*, *trust*, *economic viability* and *reactance* are statistically significantly relevant in relation to how interested people are in their protected area and positively influence their personal attitudes to the PA. In contrast, we could not confirm in our cases that the environmental worldview empirically influenced the overall PPR. Also, "economic rationalism" (Stern, 2008), i.e., positive economic effects due to tourism and fostering positive attitudes towards PAs, seems to be less pronounced in the Pomerania region compared to the German Bavarian Forest and Berchtesgaden national parks (Job et al., 2021), given the lower statistical associations of the respective variables in our studies. One potential reason could be the mostly much lower intensity of tourism in large parts of the Pomerania region compared to the two national park regions in south-eastern region of Germany (Job et al., 2013). Furthermore, local people, especially in the Polish part of the Pomerania region, might have been less aware of the economic benefits generated by PA tourism. Still, the analysis confirmed that tourism development in the PA had a positive influence on the overall identification of the population with their environment and that inhabitants support a more qualitative tourism. In contrast to the rather similar level of local people's overall attitudes, we found differing PA awareness between the Polish national and landscape parks. One explanation may be the different protection regimes for landscape parks (more lenient – and thus less noticeable for the local community) and greater restrictions on the use of the protected area in the case of national parks, which affected the level of awareness of their existence. This is underlined by more results provided by Mayer et al. (2019), who analysed awareness of protected area categories in the Polish-German border region and revealed that national parks were better known as a PA category, in comparison to other PAs.

The results are also prone to some limitations. First, we were not able to cover all parts of the conceptual framework in the questionnaire. For instance, the influence of constructs *perceived control* (e.g. participation) and *subjective norm* (e.g. peer group processes) on attitudes towards PAs could not be tested to lacks of the survey. Second, the suitability of the central measure of overall attitudes to PA ("Sunday question") needs to be questioned (see also Job et al., 2021). Due to the very high share of confirmations, it was not possible to implement advanced statistical analyses such as logit regression models to explain influencing factors on this binary overall

attitude variable – even in the case of our PPR studies with more than 5,500 observations. This leads us to a very general constraint, namely that there is no 'overarching' acceptance of protected areas (Liebecke et al., 2008, 2011) but rather slightly differing attitudes on several topics, which finally lead (or do not lead) to actions in favour of or against the PA. This implies that 'acceptance' analyses, also in the case of tourism, require sophisticated measurement tools, including a range of parameters, to capture the overall attitude of residents on a much more differentiated level.

3.6 Supplementary publications

The publication *Measuring sustainability in tourism – development of a tourism sustainability satellite account* (Appendix I), aimed to create a national indicator system for Germany that would provide an empirical overview of the sustainable development of tourism over time and in relation to the economy as a whole. For this purpose, we identified eighteen sustainability indicators and calculated them, using a combination of German National Accounts and German Environmental-Economic Accounts. The indicator scheme is designed as an expanded tourism satellite account with the addition of ecological and social sustainability indicators. The research project was part of the global initiative Measuring the Sustainability of Tourism (MST), by the World Tourism Organisation, which is developing a general statistical framework for the collection of sustainability-related data on tourism (UNWTO 2017b). The results of this publication were an important baseline and starting point for several conceptual ideas outlined in this thesis, with the aim of applying similar methods on a subnational tourism level, especially regarding climate accounting principles, economic impact analyses and tourism acceptance, elaborated herein as park-people relationships.

The report *Estimating the effects of German outbound tourism on sustainability in visited countries* (Appendix II) emphasises the 'polluter pays' principle for sustainability assessments in tourism, by evaluating several related studies from the perspective of the country from where tourism demand originates (outbound tourism). It argues that tourism-related impacts occur not only in destinations, but also, for example, in the case of transportation, during the journey to and from the destination. The results of this report show that this perspective is still widely missing in sustainability assessments. Thus, it was a specific motivation for my further research to include the 'polluter pays' principle in the undertaken analyses, especially regarding the environmental impacts of tourism.

The publication *Sustainability in tourism: developments, approaches and clarification of terms* (Appendix III) summarises general principles underpinning the idea of sustainable development in tourism. In essence, it highlights substantive aspects and developments in the sustainability debate and explains how these can be used to define sustainability in tourism. The study aims to help clarify the term 'sustainability in tourism' in the German-speaking context, in order to foster consensus regarding German tourism policy. Several aspects of the report supported my desire to implement in-depth reviews about sustainability assessments and the principles of carbon management in tourism.

The practical report *On the way to climate neutrality in tourism destinations. Guide to climate accounting in tourism* (Appendix IV) presents specific cases for a comprehensive assessment of

tourism-specific GHG emissions, by applying both bottom-up and top-down climate accounting approaches for subnational tourism destinations. It describes the specific approaches taken for both methods and presents outcomes of tourism-specific GHG assessments for the city of Berlin, the province of Mecklenburg Western Pomerania and the local Northern Black Forest. The report is a practical continuation of the work presented here in Chapters III and IV and represents a first pilot study for applying GHG accounting methods for German tourism destinations.

The paper *Is sustainable tourism rising as a phoenix from the crisis?* (Appendix V) was a first reflection on the impacts of Covid-19 on tourism development. It argues that setting up strong cooperation models and sustainability-based strategies will offer opportunities for tourism innovations in the long run. Based on expert interviews, the paper concludes that tourism activities will have to meet new requirements in terms of hygiene, health and safety, which arise from the corona situation and are perceived by guests as a new basic quality. These new qualities will be linked to criteria associated with environmentally friendly business practices, regional identity and social responsibility. The paper provided me with some general guidance on the further research implications of this thesis, especially depicting the three main parameters carbon management, local economic values and tourism acceptance as examples of new tourism 'qualities'.

The publication *Effects of Covid-19 on visitation and tourism in the protected areas of the Pomerania region* (Appendix VI) includes research that is directly related to Chapters V and VI, as it empirically presents the effects of the coronavirus pandemic on tourism in selected PAs in the Pomerania region, covering the perspectives of residents (directly related to Chapter VI), the demand side (directly related to Chapter V) and the tourism industry itself. The study was an important complement for the overall empirical research undertaken in the Pomerania region, thereby providing further insights especially for PA management.

4. Synthesis

This last section of the framework paper synthesises insights and findings from my presented research by focusing on theoretical, methodological and practical contributions and offers a general critical reflection.

4.1 Theoretical contributions

This research contributes to the existing literature by exploring specific elements of tourism development that are currently challenging related models. It focuses on the advancement of monitoring and measurement approaches to improve destination sustainability performance with the support of sustainability assessments in tourism (SAT). From the literature, we found that the development of SAT has increased tremendously in the last decades (Vukadin, Zovko & Kresic, 2020; Rasoolimanesh et al., 2020; Asmelash & Kumar, 2019), in turn also creating unrealistic expectations in terms of sustainable tourism indicators leading to change (Font et al., 2021). In addition, authors claim that indicator schemes are not yet playing an instrumental and structural role in political decision-making (Crabolu et al., 2023; Miller & Torres-Delgado, 2023), the reasons for which are manifold, with some scholars demanding a more thorough systems

perspective (Kristjánsdóttir et al., 2017; Mai & Smith, 2015; Schianetz & Kavanagh, 2008) and others focusing on influencing factors for their non-use in decision-making (Bauler, 2012; Bell and Morse, 2011). Our systematic review showcased that there is a need to contextualise sustainability assessments and that the focus should be on advancing core issues that are of generally high global relevance and trigger sustainable tourism development, rather than intending to develop a standardised and most-suitable set of indicators for all destinations. This is not in conflict with current approaches that intend to embed SAT in complexity science, thus providing important insights into influencing factors that create stakeholder buy-in, active engagement and lead to policy changes for destination management (Crabolu, 2021; Font et al. 2021). My research rather complements such efforts by showcasing concrete use cases that mainly focus on the implementation of specific quantification approaches, in terms of conceptual backgrounds, methodological implications and measurability necessities. This also refers to the idea that indicators serve a political purpose, with the aim of choosing politically desired evidence to justify certain decisions (Gudmundsson & Sørensen, 2013; Hezri & Dovers, 2006). In the case of carbon accounting and economic impact analyses, it became evident that there is a range of possible accounting principles influencing the results, even though the amount of 'carbon emissions' will be perceived as one particular indicator. Therefore, it is necessary to explore different approaches in detail and to evaluate possible variations in outcomes, as we exemplify in Chapters III, V and VI.

Decision-making in complex systems such as tourism relies on information based on certain levels of agreement and certainty (Stacey, 2010; Head, 2010). A purely technical decision-making process, where data can be directly used to predict actions for the future, is almost unachievable in systems like tourism, which are often characterised by uncertainty, messiness and controversial ideologies (Head, 2015). Decisions for destination management are often confronted with low levels of agreement for certain actions, even though evidence is clear (for example, the choice of strategies in cases of low tourism acceptance), or they are unclear in terms of actual evidence, even though there is a high level of agreement (for example, reducing the impacts of tourism on the natural environment, without having empirical evidence on tourism effects). This is why current research uses complexity theory and design principles to support a more practical and applied approach to systems-based decision-making (Geyer and Cairney, 2015; Nijs, 2014; Cairney, 2012; Eppel & Rhodes 2017;). For sustainability assessments in tourism, aspects of complexity should be embraced by focusing on specific issues that foster different sustainability elements as the main drivers for change and encourage management or policymakers to take decisions that affect multiple sustainability issues. Different examples are provided in Chapters III, IV, V and VI. For example, in the case of carbon management, integrated climate action strategies will need to include measures that cut emissions drastically, including a shift towards more regionalised value chains that might provide alternative income possibilities for several tourism stakeholders and strengthen local economies. Thus, a significant part of this research attempts to investigate the potential variables (specifically climate management, economic value creation and local sentiments towards regional development) that act as enabling conditions for a wider implementation of sustainability strategies in destinations.

4.2 Methodological contributions

This research makes several methodological contributions to evaluating the environmental and socio-economic impacts of tourism. First, it addresses methodological considerations of sustainability assessments in tourism from a meta perspective by reviewing different concepts and accounting principles and applying them to different scales of tourism concepts. Thus, we attempt to integrate our considerations into wider conceptual and application-based spectrums, by providing different options for assessment contexts and including additional projections such as emission reduction potentials with the help of existing estimates, for example in our papers in Chapters III and IV. As such, this research contributes to work about recent critical evaluations of sustainability assessment methods by scholars such as Font et al. (2021), Rasoolimanesh et al. (2020), Asmelash & Kumar (2919) and Kristjánsdóttir et al. (2017), as well as contributions about climate accounting approaches in tourism by Sun & Higham (2021), Scott & Gössling (2022), Becken (2019), amongst others.

Additionally, we put several conceptual frameworks about trajectories for developing sustainable destination economies and tourism policy paradigms into context, such as the different orders of change by Hall (2011), the concept of the destination tripartite by Gössling & Higham (2020) or the explanatory model for attitudes and behaviours of local people in relation to protected areas by Mayer & Stoll-Kleemann (2016). In these cases, we attempt to clarify their ideas by depicting specific parameters, reviewing them in detail and then applying them to concrete cases in selected regions.

Furthermore, we apply modern and complex data collection and analysis methods with a focus on quantitative data collection methodologies, as presented in Chapters V and VI, as a well as in Appendix VI. In particular, we demonstrate in the case of tourism impact analyses in protected areas, that data collection may be facilitated by applying I/O-models in combination with interviews. Also, we experimented on ways of making economic impact assessments more cost-efficient and practical, as proposed in Spencely et al. (2021). The outcomes and learnings herein can support other scholars when setting up similar assessment approaches. With regard to park-people relationships, we were able to generate a remarkable sample-size for a peripheral, cross-border region by applying CATI and thus elaborated on a range of potentials of and barriers to this method for data analysis and the robustness of results. Overall, this may open up opportunities for other researchers seeking to identify causalities when investigating residents' sentiments towards tourism development through quantitative approaches.

4.3 Practice contributions

A substantial ambition of my research was to contribute to current practices of tourism governance and SAT applications. The recent development and implementation of tourism sustainability indicator schemes for decision-making has received a lot of attention from international and national tourism institutions. They strive to create standardised approaches for sustainable tourism monitoring, with the aim of creating consistency in methodologies and comparability between destinations. Examples are the UNWTO initiative 'Measuring Sustainability of Tourism' (UNWTO, 2017b) and the International Network of Tourism Observatories (UNWTO, 2022), several national OECD projects on tourism indicator schemes

(OECD, 2022), funded by the EU Commission or the recently published EU Tourism Dashboard by Eurostat (2023). There is a clear tendency to establish ambitious sets of sustainability indicators as comparable information systems for tourism decision-making. Most of them, however, lack specific methodological approaches, remain on the national scale or have a tendency towards simplified and reductionist parameters without being tourism-specific. As shown in this research, such 'indicator lists' fall short in their applicability on the subnational destination level and may result in a missing practical implementation. As in the case of carbon accounting, a recent review study by the UNWTO (2023) on methodologies and tools for measuring GHG emissions concluded that destinations rarely have tools or support instruments when seeking to measure emissions. Similar situations apply to estimating the economic impacts of tourism and tourism acceptance on the regional or local level. Thus, this research provides some clarifications about certain measurement methodologies and could thus enhance ongoing debates about specific issues. As briefly presented in Appendix IV, some recommended approaches for carbon accounting have already been developed further by us, published as a practical guide and applied in several German tourism destinations, mainly implementing the recommendations made by Chapters III and IV.

The thesis also supports participatory processes, stakeholder buy-in and the active engagement of tourism stakeholders in destinations. Part of the empirical research presented in Chapters V and VI involved the implementation of dozens of scientific planning meetings, conceptual workshops with local tourism stakeholders and dissemination events for a wider interested audience. The results for Chapters II and III were also presented at several regional, national and international tourism events, partly as a result of invitations received from tourism policy institutions such as ministries, tourism associations or international bodies such as the UNWTO. This ensured the overall practical relevance of each of the presented chapters and will hopefully generate further significant impacts for the industry.

4.4 General critical reflection

In addition to the already presented individual chapters, the thesis was confronted with some general constraints and research gaps at both the methodological and the conceptual level while conducting the research. A main limitation relates to the coronavirus pandemic during the research period, which resulted in adapting the overall research and influenced the coherence of parts of the thesis. Thus, I decided to place stronger emphasis on conceptual elements of the thesis and elaborated more on specific topics such as climate management. In addition, we included Covid-19 effects on tourism in our empirical research, in order to gain more knowledge on actual impacts for destinations. However, due to the various lockdown periods and social distancing regulations, we also had to adapt parts of the empirical research, focusing more on offsite methodologies such as CATI and stopping personal interviews. Furthermore, a business survey we conducted, which aimed to provide more information about the environmental and social sustainability aspects of tourism businesses, with the intention of combining environmental and economic sustainability impacts, did not deliver satisfactory results, which meant it was not considered herein.

Another constraint (and strength) of the thesis is the choice of specific sustainability issues as conceptual and empirical cases. There might be the impression of arbitrary selection and that any other indicators could fulfil the same purpose of being chosen as focal points. This notion is countered with recent literature such as by Gössling & Higham (2021), Scott, Hall, & Gössling (2019), Sharpley & Telfer (2015) and Schilcher (2007), all of whom point to the pressing need for tourism destinations to explicitly provide solutions for low-carbon tourism, maintaining local incomes and employment benefits as well as assuring positive community sentiments towards tourism – all of which are the main drivers of future destination management. In addition, these aspects cover important topics in relation to the main sustainability dimensions and therefore reflect specific sustainability issues. Finally, choosing these issues meant that it was possible to explore them in great detail and to empirically experiment on different assessment approaches, which would not have been possible otherwise.

Finally, as outlined at the beginning of this chapter, the thesis takes a rather pragmatic and application-based perspective, referring as it does to several theoretical concepts and frameworks. This comes with a certain degree of difficulty in terms of clinging on to a single theory as an overarching topic, other than the general concepts of transition, systems understanding and resource economics. Backed up by these general ideas, the thesis deliberately provides specific solutions of evidence-based information for destination managers, to help them cope with existing transformative challenges.

5. Conclusion

This thesis is part of recent efforts to establish profound and effective measurement approaches for sustainable tourism. It highlights that concrete assessment tools are needed for evidence-based decision-making and the establishment of effective actions in destination management. Sustainability assessments need to be better contextualised, and unrealistic expectations of constructing ideal schemes will need to be adapted. The thesis supports the idea that assessments should focus on specific issues that foster different sustainability elements as the main drivers of change and encourage management or policymakers to take decisions that affect multiple sustainability issues. It also addresses methodological considerations of sustainability assessments in tourism from a meta perspective by reviewing different concepts and accounting principles. In addition, it looks at conceptual frameworks about developing sustainable destination economies with a specific emphasis on carbon accounting, economic value creation and local sentiments. The thesis empirically evaluates and applies these issues in specific cases, with the help of quantitative data collection methodologies. Overall, the research provides clarification about certain measurement methodologies and will enhance ongoing debates about the sustainability impacts of tourism. Thus, the findings of this research are of value to tourism managers and international organisations involved in designing, promoting and implementing sustainability assessments.

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Chapter III

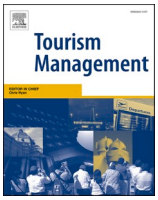
A review of tourism and climate change mitigation: The scales, scopes, stakeholders and strategies of carbon management

Tourism Management 95 (2023) 104681

Contents lists available at ScienceDirect

Tourism Management

journal homepage: www.elsevier.com/locate/tourman



A review of tourism and climate change mitigation: The scales, scopes, stakeholders and strategies of carbon management

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ARTICLE INFO

Keywords:
Climate change
Decarbonization
Destination management
Net-zero emissions
I/O analysis
Science-based targets

ABSTRACT

Tourism needs to reduce emissions in line with other economic sectors, if the international community's objective of staying global warming at 1.5°-2.0 °C is to be achieved. This will require the industry to half emissions to 2030, and to reach net-zero by mid-century. Mitigation requires consideration of four dimensions, the Scales, Scopes, Stakeholders and Strategies of carbon management. The paper provides a systematic review of these dimensions and their interrelationships, with a focus on emission inventory comprehensiveness; allocation principles at different scales; clearly defined responsibilities for decarbonization; and the identification of significant mitigation strategies. The paper concludes that without mitigation efforts, tourism will deplete 40% of the world's remaining carbon budget to 1.5 °C. Yet, the most powerful decarbonization measures face major corporate, political and technical barriers. Without worldwide policy efforts at the national scale to manage the sector's emissions, tourism will turn into one of the major drivers of climate change.

1. Introduction

The world has agreed to stay global warming at 1.5° to 2 °C compared to pre-industrial levels, for which it will be necessary to reduce emissions of greenhouse gases to net-zero by mid-century (IPCC, 2022a; UNFCCC, 2018). As a result, there is a pressing need to identify strategies that can significantly reduce emissions throughout the world economy. Tourism has considerable relevance for achieving this goal, as it includes various vital emission subsectors such as aviation, and is estimated to have been responsible for 8% of global CO_2-equivalent emissions in 2013 (Lenzen et al., 2018). Tourism is also a growth sector, further emphasizing the importance of mitigation (Gössling & Peeters, 2015), specifically since a COVID-19 rebound is evident and future high growth rates are expected (ICAO, 2020; UNWTO, 2022). Carbon management, including CO_2 as well as other greenhouse gases, is thus a key management challenge for the sector (Gössling, 2011).

This paper reviews the literature on climate change mitigation. To this end, an analysis of the situation is followed by the introduction of the S4C model of carbon management that considers four key dimensions of decarbonization: Scale, Scope, Stakeholder and Strategy. Any science-based decarbonization trajectory relies on the measurement of a range of greenhouse gases along the supply chain (scope), including global, national, subnational and firm perspectives (scale). Questions of transparency and accountability need to be resolved to determine responsibilities for mitigation (stakeholder). Measures to significantly reduce emissions (strategy) are identified. Based on the S4C model, recommendations are then made to advance net-zero goals in tourism.

1.1. Global climate stabilization goals and tourism

The IPCC (2022a) reports that global net anthropogenic greenhouse gas emissions amounted to 59 ± 6.6 $GtCO_2$-equivalent in 2019, 54% more than in 1990. There is consequently an acceleration in emissions that adds to the historical built-up of CO_2 in the atmosphere. The IPCC (2022a) concludes that historic emissions of CO_2 (1850–2019) have increased global temperatures to two thirds of 2 °C (67% probability), with 2 °C being defined as the upper limit for acceptable warming, and a desirable 1.5 °C limit. This has been agreed on by the international

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https://doi.org/10.1016/j.tourman.2022.104681
Received 26 July 2022; Received in revised form 18 October 2022; Accepted 19 October 2022

community in the Paris Agreement (UNFCCC, 2018). Staying global warming at this level implies that a total amount of 890 $GtCO_2$ can still be emitted before the critical temperature threshold of 2 °C will be exceeded. The amount represents the remaining carbon budget, within a range of 640–1160 Gt CO_2 (67% probability to 2 °C; IPCC, 2022a). To stay within the more desirable limit of 1.5 °C, a carbon budget of 510 $GtCO_2$ remains before this objective is no longer achievable with reasonable likelihood (medium estimate, >50% probability; IPCC, 2022a).

The COVID-19 pandemic has led to a short-term decline in emissions (Le Quéré et al., 2021; Friedlingstein et al., 2022). At the time of writing in July 2022, a rebound in many economic sectors including tourism is evident, though the Ukraine war has disrupted global fuel and commodity chains. This has caused significant inflation and fears of recession (IMFBlog, 2022), and a rise in fuel costs (Trading Economics, 2022). However, there is currently limited evidence that global emissions of greenhouse gases decline in significant ways (Eurostat, 2022).

Continued growth in emissions is problematic in any economic sector, as steep cuts are needed in the immediate future to avoid depleting the remaining carbon budget (IPCC, 2022a). To stay within 1.5 °C will "require global greenhouse gas emissions to peak before 2025 at the latest, and be reduced by 43% by 2030" (IPCC, 2022b, no page). The European Union is currently the only region that has adopted science-based decarbonization targets, with pledges to cut emissions by 55% by 2030, compared to 1990 levels, and "climate neutrality" by mid-century (European Commission, 2022). However, some important economic sectors, such as international aviation or shipping, are not fully covered under this policy (Joung, Kang, Lee, & Ahn, 2020; Lyle, 2018). China, Russia and other significant countries are not committed to required emission reductions: For example, China seeks to "peak" in emissions "before 2030", while the Russian Federation aims to reduce emissions by 30%, accounting for the "maximum absorptive capacity of forests" and subject to "balanced social economic development" (UNFCCC, 2022; quotes from national submissions).

Tourism is a significant contributor to emissions of greenhouse gases, for which various assessments have been presented over the years (Table 1). Early global estimates concluded that transportation, accommodation and activities are responsible for about 5% of global direct energy use and emissions (Gössling, 2002; UNWTO, UNEP & WMO, 2008). A more recent analysis by Lenzen et al. (2018), including more sub-sectors, found that tourism is responsible for 8% of warming from CO_2 and other long-lived greenhouse gases (methane, nitrous oxide, hydrofluorocarbons, chlorofluorocarbon, sulfur hexafluoride, nitrogen trifluoride) in the year 2013, an estimate that includes indirect emissions from suppliers. This is equivalent to between 3.9 and 4.5 Gt CO_2-equivalent, and does not account for aviation's additional warming at flight altitude[1] Adding aviation's non-CO_2 contribution to climate change on the basis of an effective radiative forcing weighting increases tourism's contribution to global warming to 10% in 2013. No recent scientific assessments of the magnitude of emissions from tourism are available, though WTTC-UNEP-UNFCCC's (2021: p. 13) "net-zero" report suggests that tourism may have emitted some 5.4 $GtCO_2$-equivalent in 2019[2] (not including aviation non-CO_2 warming). As shown in Table 1, transport is by far the most important contributor to emissions, specifically road and air transport.

Aviation is the most important tourism subsector in terms of growth in emissions. Between 1960 and 2018, the sector grew by a factor of 6.8 to an estimated total of 1034 Mt CO_2 (Lee et al., 2021). An estimated 75% of this fall on commercial passenger transport, including a 4% share of private aviation (Gössling & Humpe, 2020). Further growth is expected in the sector's post-COVID rebound and longer-term developments: Industry expects that aviation will double or even triple to 2050 (ICAO, 2020). Apart from its central role in emission growth, aviation is also of relevance in the context of responsibilities for mitigation, as only a small share of its emissions is covered by existing legal frameworks (Gössling & Humpe, 2020).

Tourism is also poised to grow as an overall system. Its resource and emission-growth dynamics have been illustrated by UNWTO, UNEP & WMO, 2008, Gössling and Peeters (2015) and Lenzen et al. (2018). National studies pointing to continued emission growth in tourism include China (Meng, Xu, Hu, Zhou, & Wang, 2016), New Zealand (Sun & Higham, 2021), Portugal (Robaina-Alves, Moutinho, & Costa, 2016), Sweden (Gössling & Hall, 2008), Spain (Cadarso, Gómez, López, Tobarra, & Zafrilla, 2015), Taiwan (Sun, 2016), or Norway (Sun, Gössling, & Zhou, 2022). Continued growth is also expected by industry (WTTC-UNEP-UNFCCC, 2021; see also Table 2), with the UNWTO (2022) acknowledging that even though there is an 'ambition' to *half* emissions from tourism by 2030, the likely scenario is a 25% increase.

The paradox of continued growth expectations and simultaneous hopes to see very significant emission reductions is evident in all industry documents (Table 2). For instance, ICAO (2016b), IATA (2021, 2022), and ATAG (2021) expect aviation to at least triple in its fuel use, and double in its emissions in the period 2020–2050. In terms of measures to reduce emissions, it is emphasized that air travel will become more efficient and that a share of emissions will be "abated". Currently not existing technologies are proposed as future solutions, including significantly more costly sustainable aviation fuels. Offsetting remains a major part of its strategy, with a focus on afforestation. While a role of government is acknowledged, carbon taxes are rejected by the sector. These contradictions mirror a lack of viability and reliability (Gössling & Lyle, 2021; Grewe et al., 2021; Guix et al., 2021; Peeters, Higham, Kutzner, Cohen, & Gössling, 2016). As Table 2 indicates, this is equally true for tourism more generally.

1.2. Mitigation challenges

Fig. 1 illustrates the mitigation challenge for tourism, depicting expected emission growth (red dotted line) in comparison to the "ambition scenario" presented by WTTC, UNEP & UNFCCC (2021; green line), and a trajectory towards net-zero emissions aligned with a 1.5 °C objective in reference to IPCC (2022b, blue dotted line). The figure reveals two important insights: First, there is a discrepancy between sector's expected growth in emissions, the less likely "ambition scenario", and necessary emission reductions to stay within 1.5 °C. As the preceding section has revealed, it is unclear how the gap between these trajectories will be closed. Expected annual growth rates of 3% (aviation) and 5% (all other tourism-related industries) (WTTC-UNEP-UNFCCC, 2021) are in stark contrast to a necessary reduction by 5% per year from current levels (linear integration to net-zero). To align growth expectations and decarbonization needs requires decarbonization at a rate of 8%–10% per year. Such rates are impossible to achieve. For comparison: In 2020, the first year of the COVID-pandemic, global emissions declined by an estimated 6% (Friedlingstein et al., 2022). Notably, aviation almost completely suspended its operations, illustrating the systemic implications of very steep mitigation trajectories.

The impossibility of accommodating further growth and emission reductions aligned with scientific targets was already outlined in the UNWTO, UNEP & WMO, 2008 report "Climate Change and Tourism – Responding to Global Challenges". Even in the most ambitious mitigation scenario, the sector's emissions were projected to fall by just 16% (2005–2035) if growth continued. National studies confirm this. For example, research for Norway has shown that under a continued tourism

[1] Aviation is not easily compared to other emission sub-sectors, because of this sub-sector's contribution to non-CO_2 emissions, i.e. contrail cirrus and cirrus cloudiness, as well as nitrous oxide emissions. At flight altitude, these make additional, though short-lived contributions to warming. Integrated as effective radiative forcing, non-CO_2 warming renders aviation's contribution to global warming three times larger than from CO_2 alone (Lee et al., 2021).

[2] Own calculation based on a 17% share of emissions from aviation (915 Mt CO_2) detailed in the report.

Table 1
Global tourism emissions (Mt and percentages).

Source	Gössling (2002)	WTO-UNEP-WMO (2008)	Peeters and Dubois (2010)	UNWTO & ITF (2019)	WTTC-UNEP-UNFCCC (2021)	Lenzen et al. (2018)
Reference year	2001	2005	2005	2016	2019	2013
Subsectors included						
Agriculture						353 (8%)
Mining						121 (3%)
Food						194 (4%)
Goods						534 (12%)
Utilities						0 (0%)
Construction						139 (3%)
Trade						0.2 (0%)
Hospitality unspecified						58 (1%)
Accommodation	81 (6%)	274 (21%)	275 (24%)		324 (26%)	282 (6%)
Food & beverage serving						227 (5%)
Transport unspecified		45 (3%)	38 (3%)	76 (5%)	27 (2%)	871 (20%)
Road transport	680 (49%)	420 (32%)	305 (26%)	671 (46%)		602 (14%)
Rail transport	108 (8%)			20 (1%)		55 (1%)
Air transport	467 (33%)	515 (40%)	504 (43%)	679 (47%)	915 (72%)	547 (12%)
Water transport	8 (1%)					98 (2%)
Services	55 (4%)	48 (4%)	48 (4%)			350 (8%)
TOTAL	1399	1303	1170	1446	1266	4430
Contribution to global CO_2-equivalent emissions	5.3%	2.8%	2.5%	2.9%	2.5%	8.0%
Including air transport with a factor 3[a]						
Air transport (Mt CO_2-equivalent)	1401	1545	1512	2037	2745	1641
TOTAL	2333	2333	2178	2804	3096	5524
Percentage of air transport emissions	60%	66%	69%	73%	89%	30%
Sector's contribution to global CO_2-equivalent emissions (%)	8.8%	5.0%	4.7%	5.7%	6.2%	10.0%
Scopes included						
Visitor expenditure						
Transport	v	v	v	v	v	v
Accommodation	v	v	v		v	v
Activities	v	v	v			v
Food						v
Shopping						v
Emissions						
Direct effect (scope 1 + scope 2)	v	v	v	v	v	v
Indirect effect (scope 3)						v

[a] Calculation considers aviation's effective radiative forcing at flight altitude at three times the warming of CO_2.

growth scenario, country-wide decarbonization rates would have to be 30 times higher than observed rates to approach net-zero by 2050 (Sun, Gössling, & Zhou, 2022). Decarbonization challenges for tourism have now been repeatedly outlined (Becken, 2019; Becken, Whittlesea, Loehr, & Scott, 2020; Gössling, Humpe, Fichert, & Creutzig, 2021; Scott & Gössling, 2022; Scott, Peeters, & Gössling, 2010), with the central conclusion that tourism will not achieve carbon-neutrality under continued growth scenarios.

Fig. 1 highlights a second insight of importance, i.e. the difference between immediate (blue dotted line) and postponed mitigation efforts, as in WTTC-UNEP-UNFCCC's (2021) "ambition scenario" (green line). Following the decarbonization trajectory of the "ambition scenario" will mean that the carbon budget will be depleted much faster than in the rapid reduction scenario represented by the blue dotted line. Even greater is the gap between a business-*as*-usual and a 1.5 °C reduction scenario. In terms of absolute emissions, the difference between the 'worst' (red line) and the desired (blue line) trajectory may amount to several hundred Gt CO_2 between 2022 and 2050.

At continued emission rates of about 5 $GtCO_2$-equivalent per year (Table 1), tourism is likely to become a major factor in the depletion of the remaining carbon budget. If growth cancels out efficiency gains, the sector will emit 200 $GtCO_2$-equivalent over the period 2022–2050. This will deplete 22.5% of the remaining carbon budget to 2 °C, and 40% of the budget to 1.5 °C. The estimate underlines the need for tourism to engage in immediate decarbonization efforts, and to critically assess the implications of continued growth.

2. Methodology

As the preceding sections suggest, decarbonization involves four interrelated and interdependent dimensions, here described as the four S of carbon management: Scale, Scope, Stakeholder, and Strategy (Fig. 2).

- "Scale" refers to the level at which emissions can be measured or mitigation strategies be devised and implemented, i.e. the global, national, destination (sub-national) or business-level.
- "Scope" is the most complex dimension, as it defines the emissions to be included or excluded. There are four elements of Scope: (1) the subsectors to be included, such as accommodation, transport, activities, food or shopping; (2) the visitor segments to be considered with respect to domestic tourism, inbound tourism and outbound tourism (allocation), (3) the extent of the supply chain that is evaluated, for instance in terms of scopes 1–3 at the business level, or direct and indirect emissions at the destination level, and (4) the type of emissions that are included: CO_2, other long-lived greenhouse gases, and the non-CO_2 warming from air transport. Ultimately, the decision to include certain components is guided by allocation principles and data availability.
- "Stakeholder" defines accountability, i.e. the question as to who is responsible for reducing emissions. Without clearly assigned responsibilities, progress on decarbonization is unlikely. Responsibilities may be assigned to multiple stakeholders, as any country's pledges to reduce emissions have to be passed on to businesses, as well as consumers. Policymakers are thus relevant at different scales, as they implement legal frameworks setting common

Table 2
Industry perspectives on growth and decarbonization.

Sub-sector	Growth & decarbonization	Measures proposed	Responsibility
Aviation: ICAO (2016b)	Fuel consumption growth by a factor 2.8 to 3.9 (2010–40), and a factor 4–6 (2010–50). "Carbon-neutral growth" means continued emissions of 1 $GtCO_2$ per year	• Advancements in aircraft technology • Operational improvements • Sustainable alternative fuels • Carbon offsets No absolute target	Unclear.
Aviation: IATA (2021)	Emissions double between 2020 and 2050 21.2 Gt CO_2 "abated" between 2020 and 2050; 90% of mitigation through offsetting (2020–2030) 50% of mitigation through offsetting (2030–2040)	• Sustainable aviation fuels: 65% • Offsetting/carbon capture: 19% • New technologies: 13% • Infrastructure/operations improved: 3% Opposes carbon taxes.	Airlines, governments (regulations, frameworks, incentives), aircraft and engine manufacturers, fuel-producing companies, airports, air navigation services providers
Aviation: ATAG (2021)	Growth in emissions to 2 Gt CO_2 in 2050. Compound annual growth rate between 2.3 and 3.3% 2019–2050 Net-zero in 2050	• New technologies lead to 12–34% emission reduction in 2050 • Infrastructure/operations: 7–10% • Sust. aviation fuels: 53–71% • Out-of-sector market-based measures: 6–8%	Aviation sector, governments/policy makers, energy industry, finance community, research institutions
Cruises: Oxford Economics/CLIA (2021)	Net-zero in 2050 CO_2 emissions reduced −40% in 2030 (compared to 2008)	• Technological improvements • More operational efficiency • Shore-side power • Alternative/zero-carbon fuels	Cruising industry, governments/regulators, fuel processing industry
Hotels: Sustainable Hospitality Alliance (2017)	Further strong growth expected. Emissions reductions of 89.5% (2010–50) necessary (to stay within 2 °C) 66% emission reduction by 2030, half of which is achieved by hotels.	• Increasing efficiency of equipment and operations • Renewable energy use • 'Electrification' • Restructuring and innovation of operations	Hotel owners cooperate with stakeholders in the value chain and destination, involve guests
Tourism (all sub-sectors): WTTC-UNEP-UNFCCC (2021)	Compound annual growth rate: 3% for aviation; 5% for other industries (2023 onwards). All businesses should aim to reach net zero "as soon as they can".	Accommodation: • Energy efficiency improvements • Operational improvements • Sustainable procurement and sustainable sourcing • Transition to low carbon energy • Reducing waste Tour Operators • Trip footprint • Office energy & waste • Other business travel Aviation • Improvements to existing aircraft technology • New aircraft technology • Operational efficiency • Sustainable Aviation Fuels Cruises • Operational efficiency • Lower carbon fuels • Efficient technologies • New technologies OTAs & TAs • Lower carbon energy sources • More sustainable business travel • Office improvements • Procurement • Consumer and partner education	Unclear. Highlights the need for collaboration in and beyond value chains; important roles for governments/public sector.

Source: ATAG, 2021; IATA, 2021; Oxford Economics/CLIA, 2021; Sustainable Hospitality Alliance, 2017.

rules for mitigation, which may include national, sub-national (destination), or business levels.

- "Strategy" is concerned with the mechanisms of emission reductions in significant ways, through the principles of Avoid, Reduce, Substitute and Remove as originally devised by IEMA in 2009 (IEMA, 2022).

The review and analysis of the literature in this paper follows the S4C model. To advance a state-of-the-art understanding of these dimensions, a combination of a thematic and systematic literature review (Bryman, 2016) was conducted. This includes a qualitative/quantitative view on Scale and Scope, and a qualitative evaluation of Stakeholder and Strategy. This approach is favored because a considerable number of papers have delved into the complexities of Scope, allowing for a

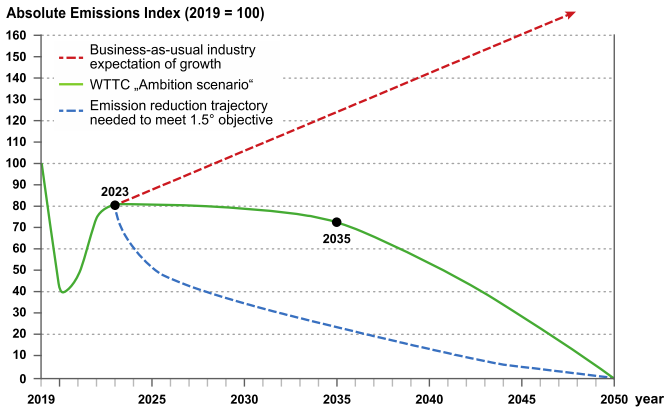

Fig. 1. Growth in tourism and global carbon budget.
Source: based on IPCC (2022b), WTTC-UNEP-UNFCCC (2021).

Fig. 2. The four S of carbon management.

quantitative analysis of this aspect. Emphasis is also put on this issue because mitigation relies on the understanding of where emissions occur.

Relevant papers were identified through two processes. First, the curated database on tourism and climate change (Scott & Gössling, 2022) identifies a total of n = 155 papers focused on greenhouse gas emissions, mitigation and carbon management in tourism, published between 1986 and 2020. This database underlies the qualitative part of the analysis, updated based on online searches for the period 2021–2022 (using Google Scholar and EBSCO). In a parallel process, a specific search for papers on emission assessment frameworks was conducted using the Web of Science, including peer-reviewed papers published over the past two decades (2002–2022). To identify papers, "tourism" was searched in combination with 'carbon', 'climate change', 'mitigation', 'emissions', and 'greenhouse gas'. This yielded a total of n = 117 studies in the initial search, which were screened for relevance in regard to assessment frameworks. A total of n = 58 papers were removed as irrelevant, and another n = 7 published in languages other than English. The remaining n = 51 papers were checked for omissions by a screening of their reference lists, which in an iterative search led to the identification of another n = 11 papers of relevance. Overall, n = 62 papers were considered relevant for the quantitative evaluation.

The qualitative evaluation of the literature focuses on an account of developments in the field over the past 25 years. Relevant knowledge is again summarized in relation to the S4C model. In regard to strategy, the identification of the most significant opportunities to reduce emissions is not straight forward. While measures for decarbonization have been presented by industry (ATAG, 2021; IATA, 2021; ICAO, 2016b; Oxford Economics/CLIA, 2021; McKinsey, 2022; Sustainable Hospitality Alliance, 2017; WTTC-UNEP-UNFCCC, 2021), reports lack validity and reliability, as illustrated by ICAO's CORSIA scheme (Gössling & Lyle, 2021).

The assessment of the five largest emissions sub-sectors thus raises the question of the significance of measures to achieve emission reductions, specifically since some of the most relevant measures appear to be politically 'taboo' (Gössling & Cohen, 2014). For example, air travel in private aircraft or premium classes causes multiple times the emissions of travel in economy class. Banning these most energy-intense forms of travel will only affect the convenience of a small share of air travellers, and not affect the transport function of aviation. Even though some discussion of private air transport has emerged recently (The Wall Street Journal, 2022), it is less likely that policymakers will adopt such measures globally. Complexities such as these are outlined, and the measures proposed for the subsectors consequently represent opportunities that also illustrate barriers to decarbonization. Mitigation options are derived from the literature, compared, and evaluated regarding potentials. This follows an expert-based approach that is necessarily subjective and indicative.

Quantitative data is generated and evaluated only in the context of 'scale' and 'scope'. This process was guided by an evaluation scheme, focused on relevant categories related to the S4C model, i.e. spatial focus, purpose, assessment method, allocation principle, visitor segment, subsectors, comprehensiveness, consideration of greenhouse gases, and assessment standard. To identify these, variables were coded as multinomial or binary categories or open text fields; the latter were then restructured into categories (Nowell, Norris, White, & Moules, 2017). The viability of this coding scheme was pre-tested on ten randomly selected publications before it was applied to all publications. A regular cross-check of results secured the consistency of the review-process.

A notable limitation of this paper is the exclusion of national Environmental Kuznets Curve investigations, which seek to determine whether the development of tourism increases or decreases the carbon intensity of an economy, and whether this has (in the past) or will (in the future) increase national emissions; often in scenarios where other economic sectors decline in importance. This body of research alone is significant, with one recent meta-study identifying n = 81 peer-reviewed studies published between 2013 and 2021 (Sun, Gössling, & Zhou, 2022). However, as findings of the meta-review suggest a low consensus on relationships, while studies fail to account for emissions from international air travel and global trade in products needed for tourism, a main conclusion is that this line of research needs methodological improvement to make valid contributions to the understanding of emission developments.

3. Results

3.1. Scale

Emissions from tourism have been investigated at scales ranging from individual firms to destinations (communities, cities, counties, states), national tourism systems, and as a share of global contributions to climate change. A general observation is that these studies can be distinguished by purpose, which may include the understanding of emissions from tourism as an economic sector, specific subsectors (accommodation, etc.), tourism products, markets, trips, or travel motivation (Becken, 2002; Becken, Frampton, & Simmons, 2001; Becken & Simmons, 2002; Eijgelaar, Thaper, & Peeters, 2010; Falk & Hagsten, 2021; Gössling, Ring, Dwyer, Andersson, & Hall, 2016; Whittlesea &

Owen, 2012). Assessments have included financial aspects, such as revenue, in relation to emissions (Gössling et al., 2005; Sun, Lin, & Higham, 2020) to gain longitudinal perspectives on emission growth and for comparison with other economic sectors (e.g. Sun, Lin, & Higham, 2020). As initially outlined for the global level, national studies are often not comparable, as they rely on different assessment frameworks (Gössling, 2013).

3.2. Scope

Tourism's contribution to climate change was overlooked for long periods of time, as the thinking was dominated by notions of tourism as a 'white', pollution-free industry (Kasim, 2006), in which the sector was only subsequently seen as having relevance for climate change. Since the early 2000s, studies have sought to develop frameworks for calculations of greenhouse gas emissions from tourism systems, and usually with an applied angle geared towards reductions. National, subsector-specific, or trip-specific assessments began to emerge in the 2000s (Becken, 2002; Becken et al., 2001; Becken & Patterson, 2006; Becken & Simmons, 2002; Patterson & McDonald, 2004). These relied on bottom-up or top-down methods to determine emissions. Bottom-up assessments aggregate emissions from all elements of travel consumption by tracking units of tourism service consumption (for instance on the basis of guest nights) and multiplying these by their energy use and emissions (emissions per guest night). Top-down methods use existing data, for instance for bunker fuels, to derive estimates of emissions. This omits 'indirect' emissions (Cadarso et al., 2015; Dwyer, Forsyth, Spurr, & Hoque, 2010; Filimonau, Dickinson, Robbins, & Reddy, 2013; Filimonau, Dickinson, Robbins, & Reddy, 2011). Bottom-up approaches are thus suitable for smaller regions at the sub-national level, individual tourism subsectors, or trips. At this level of analysis, their potential advantage is the provision of detailed emission profiles for specific travel activities with more limited data requirements. For firms, more detailed scopes of analysis were formally introduced in 2001, to provide accounting and reporting standards. These refer to direct emissions that are owned or controlled by a company (scope 1), indirect emissions from the generation of purchased electricity, steam, heat, or cooling (scope 2), as well as emissions caused by activities of a company, but not sourced or controlled by it (scope 3), for instance emissions from suppliers (Greenhouse Gas Protocol, 2022).

With the development of environmental accounting methods, comprehensive top-down assessment methods were introduced. These trace visitor expenditure throughout the economy and identify the corresponding impact (emissions) along the chains of production and distribution. Within this line of research, both environmentally extended input-output (EEIO) model and the more dynamic Computable General Equilibrium (CGE) model provide tools to assess the complete scopes of tourism emissions by subsectors, and in standardized territorial grids (such as emissions associated with imports and exports). Based on these models, tourism emissions have been analysed at global (Lenzen et al., 2018) and national level (Table 3), as well as larger subnational territorial levels (mostly level 2 of the international OECD classification; OECD, 2022).

As tourism is an economic activity that involves residents and

Table 3
Carbon inventory principles, national scale.

Principle/ Responsibility	Type of analysis	Description	Includes emissions from				Source
			Domestic tourism	Inbound tourism	Outbound tourism (market)	Outbound tourism (destination)	
Production (polluter allocation)	Kyoto Protocol Framework (KPF)	Emissions from production incurred within the national territory and offshore areas over which the country has jurisdiction	++-	+–	+–	—+	Eggleston, Buendia, Miwa, Ngara, and Tanabe (2006)
	Production-based approach (PBA)	Emissions directly produced by tourism industries, from imports used as inputs in producing goods and services to the country's tourism industry	+++	+++	++-	–	Dwyer et al. (2010)
	Tourism producer responsibility (TPR)	Emissions in an area that are linked to the supply of domestic tourism goods and services	+++	++-	++-	–	Cadarso et al. (2015)
	Production accounting principle (PAP)	Territorial emissions that are directly produced by tourism industries and their suppliers, disregarding where the good is consumed	++-	++-	++-	—+	Sun et al. (2019)
Consumption (beneficiary allocation)	Residence-based accounting (RBA)/ Consumption Accounting Principle (CAP)	Emissions allocated to the residence of tourists (national tourism)	+++	–	+++	++++	Lenzen et al. (2018) Sun et al. (2019)
Destination (recipient allocation)	Expenditure-based approach (EBA)	Emissions from expenditures by non-resident-based and domestic tourists on tourism in the country	+++	+++	+++	–	Dwyer et al. (2010)
	Total Tourism carbon footprint (TCF)	Tourism producer responsibility added with emissions to the target destination	+++	+++	+++	–	Cadarso et al. (2015)
	Destination-based accounting (DBA)	Emissions allocated to the tourism destination	+++	+++	+++	–	Becken and Patterson (2006) Lenzen et al. (2018)
	Tourism Satellite Accounting Principle (TSAP)	Domestic and foreign emissions that are produced to support all travel activities within the geographic territory of an economy	+++	+++	+++	–	Sun et al. (2019)

Pluses/minuses refer to included/excluded under inventory principle: +– domestic consumption; - + - air transport; – + imported goods; — + exports (only relevant in outbound tourism).
Source: adopted from Sun et al., 2019, Sun, Cadarso, & Driml, 2020, expanded.

foreigners travelling to national or international destinations, with expenditures in different locations, and services produced domestically and internationally, it is difficult to define the components to be incorporated in emission inventories at scales below the global. For example, if a tourist arrives in a country, is the country accountable for the visitor's emissions from travel to the country, the return to his home country, both, or none? In the absence of a common standard, Sun, Cadarso, and Driml (2020) propose three main guiding principles for national carbon inventories, which may be production, consumption, or 'destination' guided. These are summarized in Table 3, and may also be applied at the sub-national destination scale, for instance by communities, counties or states with the corresponding data. Production and consumption are common carbon accounting principles at the national and business level (Lenzen, Murray, Sack, & Wiedmann, 2007). The destination principle is specifically relevant given tourism's multi-sectoral character across various spatial scales. Emissions can be considered under the three general principles with the aim of specifying responsibilities, i.e. emissions allocated to producers in a specific destination (polluter allocation), the loci of tourism consumption (consumer or beneficiary allocation), or the territory where tourism activities occur (recipient allocation). The idea is to put the country of production, the country of consumption and the country of residence of travellers into perspective (Sun, Lenzen, & Liu, 2019).

Interrelationships between the three principles are illustrated in Fig. 3, which shows that there are eight emission components linked to domestic, inbound and international tourism. Each component can be interpreted as emissions generated by people from [country of residence] at [country of consumption] for consuming services produced by firms located at [country of production]. For example, cube 1 refers to emissions generated by foreign tourists within the destination for consuming services produced by domestic firms. Based on this system, complex allocation issues in tourism can be resolved, such as allocating responsibilities for international aviation emissions or supply chain effects. For example, Singapore airlines flying Australians from Sydney to London, would associate flight emissions with cube 2 for Singapore, cube 3 for the UK, and cube 8 for Australia. Depending on the allocation principles, these specific flight emission can then be assigned to Singapore (polluter allocation), UK (recipient allocation) or Australia (beneficiary allocation).

Details on principles and types of analysis are illustrated in Table 3 for national studies. The different scopes of tourism consumption (domestic consumption, air transport, imported goods, exported goods) determine the emissions included under each principle. Aviation is the most relevant subsector, and should not be omitted in assessments (Becken & Patterson, 2006; Dwyer et al., 2010; Sun, 2014; Sun et al., 2019; Sun & Higham, 2021). Imported goods for domestic production processes also influence total tourism emissions (Dwyer et al., 2010; Filimonau et al., 2013; Whittlesea & Owen, 2012), but their allocation varies depending on inventory principle.

Table 3 thus illustrates the complexities in using different accounting frameworks, and the incomparability of the results. Given the importance of national scale assessments, specifically in regard to

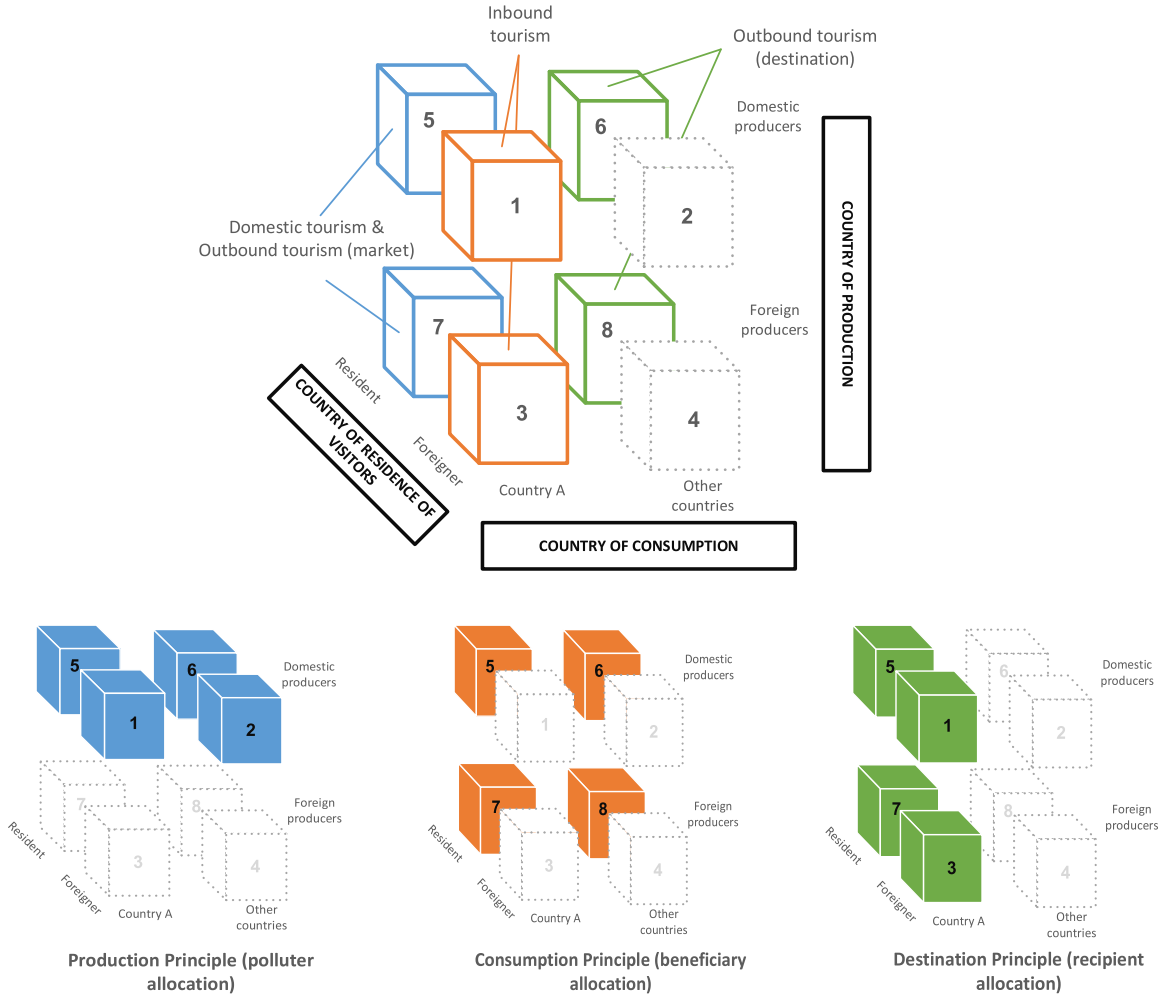

Fig. 3. Allocation principles based on country of production, country of consumption and country of residence of visitors.

accountability (Stakeholder) and decarbonization (Strategy), it is desirable that emission inventories be harmonized. Here, the TSAP that incorporates Tourism Satellite Accounts and the EEIO model based on the System of Environmental-Economic Accounting (SEEA), has been recommended by UNWTO . Acknowledging methodological limitations (Sun, Cadarso, & Driml, 2020, Sun & Wong, 2014), EEIO analyses provide robust and comparable approaches to national tourism carbon assessments, and account for all emissions in the system, including long-lived greenhouse gases (Cadarso, Gómez, López, & Tobarra, 2016; Cadarso et al., 2015; Sun et al., 2019). EEIO also allows for a differentiated consideration of emission sources, and the identification of high-emission subsectors (Sun, Gössling, & Zhou, 2022; Sun & Higham, 2021). As EEIO analyses integrate economic and environmental data, they can advise on mitigation strategies that are less economically disruptive, or inspire the definition of win-win markets (low emissions, high profitability) (Gössling et al., 2005; Gössling & Higham, 2021). EEIO analyses do not consider non-CO_2 emissions from aviation, which however can be integrated retrospectively.

The calculation of emissions at the sub-national destination scale – especially for jurisdictions below the national level (OECD territory 3, and below; OECD, 2022) such as a city or tourist region– is complex and there is no consensus on the most suitable approach (Cai, 2016; Dwyer et al., 2010; Hoque et al., 2010; Munday, Turner, & Jones, 2013; Tang & Ge, 2018; Tsukui, Ichikawa, & Kagatsume, 2017; Whittlesea & Owen, 2012). Destinations have to define emission scopes individually and are limited by data availability. There are trade-offs between comprehensiveness and effort. For instance, data collection from individual businesses in the destination is time-consuming, though it improves the quality of results and can serve the added purpose of engaging stakeholders in net-zero ambitions. At the state or province scale, regional Tourism Satellite Accounts or comprehensive visitor survey data may be available. EEIO approaches have been used in Shanghai, China (Tang & Ge, 2018); Wales, UK (Munday et al., 2013); South Tyrol, Italy (Cai, 2016); Tokyo and Kyoto, Japan (Tsukui et al., 2017); Auckland and Queensland, Australia (Pham, Meng, & Becken, 2022), and Scotland (Sun, Gössling, & Zhou, 2022). The scope of these subnational studies varies and international aviation emissions are often omitted.

Where no data is available, empirical studies often have collected information on energy throughput (direct energy use) for CO_2, hence omitting indirect emissions (Kelly & Williams, 2007; Konan & Chan, 2010; Kuo, Lin, Chen, & Chen, 2012; Rico et al., 2019). Their focus has often been on smaller units of analysis, such as tourism segments (El Hanandeh, 2013; Thongdejsri & Nitivattananon, 2019); sites (Li & Zhang, 2020; Susilorini et al., 2022; WWF Germany, 2013), cities (Rico et al., 2019; VisitValencia, 2019); events (Cooper & McCullough, 2021), or transport (Antequera, Pacheco, Díez, & Herrera, 2021; Boussauw & Decroly, 2021; Gunter & Wöber, 2022). Another group of studies has modelled emissions (Huang & Tang, 2021; Luo, Mou, Wang, Su, & Qin, 2020; Tang & Huang, 2021), used decomposition analyses (Yu, Bai, & Liu, 2019), or developed indices (Zha, He, Liu, & Shao, 2019; Zhang & Zhang, 2020).

A few studies combine top-down and bottom-up approaches at the subnational level and seek to overcome shortcomings of each method. Whittlesea and Owen (2012) for example developed and applied a hybrid I/O and activity-based destination and scenario emission tool for South-West England that allowed a calculation of direct and indirect supply-chain emissions for multiple subsectors with the support of primary business-data and EEIO. In addition, they also included scenario-based analyses and examined mitigation strategies and emission reduction potentials of tourism activities.

Last, at the business scale, emissions may be calculated following established frameworks and international standards such as ISO 14064 and ISO 14040 for the Corporate Carbon Footprint (CCF), ISO 14067 and PAS 2050 for the Product Carbon Footprint (PCF) or the Greenhouse Gas Protocol for general business-related emission calculations (Becken & Bobes, 2016). Other frameworks include the Hotel Carbon Measurement Initiative (HCMI), the Airport Carbon and Emissions Reporting Tool (ACERT), or the Carbon Management Tool for Tour Operators (CARMACAL). Benefits of these tools include a practical user-friendly access to GHG-assessments and opportunities for comparison on the basis of key performance indicators, such as energy use per guest night (Gössling & Peeters, 2015). These tools, however, are limited to direct emissions. The recent developments encourage the combination of the bottom-up approach with the EEIO method by leveraging the latter in tracking down indirect, higher order effects (Scope 3 emissions) (Crawford, Bontinck, Stephan, Wiedmann, & Yu, 2018; Malik, Egan, Du Plessis, & Lenzen, 2021).

Table 4 provides an overview of aspects with relevance in emission assessments, and studies that have discussed these. The table summarizes the issues discussed in the preceding section, and the need to consider various dimensions in assessments, starting with clearly defined system boundaries.

Fig. 4 analyses the sample of papers (n = 62) in regard to the main aspects of Scale and Scope, i.e. spatial focus, assessment methodology, allocation principle, sub-sectors, the comprehensiveness of assessment, and accountability. Note that total counts can exceed n = 62, as some studies include multiple approaches to specific aspects. Results show that 82% of the studies have analysed emissions at the national and subnational destination level, using predominantly top-down (37% of studies) and bottom-up methodologies (32%). Life Cycle Assessments (LCA) were applied by only seven studies, mostly in a business or product-related context. About half of the top-down and two thirds of the bottom-up approaches use destination-based allocation principles. About half of the analysed publications investigate multiple subsectors, one in ten is focused on single aspects of the tourism system, and one third uses a TSA-based approach. This is also reflected in the comprehensiveness of assessments, as a large share of papers (42%) only considers direct emissions. Last, a relevant finding is that a broad majority of papers (77%) assigned mitigation responsibilities to governmental bodies. This is discussed in the following section.

3.3. Stakeholder

To reduce emissions, it is necessary to assign responsibilities, as mitigation represents a cost. As Fig. 4 indicates, responsibilities are discussed in all of the papers reviewed, with a majority proposing key roles for policymakers at the national scale. Governments can implement policies, but mitigation efforts will ultimately rest with producers or consumers. Notably, industry reports such as WTTC-UNEP-UNFCCC (2022) or McKinsey (2022) see responsibilities for mitigation with firms, though they highlight roles for governments in providing incentives, subsidies, or financing Research & Development. Consumers, on the other hand, will primarily reduce their demand for carbon-intense goods and services when these are priced higher (Gössling & Dolnicar, 2022). There is currently limited evidence of climate governance in tourism contexts, specifically not in terms of a measurable decline in absolute emissions (Becken et al., 2020; OECD & UNEP, 2011).

A potential barrier to decarbonization are industry's persistent greenwashing efforts. Examples include the VW diesel deception (Aurand et al., 2018), and the automobility industry's efforts to water down legislation seeking to reduce emissions (Paterson, 2000). Airlines provide misleading information to customers (Guix, Ollé, & Font, 2022), while aviation industry sustainability targets proposed since 2000 have been found missed, abandoned, or no longer been reported on (Possible, 2022). Discourses on aviation technology 'solutions' rarely survive the headlines they generate, and have subsequently replaced each other (Peeters et al., 2016). Some jurisdictions have for this reason sought to increase transparency on emissions, in efforts to guide investors. For example, the European Union acknowledges that "the information that companies report is not sufficient" (EC, 2021, no page). To close the "accountability gap", the European Union's Corporate Sustainability

Table 4
Overview of aspects (scale & scope) in emission assessments.

Aspect	Categories				Source
Scale					
Spatial focus	Global	National	Subnational	Business	Sun and Higham (2021)
Purpose	Total/relative emissions	Intensities/eco-efficiencies	Targets/ benchmarking	Projections/scenarios	Sun et al. (2021)
Scope					
Assessment method	Top-Down Input-Output Analysis	Bottom-Up Multiplication	Bottom-Up Process Analysis (LCA)	Mixed Approaches	Whittlesea and Owen (2012) Wiedmann and Minx (2008)
Allocation principle	Production related Principle "polluter pays"	Consumption related Principle "beneficiary pays"		Destination related Principle "recipient pays"	Sun et al. (2019 & 2020b)
Visitor segment	Domestic	Inbound		Outbound	Patterson and McDonald (2004) Sun et al. (2019 & 2020b)
Subsector	Single	Multiple		TSA-specific	Becken and Patterson (2006)
Comprehensiveness	Direct (scope 1)	Indirect/induced (scope 2–3)			Filimonau et al. (2011)
GHG consideration	CO_2	CO_{2e}/non-CO_2			Hunter (2002) Gössling (2000)
Assessment Standard	GHG-Protocol	ISO 14064/PAS 2050	SNA		Gao, Liu, and Wang (2014) Becken and Bobes (2016)

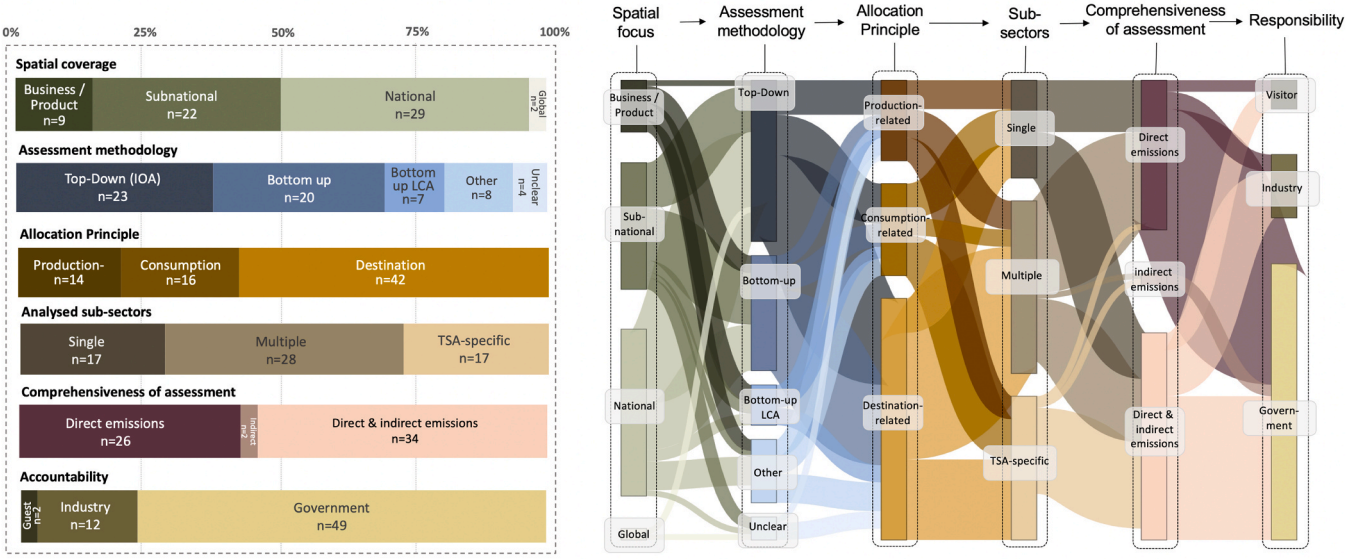

Fig. 4. Quantitative analysis of papers.

Reporting Directive will in the future force small and medium-sized enterprises to report on sustainability, and support the G20 initiative to introduce global sustainability reporting standards building on the Task Force on Climate-related Financial Disclosures' work. Results are intended to guide investors, with the European Central Bank already announcing to put greater emphasis on emissions in the future (Banking Supervision, 2022).

This points to the importance of assigning responsibilities at different scales (Table 5). At the global level, the Paris Agreement (UNFCCC, 2015) represents the world's consensus on stabilizing warming. It is an agreement ratified by nations, though non-binding in character: emission reductions have to be achieved at the aggregated national level. Countries thus submit Nationally Determined Contributions (NDCs) to the UNFCCC, in which they pledge to reduce emissions. These are

Table 5
Emission reduction responsibilities.

Scale	Ambition	Basis	Responsibility	Character	Mechanism
Global	Paris Agreement	Carbon budgets to 1.5 °C/2.0 °C	National ratification	Non-binding	Agreement
National	Nationally Determined Contributions (NDCs)	Greenhouse gas inventories (UNFCCC)	National pledges	Non-binding	Pledges
Subnational	Voluntary commitments	Self-defined boundaries	Local government	Non-binding	Pledges
Business	Disclosure, Emission Allowance (EU ETS)	GHG Protocol, others	Regional (EU), national	Binding/Non-binding	Reductions, Auctioning, Trading
Consumer	Reductions in per capita emissions	Per capita emissions	Individual	Binding	Taxes, fees

achieved by addressing businesses (production) and citizens/residents (consumption). Depending on country and/or region, laws may force companies to reduce emissions, or to participate in auctioning and trading. For example, the EU Emissions Trading System (EU ETS) is the world's largest carbon market, in which large emitters have to reduce emissions by 43% to 2030 compared to 2005, corresponding to a linear annual decarbonization rate of 2.2% per year (EC, 2022).

Carbon taxes have important roles in reducing emissions by making production (and consumption) more expensive, to increase the interest in energy savings and emission reductions, or to discourage consumption (e.g. Falk & Hagsten, 2019). At the sub-national level, destinations may pledge to voluntarily achieve emission reductions. Consumers are not legally responsible to reduce their individual emissions, but their consumption patterns are highly relevant for aggregated emission growth (Barros & Wilk, 2021). As the overview shows, legislation is specifically relevant at the national level, where policies of relevance can be introduced with a binding character for industry.

An added complexity is that countries communicate their ambitions to reduce emissions in Nationally Determined Contributions, which partially covers tourism, but excludes international aviation and shipping. As originally agreed upon in the Kyoto Protocol (1997, article 2-2), aviation bunker fuels used for international operations were to be treated through the International Civil Aviation Organization (ICAO) and the World Maritime Organization (WMO), and this provision has not changed despite all economic sectors now being covered by the 2015 Paris Agreement (Gössling & Lyle, 2021).

Given the shortcomings of the proposals made to reduce emissions from these sectors by ICAO (2016a,b) and IMO (2020), Lyle (2018) argues that national accountability will be a necessary precondition to force airlines into adopting new fuels and technologies. Mitigation in this sector will also have to integrate production and consumption perspectives, as there is much evidence that continued growth in fuel demand, driven by super emitters (Barros & Wilk, 2021), will negate progress on decarbonization.

The situation is somewhat similar for shipping and in particular cruises. Though these tourism subsectors are very small in comparison to aviation, they represent the most energy and carbon intense tourism products on a per trip or per tourist basis (Eijgelaar et al., 2010). Emissions from global shipping have consistently grown and approximately doubled between 1990 and 2020, with industry forecasts of accelerating growth that may again triple these between 2020 and 2050 (IEA, 2020; IMO, 2020). This is problematic, given that IMO (2020) defined an emission reduction goal of 50% by 2050 that is incompatible with decarbonization timelines to 1.5°-2° C (Joung et al., 2020). Carnival, MSC Cruises, and TUI Cruises have announced carbon neutrality to 2050 (WTTC-UNEP-UNFCCC, 2021); yet, it remains unclear whether pledges will result in actual emission reductions.

More generally, an Accenture analysis of 250 travel and tourism businesses found that only 42% had climate targets, and a mere 8% science-based targets (WTTC-UNEP-UNFCCC, 2021). The overall situation characterizing tourism is thus one of non-binding and conflicting responsibilities, specifically in regard to the most important emission sub-sectors. Will governments assume responsibility for these emissions, and force businesses to reduce these? Much evidence seems to suggest that continued emission growth needs to be expected: Only few destinations, notably at the sub-national scale, have explicit goals to reduce emissions in ambitious ways, or to focus on qualitative growth. Businesses regularly seek to expand, specifically when operating at global or multiple country scales. The UNWTO advocates continued growth, yet encourages the sector "to embrace a low carbon pathway" (UNWTO, 2022, no page). As discussed in the introduction, continued growth and science-based targets for decarbonization cannot be aligned. These contradictions highlight the relevance of defining timelines over which emission reductions will be achieved, continuous monitoring, and the introduction of policy-regimes forcing the different subsectors to decarbonize.

3.4. Strategy

Mitigation needs to be organized in ways that is significant, yet ideally not disruptive to the system in a way that jeopardizes employment or profitability. The challenge is to half emissions to 2030, which sets linear annual decarbonization rates at about 5%, and higher – unattainable – rates, should subsectors continue to grow in emissions. Industry-wide reports (WTTC-UNEP-UNFCCC, 2021) do not provide answers as to how significant emission reductions will be achieved in practice. This situation characterizes the entire tourism industry (Table 2), and requires a discussion of systemic issues.

3.4.1 Systemic considerations

As highlighted by Geels, Sovacool, Schwanen, and Sorrell (2017), system change requires consideration of technologies, infrastructures, organizations, markets, regulations, and user practices. 'Strategy' should thus be concerned with technology innovation, transition policies, and consumer behavior. Given the complete lack of evidence of decarbonization through industry initiatives, governance will determine the success of mitigation initiatives. Here, the evidence is that only regulatory and market-based policies will contribute to significant emission cuts, though voluntary policies have relevance in supporting social norm change (Gössling & Dolnicar, 2022; Gössling & Lyle, 2021). As some policies have a greater potential for emission reductions than others, the former need to be prioritized on the basis of impact assessments. There is also a need to consider policies in structured, hierarchical ways. As an example, carbon taxes will reduce demand, and hence diminish the amount of fossil fuels that need to be substituted.

Policies may be easiest to design in focusing on the main emission-generating subsectors, i.e. aviation, automobility, water-transport, accommodation, and food. They may focus on avoiding, reducing, or substituting fossil energy use. Policies need to lead to immediate cuts in emissions, but they may nevertheless consider economic objectives. For instance, if an objective is to maintain tourism's global revenue and employment potential, it is important to remember that domestic tourism accounts for 72% of total global tourism expenditure (The World Bank, 2022). For aviation, there is evidence that just one percent of the world population, the frequent travelers in private aircraft or premium classes, account for 50% of all emissions. Long-haul trips are specifically problematic. For instance, Dubois and Ceron (2009) calculate that the 2% of the longest flights cause 43% of aviation emissions of outbound flights from France.

These insights can for example be used by national tourism organizations to reconsider marketing efforts. Research shows that differences in the emissions from travel to a destination vary by up to a factor 30 (Gössling, Scott, & Hall, 2015). As an example, the average arrival to Austria from nearby Switzerland will entail a few kg CO_2, as visitors may use efficient transport modes such as electric trains running on renewable electricity. This compares unfavorably to an overseas arrival from Australia by air, which may cause the equivalent of thousands of kilograms of CO_2. Changes in the market mix of a country are likely the single most powerful measure to bring down emissions nationally, specifically if combined with measures to increase length of stay (Gössling, Scott, & Hall, 2018). As countries relying on international tourist arrivals are also vulnerable to fuel price volatility and carbon pricing (Scott, Hall, & Gössling, 2019), there are also potential benefits in economic stability. Destinations may thus seize marketing efforts in some countries, or even consider demarketing and de-growth strategies (Hall, 2009; Hall & Wood, 2021). For discussions of climate-focused destination management, see also Gössling and Higham (2021); Oklevik et al., 2019; Peng, Saboori, Ranjbar, and Can (2022); Sun and Higham (2021).

3.4.2 Measures by subsector

This reviews the main tourism emission subsectors, representing at least 62% of overall global tourism emissions (Fig. 5). Measures listed

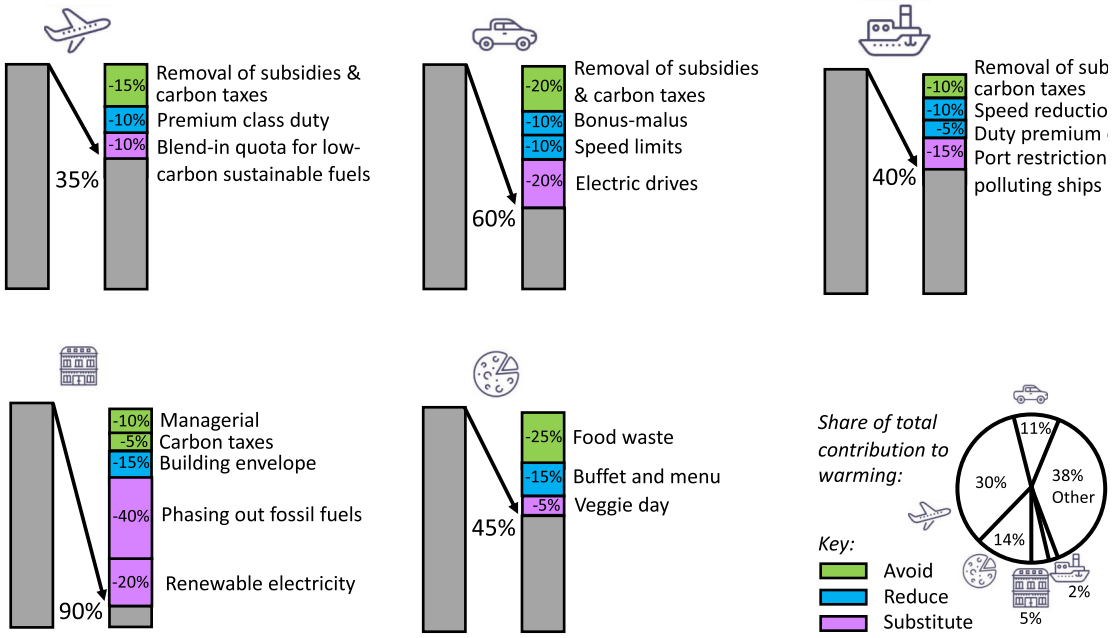

Fig. 5. Estimated mitigation potentials for sub-sectors, no growth scenario*.
*Scope 1 and 2, no growth scenario to 2030.
Source: Aviation: Craps, 2021; Falk & Hagsten, 2019; Fichert et al., 2014; Gössling et al., 2017; Gössling et al., 2021; Markham et al., 2018; McKinsey, 2022; Car: Barth & Boriboonsomsin, 2008; d'Haultfoeuille et al., 2014; Habibi et al., 2019; Østli et al., 2021; UBA, 2021; Yang et al., 2019; Cruises: IMO, 2020; Joung et al., 2020; Accomodation: Becken & McLennan, 2017; Bohdanowicz & Martinac, 2007; Gössling, 2011; Jandrokovic et al., 2012; Jelle, 2011; Sozer, 2010; Food: Filimonau et al., 2017; Filimonau & Delysia, 2019; Gössling, 2011; Poore & Nemecek, 2018; Pradhan et al., 2013; Reynolds et al., 2019; Visschers & Siegrist, 2015; Westhoek et al., 2014.

consider the hierarchy of avoid, reduce and substitute for scopes 1 and 2, with reduction potentials to 2030. Mitigation at the scales proposed will require a steady-state tourism economy without further growth in arrivals. This acknowledges that the global tourism geography will have to change and that regulatory policies will have to be implemented (Peeters & Eijgelaar, 2014; Peeters & Landré, 2011). While such policies are unlikely at the global scale, there is precedent, as evidenced by Venice's visitor fee, introduced in 2022, to limit arrivals (Euronews, 2022), or France's short-haul flight bans, introduced in 2021 (BBC, 2021).

A general issue characterizing the transport sector are significant subsidies forwarded to aviation, automobility, and water-transport. This distorts perspectives on the cost of transportation. For some sectors such as air transport, the variety and scale of different subsidies is not even known (Gössling, Fichert, & Forsyth, 2017), but the sector received more than US$130 billion in the first pandemic year alone – including government-backed loans and guarantees; recapitalization through state equity; flight subsidies; deferral and/or waiver of taxes and charges; grants; and private equity (Abate, Christidis, & Purwanto, 2020). The cost of carbon is another negative externality of air transport, as is the exemption of international flights from value added taxes (Pearce, 2003). Subsidies have contributed to the observed decline in the real cost of air travel, which IATA (2019) suggests fell by 60% over the past 20 years. If subsidies were removed, demand for air transport would likely fall (cf. Falk & Hagsten, 2019; Fichert, Forsyth, & Niemeier, 2014; Markham, Young, Reis, & Higham, 2018). This is also true for road and water transport (Merk, 2020; Van Beers & de Moor, 2001; Wang, Xu, & Guo, 2021). A general insight pertaining to all transport is thus that to remove subsidies and to internalize the full cost of carbon will lead to a decline in transport demand and affect the choice of transport modes as well as of car models, flight classes, or cabin preferences (Craps, 2021; Gössling, Hanna, Higham, Cohen, & Hopkins, 2019; Habibi, Hugosson, Sundbergh, & Algers, 2019; Østli, Fridstrøm, Kristensen, & Lindberg, 2021).

To reduce emissions from transport, it will also be necessary to consider non-linear changes in price structures. Per passenger, premium class air travel requires 3–9 times more fuel than economy class travel (The World Bank, 2013). This also applies for water transport (cabin size). Cars, vans, and mobile homes require significantly more fuel than small cars. Yet, as high emitters are also high-income earners (Oswald, Steinberger, Ivanova, & Millward-Hopkins, 2021), they are less affected by proportional carbon taxes. This can be addressed on the basis of significant duties for premium class flights or landing fees for private aviation and cruises (Gössling & Lyle, 2021), or bonus-malus systems for cars (d'Haultfoeuille, Givord, & Boutin, 2014). Mandated speed reductions for all transport modes can significantly diminish fuel use for all transport modes, including shipping (IMO, 2020) and automobility (Barth & Boriboonsomsin, 2008; UBA, 2021). Speed reductions will also make alternatives more attractive, specifically if investments are made to further improve competitive advantages, for instance including networks of high-speed railways (e.g. Yang, Lin, Li, & He, 2019).

Substitution in transport contexts will mostly refer to technology innovation. This includes alternative fuels for aviation and water-transport, or electric drives for cars. Substitution holds a considerable potential to 2030 and beyond (Gössling et al., 2021; Joung et al., 2020). Given the significantly higher cost of alternative fuels, there remains a market-issue, as airlines are unlikely to introduce solutions that increase their operational cost. It is for this reason that consultancy McKinsey (2022) recommends that governments subsidize alternative fuels, a proposition that undermines the need to reduce subsidies. It is also a risky strategy, given that the responsibility for alternative fuel production is shifted to government. Mandated blend-in quotas are thus favorable, as they force industry to find solutions, and airlines to reconsider their volume growth model (Gössling, 2020). For vehicles, market-based approaches are also relevant, as shown by Østli et al. (2021) for Norway. Here, a strongly CO_2-differentiated tax regime exempting electric vehicles from VAT has been shown to efficiently change car fleet composition. Even more effective are regulatory policies: the European Union has agreed that new cars must be

emission-free after 2035 (DW, 2022). Last, the shipping sector's carbon neutral objectives fall short of science-based targets (cf. IMO, 2020), prompting Joung et al. (2020) to call for regulation and market-based measures (see also Garcia, Foerster, & Lin, 2021).

Accommodation represents energy-intense infrastructure, including both electricity needs to power air conditioning, appliances and lighting, and primary energy consumption (oil, gas) for central heating and warm water generation (Bohdanowicz & Martinac, 2007). Depending on location, heating requires most energy, followed by hot water, and may often rely on fossil fuels (Jandrokovic, Mandl, & Kapusta, 2012; Sozer, 2010). In warm climates, air conditioning consumes considerable amounts of electricity (Jandrokovic et al., 2012). Main measures to avoid energy use thus include campaigns to raise staff awareness and knowledge (Coles, Dinan, & Warren, 2016; Gössling, 2011), the insulation of buildings, including a role for greenery to cool buildings in warm climates (Jelle, 2011), solar roofs and balconies to reduce energy consumption from the grid (Creutzig et al., 2017), and the replacement of oil or gas-based energy systems with heat pumps (Bernath, Deac, & Sensfuβ, 2019; Lund, Ilic, & Trygg, 2016). All electricity should be sourced from renewable energy suppliers. Measures such as these can be implemented through regulatory and market-based policies, and within short periods of time, as these measures are, with the exception of building envelopes, economically meaningful. In contrast to other subsectors, accommodation thus has a chance to become largely carbon-neutral in its operations to 2030.

Food is a complex source of greenhouse gases, as emissions are caused at stages from production to packaging, transport to distribution, and preparation to presentation (Poore & Nemecek, 2018). The most significant source of emissions is food waste (Reynolds et al., 2019), with estimates that one third of all edible food is wasted during the supply chain (Gustavsson, Cederberg, Sonesson, Van Otterdijk, & Meybeck, 2011). Meals also entail significant differences in emissions depending on composition, as vegan or vegetarian dishes are less carbon-intense than meat-based menus. For instance, Pradhan, Reusser, and Kropp (2013) found that differences between low and high calorie diets translated into a factor four in emissions (1.43–6.1 kg CO_2-equivalent per person per day). In a global study, Poore and Nemecek (2018) concluded that a worldwide change to vegetarian diets could half greenhouse gas emissions. Menu and buffet designs thus hold considerable potential to reduce emissions, as consumers are willing to reduce plate waste (Antonschmidt & Lund-Durlacher, 2021), or to consume more vegetarian/vegan or climate friendly options (Filimonau, Lemmer, Marshall, & Bejjani, 2017; Visschers & Siegrist, 2015).

Fig. 5 illustrates the mitigation potential of the measures. Policies could potentially half emissions from the five subsectors studied (scope 1 and 2), the greatest challenge represented by aviation. While some measures could be implemented in the short term (carbon taxes), others will take more time due to legal complexities (removal of subsidies). Yet others, such as alternative fuel production, will be determined by limits to production upscaling. Even though the selected options are promising avenues to emission cuts, there remains political and technical uncertainty. Policies would have to be introduced at the national level, and worldwide. Currently, the EU is the only jurisdiction with decarbonization timelines aligned with 2 °C goals. Aviation and shipping are seen to be the responsibility of ICAO and WMO. Whether policymakers will implement significant legislation thus remains uncertain.

3.4.3. Carbon removal

Results suggest that limiting warming to 1.5 °C is unachievable without further mitigation efforts. Industry has repeatedly pointed at a central role for carbon offsetting and removal (ICAO, 2016a; UNWTO, 2022; WTTC-UNEP-UNFCCC, 2021). Carbon removal (IPCC, 2022a), refers to "technologies, practices, and approaches that remove and sequester carbon dioxide from the atmosphere and durably store the carbon in geological, terrestrial, ocean reservoirs or in products" (IPCC, 2022a, pp. 12–35). Carbon removal involves consideration of sink types (land-based biological, ocean-based biological, geochemical and chemical), timescales (decades to thousands of years), and storage media (buildings, vegetation/soils/sediment, geological formations, minerals, marine sediment) (IPCC, 2022a).

Land-based biological removal includes afforestation, reforestation and improved forest management to store carbon in biomass and soils, sediments and buildings made of wood. This can be achieved through carbon sequestration through agricultural and pasture management, as well as the introduction of biochar, a coal created through pyrolysis of biomass (IPCC, 2022a; Smith et al., 2016). Yet another option is the combination of bioenergy production with carbon capture and storage in geological, terrestrial, or ocean reservoirs, or in products. Peat- and (coastal) wetland restoration and carbon capture by vegetation in the coastal zones, such as tidal marshes, mangroves and seagrasses are also referred to as blue carbon management. This also includes ocean-based approaches involving biological (fertilization of nutrient-limited areas) or chemical means (enhancing alkalinity with carbonate or silicate rocks). Enhanced weathering accelerates natural weathering of minerals to remove CO_2 from the atmosphere and storage in soils, land or the deep ocean. Direct Air Carbon Capture and Storage (DACCS) filters CO_2 from the ambient air, while bioenergy with carbon capture and storage seeks to store carbon geologically, for instance in depleted oil and gas fields. These approaches vary considerably regarding their technology readiness and costs (IPCC, 2022a).

Table 6 shows that the theoretical potential for carbon removal is considerable, but all approaches are limited by the availability of land, water, energy, and financial resources. There are risks for ecosystems and storage losses through the reversal of carbon flows. Some of the strategies amount to geoengineering, which creates new risks. Tourism also competes with other sectors for carbon removal. However, there is a potential for emission reductions as an *additional* activity for tourism stakeholders. As this cannot be mandated, actions would be voluntary and predominantly small-scale. For aviation and shipping, there are opportunities to engage in direct air carbon capture or bioenergy with carbon capture projects to produce synthetic fuels – a potential future technology pathway. While linkages of carbon removal to tourism should be explored in greater detail, there is currently no evidence to suggest that these schemes will play a significant role in decarbonizing the sector to 2030, also given their low technology readiness.

4. Towards net-zero

This review has outlined that tourism has a central role in emission growth and the depletion of the global carbon budget. Aviation is the most relevant subsector in this development, with the lowest potential for emission reductions. Tourism will have to change in very significant ways to become aligned with net-zero goals. The S4C model proposes that significant and immediate emission reductions in tourism will depend on emission assessments (Scales), the consideration of all greenhouse gases and aviation's contribution to non-CO_2 warming (Scope), the definition of timelines and responsibilities for decarbonization (Stakeholder), and regulation through policy frameworks with a focus on immediate and significant emission reductions (Strategy). There is little evidence of an organized emission reduction approach in any of these four dimensions, let alone in their combination.

As most policies to reduce emissions can be implemented at the country level, national assessments become the most important level of analysis and action. Here, findings suggest that TSAP in combination with environmentally extended input-output modelling (EEIO) approaches are the most suitable emission assessment framework. Destination allocation is recommended, i.e. the measurement of direct and indirect emissions associated with tourism consumption from domestic, inbound and outbound activities within a country. International air transport emissions can be included in this accounting method, as bunker fuel data is often readily available and can serve as a benchmark for tracking developments in this most relevant sub-sector. Tourism

Table 6
Carbon removal strategies (sorted by Technology Readiness Level).

Carbon removal strategy	Mitigation potential ($GtCO_2$ per year)	Cost (US$ per ton CO_2)	Technology Readiness Level	Risks	Tourism opportunities
Afforestation/ reforestation	0.5–10	0–240	8–9	Wildfires	Planting trees, engaging in afforestation/reforestation projects (accommodation, gastronomy, services, DMOs, NTOs)
Soil carbon sequestration in croplands and grasslands	0.6–9.3	45–100	8–9	Subsequent carbon loss	Cooperation with farmers to increase soil carbon (accommodation, gastronomy, services, DMOs, NTOs)
Peatland and coastal wetland restoration	0.5–2.1	n.d.	8–9	Drought	Cooperation with nature conservation groups (accommodation, gastronomy, services, DMOs, NTOs)
Agroforestry	0.3–9.4	n.d.	8–9	Food production	Cooperation with farmers and the forest sector (accommodation, gastronomy)
Improved Forest management	0.1–2.1	n.d.	8–9	Biodiversity loss	Cooperation with forest owners (e.g. state forests), nature conservation groups (accommodation, gastronomy, services, DMOs, NTOs), specifically in context of protected areas
Biochar	0.3–6.6	10–345	6–7	Loss of biodiversity, carbon stock	Cooperation with farmers (accommodation, gastronomy)
Direct Air Carbon Capture and Storage	5–40	100–300	6	Energy use	Combination with synthetic fuel production (aviation, water transport)
Bioenergy with carbon capture and storage	0.5–11	15–400	5–6	Land, water	Combination with synthetic fuel production (aviation, water transport)
Enhanced weathering	2–4	50–200	3–4	Mining	Investments by aviation, water transport
Blue carbon in coastal wetlands	<1	n.d.	2–3	Ecosystem	Cooperation with nature conservation groups in coastal areas (accommodation, gastronomy, services, DMOs, NTOs)
Ocean fertilization	1–3	50–500	1–2	Ecosystem	Investments by aviation, water transport
Ocean alkalinity enhancement	1–100	40–260	1–2	Ecosystem	Investments by aviation, water transport

n.d.: no data; Technology Readiness Level: scale from 1 to 9 with 9 being the most mature technology.
Source: adapted from IPCC, 2022a, 2022b, expanded.

Satellite Accounts have already been established in more than 60 countries, representing up to 90% of global tourism consumption (Lenzen et al., 2018). Global databases for economic-environmental accounts are also widely available and provide long-term country-specific parameters that include emission coefficients (Sun, 2016). Benefits of this approach include opportunities for longitudinal analyses and progress on decarbonization, international comparison, the identification of specifically carbon-intense economic subsectors, and consideration of economic aspects, such as the carbon-intensity of revenue.

Lenzen et al. (2018) integrated existing TSAs and visitor expenditure data into a global multi-region input-output database (MRIO) to estimate national tourism emissions for 160 countries in the period 2009–2013. The two approaches of residence-based accounting (RBA) and destination-based accounting (DBA) were compared to evaluate both consumer-driven and industry-related emissions. In the future, this approach may be complemented with an aggregation of national I/O analyses, when these become available in sufficient number. To achieve this, tourism assessments may be integrated in the UNFCCC's national greenhouse gas inventories, to create a global database and a unified approach to measuring that will allow to assign responsibilities for emissions from international aviation and water transport.

Destinations at the sub-national level will face difficulties in applying top-down approaches because of the aggregated nature of macroeconomic and environmental accounting data that comes with major limitations especially for smaller tourism regions (Cai, 2016; Dwyer, Mellor, Livaic, Edwards, & Kim, 2004; Klijs, Peerlings, & Heijman, 2015). In addition, local tourism planning often needs finer degrees of process details such as emissions from different transport modes or accommodation providers that can be used for the design of mitigation policies. The complexity of measuring emissions is a potential barrier to the involvement of individual (business) stakeholders, and is often perceived as complicated, time-consuming and costly. The understanding of benefits will be important for mobilizing stakeholders.

Comparable and comprehensive data has a high value. Where destinations – for instance at the community, county or state level - have regional TSA-data, I/O-based top-down calculations are thus recommended. Where such data does not exist, bottom-up approaches may be used (Fig. 6). Such approaches focus on tourism emissions in a specific jurisdiction (destination allocation at the subnational level) and provide a general understanding of resource use and emissions. Calculations can be based on visitor volumes and activities that are then connected with differentiated information on specific tourism industries. For example, information on transportation emissions from domestic air travel, inbound air travel, private and rented vehicles, or public transport is usually available. Domestic, inbound, and other tourism segments can be distinguished. This information is also specifically relevant for destination management. Potential weaknesses of this approach are the reliance on averaged emission-factors, lack of detailed visitor-data, and the omission of indirect emissions. Destination specific data, sourced from businesses, can improve the quality of assessments. In combination with this approach, it is advisable to develop climate action plans based on scope 1 and scope 2 emissions that provide ballpark figures. These can be used to make recommendations for short-term action.

Finally, businesses, depending on size, have their own responsibilities. This may be the EU ETS for large emitters in the European Union or the upcoming European Corporate Sustainability Reporting Directive which includes a double-materiality risk assessment for climate change and a climate action plan that is in accordance with the European climate mitigation target (European Commission, 2021). Non-financial accounting is also increasingly demanded by financial markets (e.g. Task Force on Climate-related Financial Disclosures). For small and medium sized enterprises, the rising cost of energy is likely a future driving factor in avoiding and reducing energy use, for which it is necessary to understand where energy is wasted. Smaller businesses may focus on assessments using established accounting frameworks, such as ISO, PAS, or GHGP and at least include scope 2 emissions, and also identify and assess relevant indirect emission sources.

The overall process of decarbonization is ideally embedded in positive feedback-loops, as mitigation efforts have to be upscaled swiftly. Fig. 7 illustrates this, distinguishing the different institutions and their influence on policies supporting mitigation, ambitions in regard to

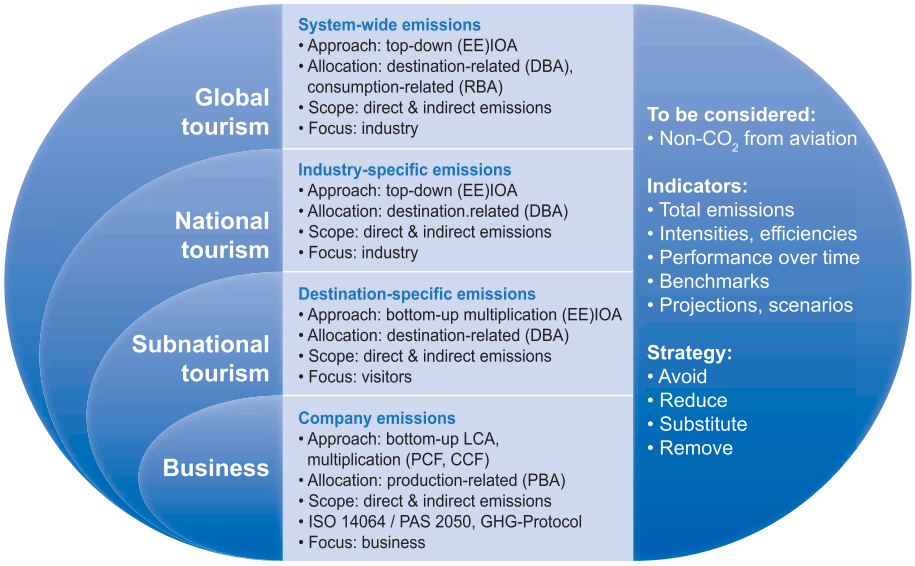

Fig. 6. Approaches to decarbonization.

Fig. 7. Net-zero self-reinforcing feedback loops.

decarbonization levels and timelines, the showcasing of best practice, the development of new strategies, as well as the communication of climate change mitigation as a societal priority reinforced by emerging social norms. Through such an interplay of actions at different scales, mitigation efforts gain traction. To date, major roadblocks to decarbonization remain the lack of governance and industry dishonesty in regard to the challenges. 15 years ago, UNWTO, UNEP & WMO, 2008: 38) concluded that:

> "Tourism can and must play a significant role in addressing climate change as part of its broader commitment to sustainable development. […] Tourism as a non-negligible contributor to climate change has the responsibility to reverse the growth trajectory of its GHG emissions over the next three decades to a more sustainable emissions pathway."

Yet, one and a half decades later, the sector's emissions continue to rise, suggesting that it is high time for the sector to heed its own conclusions.

5. Future research directions

The review of the literature on calculating emissions at different levels of scale reveals important knowledge gaps. At the most basic level, and following the relationships outlined in this paper, mitigation will demand political interventions and the willingness of businesses to engage with the net-zero challenge. Following the S4C model, important research questions include:

Scale. How are responsibilities for emission reductions distributed between global institutions, governments, destinations and businesses, and how can common goals be formulated? For example, ICAO has presented a net-zero roadmap with a focus on offsetting rather than transitioning to alternative fuels. Governments are thus required to implement feed-in quotas, with research questions related to policy-making and international coordination, changes in cost/price structures, and airline profitability. These issues also have relevance for cruises.

Scope. While this research has presented the best approaches towards emission reductions at different scales of analysis, it is of importance to better understand the barriers for businesses and destinations in calculating emissions. Are there ways in which calculations can be made easier and comparable? Can destinations learn from each other through common assessment frameworks?

Stakeholder. To assign responsibilities for progress on mitigation will be key to achieving emission reductions. It is equally important to identify transition bearers and barriers, i.e. the companies, destinations and countries moving towards decarbonization as well as those currently representing obstacles to progress. Reasons for resistance to change need to be identified, as well as opportunities to overcome institutional and structural barriers.

Strategy. For businesses and destinations, carbon management will be inspired by views on profitability and robust tourism management systems. For this it is paramount to understand how changing price structures or carbon policies will affect tourism, and whether this will result in new equilibria in global tourism flows. Firms and destinations will also want to know how regulatory policies will affect their business models. For example, market-mix changes can significantly reduce emissions, but this will also imply gains or losses in economic bottom lines. Specific forms of tourism will become significantly more expensive, making it desirable to develop carbon intensity indicators for different travel products. Overall, there is a huge consultancy demand at

the national and destination level, requiring an upscaling of educational efforts.

Author statement file with CRediT roles

Stefan Gössling, Martin Balas: Conceptualization, Martin Balas, Stefan Gössling: Data curation, Formal analysis, Stefan Gössling, Martin Balas: Methodology, Stefan Gössling, Martin Balas: Project administration, Stefan Gössling, Martin Balas, Marius Mayer, Ya-Yen Sun: Visualisation, Stefan Gössling, Martin Balas, Marius Mayer, Ya-Yen Sun: Writing - original draft, Stefan Gössling, Martin Balas, Marius Mayer, Ya-Yen Sun: Writing - review & editing.

Impact statement

Tourism is a significant source of greenhouse emissions. It is also an economic sector that faces considerable technical, financial and political decarbonization barriers. This paper reviews the available literature, and discusses the scales, scopes, stakeholders and strategies of carbon management in tourism within the framework of the S4C model. It makes recommendations for mitigation on the basis of emission assessment frameworks and significant decarbonization strategies. The paper is thus intended as the blueprint for mitigation in tourism that addresses specifically industry and policymakers.

Funding

No funding has been received for this research.

Declaration of competing interest

None.

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Chapter IV

The challenge of climate change and net zero emissions for destinations.

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Chapter V

Economic impact analysis of tourism in protected areas of the Pomerania region.

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Socio-economic research in protected areas of the Euroregion Pomerania: Visitor satisfaction, economic impacts and park–people relationships

Bogucki Wydawnictwo Naukowe • Poznań 2022

This monograph was produced as part of the project INT107 (acronym: REGE), which was carried out under the title "Cross-border cooperation between universities and large-scale protected areas in the Pomerania Euroregion" (Ger.: "Grenzüberschreitende Zusammenarbeit von Hochschulen und Großschutzgebieten in der Euroregion Pomerania", Pol.: "Współpraca transgraniczna między uczelniami i dużymi obszarami chronionymi w Euroregionie Pomerania"). The project was co-financed by the European Union from the European Regional Development Fund (ERDF) as part of the Interreg V-A Mecklenburg-Vorpommern/Brandenburg/Poland Cooperation Programme.

Reviewer: Prof. dr hab. Dariusz Pieńkowski

Citation suggestion:
Zbaraszewski, W., Balas, M., Dmytrów, K., Majewska, A., Mayer, M., & Steingrube, W. (2022). Socio-economic research in protected areas of the Euroregion Pomerania: Visitor satisfaction, economic impacts and park–people relationships. Poznań: Bogucki Wydawnictwo Naukowe. https://doi.org/10.12657/9788379864201

ISBN 978-83-7986-420-1

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Printed and bounded in Poland by CER Druk

5. Economic impact analysis of tourism in protected areas of the Pomerania region

5.1. Introduction

Protected areas (PAs) provide important benefits for humankind including conservation of biodiversity, landscape integrity, carbon sequestration, and water and air purification, as well as the possibilities for nature-based recreation (Leung et al., 2018; Naidoo et al., 2019; Juffe-Bignoli et al., 2014; Worboys, 2015). Despite these benefits, PAs are often underfinanced, are under pressure to be converted/opened to conventional land uses, or lack public support, especially among local people living in or nearby them (see Chapter 4). One important reason for this situation is that the economic benefits of PAs are often not recognised or are at least contested, and PAs are consequently regarded as loss-making businesses (Mayer, 2013, p. 28). Eagles (2007, p. 6) put it like this:

> "Any phenomenon that is not measured and reported does not exist politically. Governments, societies, communities and individuals place more value on that which is documented."

This undervaluation, in turn, is based on the public good characteristics of many benefit components of PAs, i.e. there are no market prices available, in contrast to conventional land-uses such as mining, agriculture or forestry (Dixon & Sherman, 1990, p. 24 f., 32). One of the PA benefits that is tangible and rather straightforwardly measurable is the economic impact of tourism activities in PAs generated by visitor expenditure in and around PAs (Hanley & Barbier, 2009).

> "Tourism in protected areas has the potential to generate tangible economic impacts, mainly from the money that visitors spend. Their expenditure … can be substantial. By establishing the level of visitor spending, evidence can be gathered to illustrate the economic contribution and impact of protected area tourism." (Spenceley et al., 2021, p. 18)

To sum up, the economic valuation of PA tourism is worthwhile for the following reasons (Pascual et al., 2010, p. 190; Rommel, 1998, p. 21f.; Flückiger, 2000, p. 18; Hornback & Eagles, 1999; Job, 2008; Job et al., 2021; Mayer & Stoll-Kleemann, 2016; Spenceley et al., 2021): it somewhat compensates for the missing/contested valuation of PAs' public goods; it puts PAs on the economic playing field by providing comparability through monetisation; it closes information gaps, objectifies debates, and therefore contributes to avoiding misallocations of

resources; it makes a strong argument for the existence of PAs, justifies their budgets and argues for their better financial support; its results can be used for self-evaluation and benchmarking, as well as internal and external marketing/communication; finally, its results can contribute to improving the attitudes of local people towards PAs with assumed positive consequences for nature protection outcomes.

However, what exactly is meant by economic impact and how is it measured? Watson et al. (2007) provide two related definitions:

> "Economic impacts are the net changes in new economic activity associated with an industry, event, or policy in an existing regional economy" (p. 142). "Economic impact is the best estimation at what economic activity would likely be lost from the local economy if the event, industry, or policy were removed" (p. 143).

Thus, economic impacts describe the net effects of policies that bring new revenues into the PA region that would otherwise not occur, or policies that keep revenues in a PA region that would otherwise be lost (Spenceley et al., 2021). That means the difference between the analysis of the economic contribution and the impact of tourism lies in the scope of the analysis (overall significance vs. the effect of "shocks"/"changes") and not in the methods (Mayer & Vogt, 2016). In this way, economic impacts of PA tourism are part of the tangible, direct, non-consumptive use values of PAs (Mayer, 2013; Barbier, 1991; Munasinghe, 1992).

Economic impact analyses are most often used to estimate how changes in visitation or visitor spending might affect local economies. Economic impacts describe the economic activities that are either brought into a region because of a PA designation or describe the economic activity that would be lost from the region if the PA designation was removed. Therefore, economic impact studies do not include spending by locals (Spenceley et al., 2021, p. 26) and must account for the visitors' motivation (in contrast to the economic contribution of PA tourism) (Mayer et al., 2010).

An estimation of the regional economic impact of PA tourism requires four main steps (see Spenceley et al., 2021 for details[15]): 1) The number of visitors or visitor days needs to be determined, differentiated between different visitor types with likely deviations regarding their spending patterns such as, for instance, overnight visitors vs. day-trippers, or domestic vs. foreign guests, or combinations of both and other characteristics. Staab et al. (2021) and Job et al. (2021) provide recent literature overviews for visitor counting and monitoring approaches. However, for PAs with required entry fees, such as some of the Polish national parks, there are usually relatively reliable visitation numbers, while for free-access PAs such as all German PAs and the Polish landscape parks, there are not any official visitation data available. 2) The expenditure behaviour of visitors to the PA and the PA region (which often needs to be defined first) needs to be differentiated within the same visitor groups as the visitation data, so that both data sets can

[15] This work is a recently published international guideline (approved by the UNESCO) about measuring the economic impacts of PA tourism.

be combined to calculate the gross turnover of PA tourism. The contribution by Stynes and White (2006) sums up the dos and don'ts in expenditure surveys, while Mayer and Vogt (2016) include a comprehensive review on the factors influencing spending behaviour. 3) An economic model or multipliers to determine how much of the gross turnover (i.e. visitor spending times visitor number) actually stays in the PA region (and does flow out of the region as leakage, e.g. to pay for imports, taxes to the government, transfer of profits) and how much direct, indirect and induced economic impact it generates (depending e.g. on the regional economic structure, the size of the PA region, see Archer & Fletcher, 1996). These models include (see Dwyer et al. 2010, Chap. 7–9 for an overview), for example, regional multipliers (Archer, 1977), input-output-models (Fletcher, 1989), social accounting matrices (Wagner, 1997), and computable general equilibrium models (Zhang et al., 2007). 4) Finally, the PA visitors' motivation needs to be known to be able to attribute the adequate share of regional income to PA tourism, because if visitors were to come to the region regardless of the existence of the PA, their spending cannot be attributed to the PA and should not be treated as part of the economic impact. Küpfer (2000), Job et al. (2003), Wall Reinius and Fredman (2007), Mayer et al. (2010), Arnberger et al. (2012, 2019) and Backhaus et al. (2013) came up with or used slightly differing schemes to assess PA visitors' motivation and to identify so-called visitors with a high PA affinity, i.e. visitors who most likely would not have come if the PA had not existed – Bayer et al. (2017) provide a review of these approaches.

On the international level, a few countries have set up compelling economic impact monitoring systems of PA tourism, especially the USA[16] and Finland (see Huhtala et al., 2010)[17]. For example, the US National Park Service (NPS) has been monitoring the yearly visitor numbers of the NPS units since 1904, on a monthly basis since 1979. Furthermore, there is a high level of consistency and reliability of the data for the NPS units. Since 1988, visitor spending and economic impacts have been measured and reported (Koontz et al., 2017).

This chapter is structured as follows: in the next section (5.2), an overview is provided of the state of research about tourism economic impact analyses in Polish and German PAs, while section 5.3 presents the methods used to assess the economic impact of tourism in the PAs of the Pomerania region. Section 5.4 shows the results of these analyses for the Polish and the German PAs, respectively, followed by a discussion (5.5) of these results. A short interim summary (5.6) closes this chapter.

5.2. State of Research

Below, overviews of tourism economic impact analyses in protected areas in Polish (5.2.1) and German (5.2.2) PAs are presented.

[16] See https://www.nps.gov/subjects/socialscience/vse.htm. (accessed on April 12, 2022).
[17] See https://www.metsa.fi/en/economic-benefits-of-national-parks/ (accessed on April 12, 2022).

5.2.1. Poland

In Poland, as elsewhere globally, an increasingly important role is being attributed to the socio-economic issues of operating PAs. This transformation is a slow process, though. The public opinion perceives Polish national parks as nature conservation areas to which humans and their activities are a threat (Mika et al., 2015, p. 9), while the Polish literature – compared to the multitude and scopes of studies in the USA, Finland and Germany (see 5.2.2.) – suffers from a shortage of publications describing and evaluating economic impacts in PAs. Notably, the situation in Poland corresponds to the situation in the entire Central and Eastern Europe. However, this subject is gradually attracting more interest (Bodnár, 2006; Cihar & Stankova, 2006; Harmáčková et al., 2016; Moraru et al., 2021; Nestorová Dická et al., 2020; Schneider et al., 2021).

Despite these general observations, it is important to stress that the Polish literature on the subject makes several references to the impact generated by PAs on the economy of the region and the country. Multiple studies have dealt with social conflicts, which are frequently caused by economic aspects (as discussed in more detail in subsection 4.2.1.).

A large proportion of publications have been devoted to tourism in all Polish national parks. Research has mainly focused on the effects of the anthropogenic impact (Bożętka, 1995; Macias et al., 1995; Michniak, 2018; Sikorski, 2009; Soltys-Lelek et al., 2010) and the volume of tourism, as well as its structure, spatial and temporal distribution, and intensity (Janowski, 2005; Miazek, 2020; Prędki & Demko, 2021; Rogowski, 2018a, 2019; Semczuk et al., 2014; Zawilińska, 2021).

Issues concerning systems for monitoring tourist traffic in protected areas have been widely discussed in the Polish literature, as well. Tourism intensity is mainly judged by the number of admission tickets sold by Polish national parks[18] (Pociask-Karteczka et al., 2002; Wieniawska-Raj, 2010) or based on pyroelectric detectors in use in most national parks in Poland (Buchwał & Fidelus, 2010; Spychała & Graja-Zwolińska, 2014; Rogowski, 2018b, 2020; Rogowski & Piotrowski, 2022; Rogowski & Rusztecka-Rodziewicz, 2021).

We assume the notion that national parks play a role in the local economy is gaining popularity in Poland. Research implicating a comprehensive role fulfilled by a national park, i.e. that of an employer, contractor, investor and customer, should be mentioned in this context (Bołtromiuk, 2010, 2011; Walas, 2019). The financial aspects of the functioning of Polish national parks have also been examined (Kulczyk-Dynowska, 2015b, 2015a; Pater, 2020; Pater & Zawilińska, 2014; Zbaraszewski, 2013, 2016).

In Poland, in-depth research has been initiated after 2010 into PA visitor expenditure, and the results have been used to estimate the socio-economic effects

[18] Until 2022, the requirement to pay an admission fee in Poland was mostly limited to mountain parks. According to the discussions held at the turn of 2021/22 on a new bill on national parks, plans are being made to charge for admission to all twenty-three Polish national parks.

of tourism on such places. Pilot studies aimed at estimating visitor spending were conducted in, among others, Tatra National Park in 2013 (Urbaniak & Mazur, 2014) and Wolin National Park (Zbaraszewski et al., 2014, p. 95–118). Research carried out in Babia Góra National Park in 2012–2015 (Mika et al., 2015) can be regarded as an extensive study of the economic impact of a Polish national park on the socio-economic development of the park's municipalities (towns). The study helped to identify, among other things, the size and structure of the national park's budget, the financial links that the national park had developed, the extent to which the park exerted economic effects, and the volume and structure of the park's visitor expenditure. It also considered the scope of the economic connections resulting from these expenses flowing into the immediate vicinity of the national park. As for assessing the economic effects of tourism in Babia Góra National Park, an assumption was made that the estimation should cover the entire tourist traffic in the park region regardless of the visitors' motivation for arrival. Thus, a 'wider' approach to defining national park tourism was adopted, one that did not limit tourism to those people whose sole objective was to visit the park (the 'narrow' definition of national park tourism). Studies of the volume and structure of tourist expenditure were carried out in 2012 and 2013. The survey days were chosen so as to match the distribution of tourist traffic within the park, as recorded by the park's administration. The interviews were conducted with 1,215 respondents (N = 1,125), but as some of them spoke for their whole families or groups, conclusions could be drawn for as many as 2,912 people. When asked whether their visit to Babia Góra National Park was their main objective, as many as 82.3% from this group answered that it was, while this figure rose to almost 90% for day-trippers and dropped to 75.4% for those who stayed there for the night (Mika et al., 2015, p. 129). The respondents were asked about their expected costs of the trip, including the expenses they had already incurred. In this way, information was gathered on the volume of both total expenditure and expenditure broken down into the categories of "overnight accommodation", "food", and "other". Verification and supplemental surveys were also carried out among these tourists as soon as they returned home. A *post factum* data analysis was performed based on the information collected from a group of 351 persons (n_2 = 351) who agreed to be involved. Since the value differences between the expenditure declared and the actual spending in our study group were relatively small, it was assumed that the information drawn from the actual tourist expenditure data for the n_2 group reflected the expenditure structure for the whole (N) study population. The total declared expenditure for the whole sample of 2,912 tourists amounted to PLN 435,000, with accommodation costs accounting for 36.3%, food expenses for 41.7%, and other expenditure for 22.0% (Mika et al., 2015, p. 135). The study estimated the economic benefits (as this is the term used in the study) gained by the municipalities from inbound tourism directly and indirectly linked to the national park. These were calculated by adding together the expenses of day-trippers and overnight visitors and then deducting the VAT imposed on the particular types of services and goods purchased (Mika et

al., 2015, p. 147). The following assumptions were made for the purpose of the calculation:

- the annual number of visitors to Babia Góra National Park was 100,000. The authors noted that although an electronic monitoring system (pyroelectric detectors) was in use in the park, the data obtained was so inaccurate that it could not constitute a reliable source of scientific information (Mika et al., 2015, p. 123). Therefore, the number of visitors used to estimate the economic effects was based on data from reports on tickets sold in 2014 (76,000 people) and observations by park staff, who assessed that the actual number of people entering the park was approx. 25–30% higher than the number of tickets sold.
- the results of the research reflected the relationship between day-trippers and overnight visitors visiting the park during the year,
- the 8% VAT on accommodation services was only taken into account in the case of hotel facilities, i.e. hotels, guest houses, tourist shelters, holiday centres, leisure and training facilities, and other so-called group accommodation facilities; the VAT was not accounted for in other categories of accommodation such as guest rooms and agritourism farms; with this assumption, the VAT was taken into account for 42.9% of the expenses incurred for accommodation (Mika et al., 2015, p. 147).

The calculated annual amount of visitor expenditure amounted to PLN 15.952 million (EUR 3.545 million[19]) of which 1.671 million (EUR 371,000) came from day-trippers and PLN 14.280 million (EUR 3.173 million) from overnight visitors. The largest share of the economic benefits generated by tourism in Babia Góra National Park was realised by the accommodation sector (42.9%), followed by catering and retail trade, with 28.2% and 23. 5%, respectively (Mika et al., 2015, p. 149).

An attempt to assess the economic impact on the region's economy was also undertaken for Góry Stołowe National Park in 2018. The studies based on visitation data from pyroelectric automatic counters and on surveys helped estimate the volume of the visitors' gross expenditure at PLN 359 million, or EUR 79.80 million (Rogowski et al., 2019).

The regional economic effects of tourism in a protected area have also been estimated for Drawa National Park. The study used the method for estimating regional economic impacts effects established in Germany by Prof. Hubert Job (Job et al., 2005; Job et al., 2009). The number of visitor days to this national park in 2018 was estimated at 38,200. Visitor days were calculated using a mixed method, i.e. on the basis of two data sources. The main source of information involved counting the visitors at seven locations selected by the park administration staff that could be regarded as unofficial entrances. The counting was carried out on 24 days, i.e. usually on a single weekday and a single day off work between 9 o'clock and the sunset, not later than 6 pm, in every month of 2018. At the

[19] For the purposes of comparison, the following exchange rate was adopted further in this Chapter: PLN 4.50 (PLN) = EUR 1 (EUR).

same time, the visitors were surveyed in order to estimate the size and structure of their expenditure. Visitors from outside the park region were distinguished from locals using postal codes provided by the respondents. Drawa National Park charges fees for using its water areas for amateur angling and for kayaking on the River Drawa. The park's database of tickets sold, adjusted for errors, was the second source of data used to estimate tourist traffic. By comparing the number of tickets sold and the number of visitors on the counting days, discrepancies were identified, in particular in the peak of the season, since it turned out that there were actually approx. 24% kayakers more than indicated by the number of tickets sold. Therefore, the extrapolation of the total number of visitor days used data derived from counting the visitors (for pedestrians, horse riders, and cyclists) and from the number of tickets sold (for kayakers and anglers), which were then adjusted for the identified discrepancies between the number of tickets sold and the number of visitors counted on the survey days.

Based on short (589) and long (394) interviews at seven selected locations within the park, it was concluded that 40.4% of the visitors were day-trippers (59.6% overnight visitors), while as many as 74.6% of the remaining visitors were tourists staying in the park (the park municipalities) for only one or two nights. Tourism in Drawa National Park was characterised by the tourists' high affinity to the place, since as many as 54.7% of the guests were visitors with a high national park affinity, i.e. they were not only familiar with the protected area status of the park but also came to the park as their primary destination. The study estimated value added ratios in the region concerned (broken down into accommodation, catering, retail trade, services, and park charges). According to the method adopted, which employed deducting the VAT from the tourist expenses and taking into account both value added ratios and indirect income generated in the region from intermediate consumption with the average daily expenses (derived from the study) of PLN 48.79 (EUR 10.84) as incurred by day-trippers and PLN 98.08 (EUR 21.80) as incurred by overnight visitors, the total tourist income (the regional economic impact) was estimated at PLN 1.678 million (EUR 372,900). Considering the region's average salary, this value represented an equivalent of 49 people receiving the regional average salary (Zbaraszewski & Pieńkowski, 2022).

In our literature overview, we came across a paper made as part of a Polish-Czech project realised under the Interreg V-A – Czech Republic-Poland programme that included sociometric studies carried out in the two Karkonosze national parks, i.e. both in Poland and Czechia (Kravka et al., 2019). It was found that the average spending per person and day was CZK 749 (EUR 30)[20], with Czech guests spending on average CZK 604 (EUR 24.20), Poles spending CZK 695 (EUR 27.80), and Germans spending CZK 1,280 (EUR 51.20). The study's estimates of visitor expenditure between July 2018 and June 2019 allowed for their gross values to be determined at approx. CZK 4 billion (EUR 160 million)

[20] The 25 CZK (Kč) = EUR 1 (€) exchange rate was adopted (a single fixed exchange rate has been assumed for illustrative purposes).

for the Czech national park and CZK 1.2 billion (EUR 48 million) for the Polish national park (Kravka et al., 2019, p. 35).

Our overview of research about Polish PAs showed that there had been attempts at estimating the economic impacts, although such studies had concentrated on a very limited number of national parks. In addition, the research so far had disregarded other forms of territorial nature conservation. In most of the reviewed studies, the economic impact of tourism in protected areas was – incorrectly – understood as gross expenses incurred by visitors to the given protected area, i.e. expenditure not adjusted for the VAT paid to the State Treasury, and leakages. Moreover, most of such studies failed to translate the economic effects into the hypothetical number of people employed in the protected area region thanks to the expenditure of the visitors in the region. It appears that there is a need for Polish scientists to develop a single method for estimating regional economic impacts of PA tourism, which will allow for the benchmarking of the results obtained over time and between individual protected areas.

5.2.2. Germany

Economic impact studies for protected areas in Germany face several difficulties (Mayer & Woltering, 2017; Job et al., 2021): Firstly, Germany has a free access policy for PAs resulting in a lack of visitation data. Especially in biosphere reserves and nature parks, such figures are even harder to obtain due to locals living inside the PA. Secondly, data on tourism expenditures are rare and those available are not representative of PAs but rather of urban areas, as they are strongly influenced by the retail spending behaviour of the visitors (as a trip to the next largest city is interpreted as a shopping tourism trip). Thus, costly field research including extensive visitor counting and surveying is required. Thirdly, regional economic models do not exist in the form of regionalised input-output-tables but only in the form of regional multipliers. However, these latter ones are not publicly available as they are the product of private consultancy.

Thus, with the notable exception of Kleinhenz' (1982) study about the economic impact of the first German national park in the Bavarian Forest, there were not any economic impact studies of park tourism until the early 2000s. Until then, visitor numbers of national parks were only available as rough estimations without transparent assumptions (see Bibelriether et al., 1997). It was not until a pilot study in Berchtesgaden National Park (2002/03) by Job et al. (2003) and a following larger pilot project 2004/05 in Müritz National Park and the Nature Parks Altmühltal and Hoher Fläming (Job et al., 2005) accompanied by guidelines to estimate the economic impact of tourism in protected areas (Job et al., 2006) that the economic valuation of protected area tourism in Germany took off. Since then, the regional economic impact of tourism has been estimated for 15 out of now 16 German national parks including some replication studies, for nearly all biosphere reserves (to be completed in 2022), and for four of the 104 nature parks. Funded by the German Federal Ministry of Environment, the Federal Agency of Nature Protection (BfN) and several of the PAs, most of these

studies were conducted by the working group of Hubert Job (Job et al., 2003, 2005, 2009, 2013, 2016, 2021), which established a standardised procedure for estimating the economic impact of tourism in large-scale PAs and undertook various case studies in all types of PAs. Meanwhile, other researchers used basically the same approach to estimate these values for other PAs (Rein & Schneider, 2009; Rein & Balas, 2015 for Lower Oder Valley National Park) and in replicated studies (Steingrube & Jeschke, 2011 for Müritz National Park, Rein et al. 2017/18 for Hainich National Park, see Nationalpark-Verwaltung Hainich, 2019), while others used a differing approach, which makes comparisons difficult, especially regarding the size of visitation (Wölfle et al., 2016 for Eifel National Park, Arnberger et al. 2013/14 and Allex et al., 2018 for Bavarian Forest National Park, see Arnberger et al., 2019 and Nationalparkverwaltung Bayerischer Wald & Nationalparkverwaltung Šumava, 2020). Thus, not all economic impact studies in German PAs are completely comparable, due to the differing methodologies adopted, especially regarding the crucial step of visitor day number estimation[21] (Job et al., 2021). To sum up, the degree of knowledge about visitation and the resulting regional economic impact of PA tourism in Germany has improved considerably in the last two decades. However, nothing in the line of a national monitoring program, such as in the USA or Finland, has been established so far.

Table 5.1 gives an overview of the key findings of the available regional economic impact assessments of German PAs. The results show that many large-scale PAs in Germany are important tourism attractions generating considerable regional economic impacts (see Mayer & Woltering, 2017, which is also the basis for the following, updated paragraphs).

The visitor days and structure as key parameters for economic impact studies are influenced by the location of the PAs with regard to the agglomerations: the distance between potential source regions and the PAs is crucial. For example, Bavarian Forest National Park with its long distances to major cities is dominated by overnight visitors, whereas Eifel National Park south of the Rhein-Ruhr megalopolis is highly frequented by day-trippers (Woltering, 2012). In total, for all German NLP there are an estimated 53.1 million visitor days per year (Job et al., 2016). The two Wadden Sea National Parks dominate accounting for approx. 80% of this visitation value. Based on the exactly replicated studies, there is no clear indication that the visitation to German national parks is indeed increasing, as is often suggested in the media – however, this does not include the situation during the COVID-19 crisis. The extrapolated results for all German biosphere reserves total 65.3 million visitor days per year (Job et al., 2013, p. 97; Mayer & Job, 2014, p. 83). For the 104 nature parks there are not even rough estimates of the total visitation volume available.

All German national parks generated a gross turnover of EUR 2.78 billion in 2016, showing huge variability and leading to an income equivalent of around 85,500 persons (Job et al., 2016, p. 24). All German biosphere reserves create an

[21] The study by Allex et al. (2019) also differs regarding the expenditure survey as spending for petrol is included, in contrast to all earlier studies by Job et al.

extrapolated amount of EUR 2.94 billion gross turnover with income equivalents of approximately 86,200 persons (Job et al., 2013, p. 97). The high values of the two Wadden Sea National Parks and Southeast Rügen Biosphere Reserve (part of the Pomerania region) can be explained by the fact that all three are coastal areas with a long tradition as destinations for beach/spa tourism and were designated as PAs only relatively recently. Therefore, it makes sense to assess the importance of the PAs for visitors' travel motivation. Knowledge about the status as a PA and its relevance for visitation is analysed with the help of several successive questions (see Job et al., 2005, 2009; Mayer et al., 2010).

Depending on a region's history of tourism development, the PA status represents the main visiting reason for a certain share of guests. These are usually termed as visitors with a high PA affinity. Among the national parks, Bavarian Forest achieved the highest value with a share of 57.9%, followed by Eifel (48.0%) and Müritz (47.7%), while Lower Saxony Wadden Sea and Black Forest reached only 10.9% and 9.3%, respectively, because of their respective beach/spa and hiking/spa tourism traditions. For the biosphere reserves, these results were a little lower: Schaalsee with its relatively short tourism history showed the highest share of visitors with a high PA affinity (21.5%). Rhön had a share of 13.7%, whereas Southeast Rügen reached only 4.9%. This means that only this small share of visitors would not come to the region if the biosphere reserve did not exist.

Regarding this core segment of visitors with a high PA affinity (who could also be interpreted as nature tourists in a stricter sense because they are motivated by the PA status), the results of the economic impact analysis must be adapted: overall, for all national parks, this segment attracted 9.51 million visitor days and a related gross turnover of EUR 431 million per year. The total economic impact of tourism in the 15 national parks analysed totaled EUR 252.1 million for the visitors with a high PA affinity and EUR 1.445 billion, respectively, for all national park visitors (Job et al., 2016, p. 24 f.).

For the biosphere reserves, the extrapolated results for all German biosphere reserves reduce to 4.2 million the visitor days motivated by the biosphere reserve status, generating a yearly gross turnover of about EUR 181.5 million and 5,261 income equivalents (Job et al., 2013, p. 97). Overall, the large gap in the results for both PA categories indicates that there was still a huge tourism potential, especially looking at those visitors who were attracted mostly by the PA. This also held true for the two nature parks analysed, where the share of visitors with a high PA affinity was very low (only 4.1% in Hoher Fläming) or limited (15.3% for Altmühltal, presumably a rather high value for nature parks).

Table 5.1 also highlights the mostly marginal shares of foreign visitors to German large-scale PAs. Only Berchtesgaden, Black Forest and Eifel National Parks registered more than 10% of incoming guests due to the proximity to Austria, France and Switzerland, and Belgium and the Netherlands. The shares were even lower in BR, potentially due to their limited prominence.

In addition to the economic impact of national park tourism, Mayer and Woltering (2018), as well as Sinclair et al. (2020), estimated the consumer surplus

Table 5.1. Regional economic impact of tourism in selected German protected areas

Name	Area [ha]	Designation Year	Survey Year	Visitor Days [Million]	Share of Day-trippers [%]	Share of Foreign Visitors [%]	Share of Visitors with High PA Affinity [%]	Average Spending per Person and Day [€]	Gross Turnover all visitors [Million €]	Income all visitors [Million €]	Income Equivalent all visitors [Person]
National Park											
1 Bavarian Forest	24 217	1970	2007	0.76	33.0	3.8	45.8	36.57	27.8	13.5	904
			2018	1.36	58.6	–	57.9	38.49	52.4	26.1	–
2 Berchtesgaden	20 804	1978	2002	1.13	23.0	–	10.1	44.27	8.2*	4.6*	206*
			2014	1.58	25.4	15.6	27.7	59.35	93.8	47.5	2103
3 Eifel	10 770	2004	2007	0.45	76.0	11.7	27.3	19.31	8.7	4.3	251
			2014/15	0.87	64.5	10.3	48.0[a]	46.42	30.2	15.2	674
4 Hainich	7 513	1997	2007	0.29	76.0	1.4	40.7	17.25	5.0	2.5	168
			2017/18	0.30	60.0	7.0	40.0	28.83	8.5	5.2	266
5 Harz	24 732	1990/ 1994	2012/13	1.75	49.8	4.9	24.4	42.57	74.3	39.6	2312
6 Kellerwald-Edersee	5 738	2004	2007	0.20	59.0	5.8	25.8	19.48	3.9	1.9	111
7 Lower Oder Valley	10 323	1995	2007/08	0.21	92.0	–	32.1	9.45	1.9	0.9	61
			2013/14	0.14	83.9	3.0	39.0	14.85	2.1	1.0	63
8 Lower Saxony Wadden Sea**	345 000	1986	2007	20.65	15.0	1.5	10.9	50.37	1040.2	525.1	34525
9 Müritz	32 200	1990	2004	0.39	39.0	–	43.7	34.30	13.4	6.9	628
			2010	0.38	9.2	4.0	47.7	53.96	20.2	10.4	768
10 Saxon Switzerland	9 350	1990	2009	1.71	46.0	6.3	28.8	34.30	58.7	29.3	1878
11 Schleswig-Holstein Wadden Sea***	441 500	1985	2012/13	18.80	18.5	1.8	17.1	57.19	1065.6	572.1	30401

Name	Area [ha]	Designation Year	Survey Year	Visitor Days [Million]	Share of Day-trippers [%]	Share of Foreign Visitors [%]	Share of Visitors with High PA Affinity [%]	Average Spending per Person and Day [€]	Gross Turnover all visitors [Million €]	Income all visitors [Million €]	Income Equivalent all visitors [Person]
12 Black Forest	10 062	2014	2014/15	1.04	60.2	14.6	9.3	42.98	44.7	22.8	825
13 Jasmund	5 738	1990	2013/14	0.68	8.2	7.6	27.5	69.97	47.5	24.8	1583
14 Western Pomerania Lagoon Area	78 600	1990	2013/14	4.77	14.0	7.0	31.5	60.86	290.1	150.4	9582
Biosphere Reserves											
I Palatinate Forest	180 969	1992	2011/12	5.72	60.6	3.6	3.5	38.20	229.0	116.2	5271
II Rhön	243 323	1991	2010/11	6.37	68.1	1.0	13.7	45.57	185.6	94.6	4786
III Schaalsee	31 000	2000	2011/12	0.49	82.4	0.7	21.5	22.97	11.6	5.7	336
IV Southeast Rügen	22 800	1991	2011/12	5.29	6.7	2.8	4.9	71.43	379.3	203.9	14281
V Spree Forest	47 509	1991	2011/12	1.94	48.7	1.0	8.7	62.16	90.0	47.4	2971
VI Vessertal-Thuringian Forest	17 081	1979	2010/11	0.49	64.1	6.7	11.1	24.89	12.7	6.4	392
Nature Parks											
A Altmühltal	296 617	1969	2004	0.91	63.0	–	15.3	22.80	20.7	10.3	483
B Hoher Fläming	82 718	1997	2004	0.30	83.0	–	4.1	20.60	6.2	3.0	211

* Data available only for visitors with high national park affinity; only net turnover available; ** About 93.0% water surface; *** About 97.7% water surface; [a] without local visitors.

Source: adapted from Mayer & Woltering, 2017, pp. 140f. and Mayer & Stoll-Kleemann, 2020, pp. 489f., based on Job et al., 2003, 2005, 2009, 2013, 2016; Mayer & Job, 2014; Mayer & Woltering, 2018; Merlin, 2017; Nationalparkverwaltung Bayerischer Wald & Nationalparkverwaltung Šumava, 2020; Nationalpark-Verwaltung Hainich, 2019; Rein & Schneider, 2009; Rein & Baláš, 2015; Steingrube & Jeschke, 2011; Wölfle et al., 2016; Woltering, 2012.

of visitation to the German national parks – these benefits surpass the economic impact considerably, even using conservative assumptions. This indicates that the direct vicinity of national parks does not only bring economic profits from their visitation, but also the German society as a whole benefits from the recreational value of such sites.

5.3. Methods

5.3.1. Polish protected areas

The economic impact of tourism in protected areas (PAs) is analysed by considering the demand generated by visitors to such sites. This demand is satisfied by local companies. To meet the increased final demand (i.e. the demand that is not transferred between industries in the production process), companies need to increase production. As the output from each industry is sent to all other industries, there are multiplier effects in the economy, resulting in increased output in all industries (even if only some of them directly profit from visitor expenditures). We call the transfers of shares of production between industries inter-industry flows. Knowing the production volumes of each industry and their use for intermediate consumption in other industries, we create an input-output table, which is the basis of the input-output model.

Therefore, an assessment of the economic impact of tourism in PAs is conducted by means of the input-output (I/O) model. The basics of this method were proposed by François Quesnay (1759) in his *Tableau économique*, and by Léon Walras (1874). The matrix form of the input-output analysis was proposed by Wassily W. Leontief (1936).

The input-output model exists in two forms: natural and monetary. As production of different industries is measured in different units, the monetary form of the input-output analysis is much more widely used. The I/O table is presented in the monetary form in Table 5.2.

Table 5.2. The I/O table in the monetary form.

		Outputs				
		X_1	X_2	⋯	X_n	y_i
Inputs	X_1	X_{11}	X_{12}	⋯	X_{1n}	y_1
	X_2	X_{21}	X_{22}	⋯	X_{2n}	y_2
	⋮	⋮	⋮		⋮	⋮
	X_n	X_{n1}	X_{n2}	⋯	X_{nn}	y_n
	X_0	X_{01}	X_{02}	⋯	X_{0n}	y_0
	M	m_1	m_2	⋯	m_n	

where:
X_i – value of production (input) in *i*-th industry,
X_{ij} – value of production (input) in *i*-th industry and transferred to the *j*-th one,
X_0 – salaries in the industries,
y_i – final output (demand),
y_0 – salaries in the non-production sectors,
M – profits (value added) in the industries.

Output allocation equation:

$$X_i = \sum_{j=1}^{n} x_{ij} + y_i \quad i = 1,2, \ldots, n$$

Input allocation equation:

$$X_j = \sum_{i=1}^{n} x_{ij} + x_{0j} + m_j \quad j = 1,2, \ldots, n$$

Labour force equation:

$$X_0 = \sum_{j=1}^{n} x_{0j} + y_0$$

National income equation:

$$\sum_{i=1}^{n} y_i = \sum_{j=1}^{n} x_{0j} + \sum_{j=1}^{n} m_j$$

In real-life situations, it is much more convenient to analyse not the total value of production (input) in the *i*-th industry and transferred to the *j*-th one, but the cost coefficients (b_{ij}), denoting the input of resources from the *i*-th industry needed to produce a unit value of output in the *j*-th industry:

$$b_{ij} = \frac{x_{ij}}{X_j}$$

The output allocation equation with the use of cost coefficients is as follows:

$$X_i = \sum_{j=1}^{n} b_{ij} X_j + y_i \quad i = 1,2, \ldots, n$$

The input allocation equation with the use of cost coefficients is as follows:

$$X_j = \sum_{i=1}^{n} b_{ij} X_j + x_{0j} \quad j = 1,2, \ldots, n$$

We present the matrix of the cost coefficients (B), vectors of the value of global output (X) and final output (Y):

$$B = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ b_{n1} & b_{n2} & \cdots & b_{nn} \end{bmatrix} \quad X = \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{bmatrix} \quad Y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix}$$

Because the values of vector Y are known and result from social demands, we must find the vector of global output needed to satisfy the final output. The output allocation equation in the matrix form is as follows:

$$X = BX + Y \tag{5.1}$$

Solving equation (5.1) with respect to X, we obtain:

$$X = (I - B)^{-1}Y \tag{5.2}$$

Where $(I - B)^{-1}$ is the matrix of additional input coefficients.

Since the input-output tables are available at the national level, we need to perform a regionalisation procedure in order to obtain the input-output table at the regional level. It is important to do this, because the economic impact of tourism is analysed here only for specific regions, and not for the whole country. Regionalisation is done by means of the *location quotients* (LQs). The simplest method of calculating the LQs is to use shares of regional output or employment in relation to the national share of output or employment in this industry – this way we arrive at the simple LQ (SLQ) (Arnegger, 2014):

$$ELQ_{ir} = \frac{\frac{O_{ir}}{O_r}}{\frac{O_{in}}{O_n}} \tag{5.3}$$

where:
O_{ir} – output (or employment) in the *i*-th industry in the analysed region,
O_r – total regional output (or employment),
O_{in} – national output (or employment) in the *i*-th industry,
O_{jr} – total national output (or employment).

However, formula (5.3) is suitable only for input-output within a given industry. In order to consider the transfers between various industries, we must introduce the *cross-industry location quotients* (CILQs) (Arnegger, 2014):

$$CILQ_{ij} = \frac{\frac{O_{ir}}{O_{in}}}{\frac{O_{jr}}{O_{jn}}} \tag{5.4}$$

where:
i – supplying (selling) industry,
j – purchasing industry,
O_{ir} – output (or employment) in the i-th industry in analysed region,
O_{in} – national output (or employment) in the i-th industry,
O_{jr} – output (or employment) in the j-th industry in analysed region,
O_{jn} – national output (or employment) in the j-th industry.
By means of the equations (5.2) and (5.3) we regionalise the cost coefficients matrix (B). Knowing the final demand in the analysed region, we can calculate the global output (production) for the analysed region needed to satisfy the final demand. When we divide the value of global production by the average wages in the area, we can calculate the equivalent of the additional employment needed to achieve the regional global output, thus, to satisfy the final demand. The global production and its equivalent in employment can be considered as the economic impact of tourism in PAs.

We conducted the analysis for Wolin National Park by using the input-output tables for Poland (OECD, 2022). The latest edition of these tables was available for the year 2015. By using the structure of employment for Poland and the region (Zachodniopomorskie Voivodship) in 2020 (Statistics Poland, 2022) we regionalised the input-output tables by using the formulas (5.2) – (5.4). In order to assess the equivalent of employment, we used the average wages in the industries in the region (Statistics Poland, 2022).

One very important step in the assessment of the economic impact of tourism in PAs is the calculation of visitor days and the assessment of the visitor expenditure in the sites. The visitor days were calculated on mixed bases of information. First, the data from 17 automatic counters (devices used for automatic counting of visitors that entered the park) were obtained. Next, the data was revised by the national park staff to account for dysfunctional devices and, additionally, an estimation was made of visitors entering the park on paths without automatic counters. There are two main entrances where people can enter the park area by different paths, but only one is checked by an automatic counter. These two locations were observed on eleven days by interviewers, who manually counted all the entering people, independent of the method they used for that purpose. This delivered a correction factor for the data from the automatic counting devices – the automatic counters recorded only about 80% of the true number of entrances.

We received the visitor expenditure values by means of 1440 face-to-face interviews at six entrances to the national park (for the questionnaire please see Appendix E, https://doi.org/10.12657/9788379864201-apps). We conducted the surveys on 17 days in the period from 25.01.2020 to 25.09.2021. This period was interrupted several times due to restrictions related to the COVID-19 pandemic, but all seasons were covered over two years. We divided the visitors into day-trippers (those who were in the area for only one day) and overnight visitors (those who stayed in the area for at least one night).

5.3.2. German protected areas

The research in Germany focused on the socio-economic monitoring in the UNESCO Biosphere Reserve Schorfheide-Chorin in the German Federal State of Brandenburg. The aim was to apply the method introduced for biosphere reserves by Job et al. (2013) in order to gain a profound understanding of this method and to identify potential adaptations for an optimised methodological approach applicable to the Pomerania region.

Especially visitor numbers and the specific structure of visitor expenditure were necessary to carry out the economic impact analysis of PA tourism. In order to determine these data, visitor counts as well as interviews were systematically conducted in the Biosphere Reserve at ten predefined locations over a period of 12 months in the years 2020/2021 (for the questionnaire please see Appendix F, https://doi.org/10.12657/9788379864201-apps). The surveys were carried out in the summer season between 10 am and 6 pm and in the low season between 10 am and 4 pm due to the shorter daytime and the reduced leisure behaviour of guests. All the surveys were carried out electronically via mobile phones with the app *mQuest traffic* that allowed for the surveys to be conducted offline.

Due to the COVID-19 pandemic, several methodological adaptations had to be made and will be explained within the following sections.

5.3.2.1. Visitor numbers

As there are no "entrances" to the Biosphere Reserve, there is no reliable information on the visitor numbers in the region. In order to determine the total number of visitors, visitor counts combined with short interviews were carried out throughout the Biosphere Reserve. The locations were identified with the support of the PA's administration and aimed to cover all the main visitor hotspots and other potential points of interests for different visitor types. A similar study with the same methodological approach had already been carried out in 2017/18 by the Institute of Geography and Geology at the University of Würzburg (see Job et al., 2023). The results are expected to be published in 2023, but preliminary results are already available, so that comparisons between our study and the analysis from 2017/18 can be drawn. In accordance with the previous study from 2017/18, five locations were not used during the low season and two other locations were staffed with two interviewers each because of high visitor frequencies. The approach was an attempt to replicate the previous study and aimed to represent the conditions on site in the best possible way.

The short interviews were conducted at a flexible frequency during the counts and provided information about overall visitor characteristics, such as whether they were residents, day-trippers or overnight visitors, as well as further information about overnight visitors. By adhering to a clear frequency, a true random sample was obtained and the representative structure of visitors could be determined.

Residents were identified by local zip-codes within the Biosphere Reserve and additionally by asking the purpose of the visit (leisure or transit/other daily

purposes) in the long interviews. Residents with leisure purposes were classified as day-trippers and included in the economic analyses, but residents that were in the area because of their daily-life routines were excluded (according to the definition of tourism visitors in UNSD, 2010, p. 12). For overnight visitors, the category of accommodation (hotel, camping, etc.) was determined and the range of money spent (e.g. up to EUR 30) was asked in order to be able to weight upcoming extrapolations. The short interviews, which were conducted in combination with the visitor counts, alternated with long interviews every half hour.

As visitor numbers tend to vary both temporally and spatially, and over the week and the single day, the survey days were divided according to specific seasonal periods, as suggested in Job et al. (2013) (Table 5.3):

Table 5.3. Survey days per season

Season	Amount of survey days
Summer season I (18/07/2020–14/09/2020)	6 survey days // 4 weekends, 2 week-days
Low season I (15/09/2020–14/11/2020)	3 survey days (COVID-19 lockdown from 01 November) // 1 weekend, 2 week-days
Winter season (15/11/2020–14/03/2021)	0 survey days (COVID-19 lockdown)
Low season II (01/04/2021–30/04/2021)	1 survey day // 1 weekend (during lockdown)
Low season III (01/05/2021–14/06/2021)	4 survey days (COVID-19 lockdown until 06 May 2021) // 1 weekend, 3 week-days
Summer season II (15/06/2021–17/07/2021)	2 survey days // 1 weekend, 1 week-day

Source: own elaboration.

Due to the COVID-19 pandemic, parts of the low season I (November 2020), the complete winter season, and parts of the low season II (until May 2021), were in lockdown with a total tourism-closure of 197 days, so that no survey days were undertaken during that time. An exception was Easter 2021, with a survey day carried out during the weekend in four main locations of the region which focused on visitor counts and short interviews. Hence, the weekends of April 2021 could be included in the visitor estimations. In total, 16 survey days with an even split between weekends and weekdays could be implemented, covering a period of 187 total days from 18 July 2020 until 17 July 2021.

The counts and short interviews of a survey day normally covered eight half-hour intervals between 10 am and 6 pm in a single day (or six half-hours from 10 am to 4 pm during the low season, respectively). The counted visitors were extrapolated site-specifically by calculating the average value to the minute and then extrapolating it to a full hour. The sum of the hourly values give the number of visitors during the survey period. However, this only covered part of the day, so that the result were extrapolated to an entire day, as per Job et al. (2006, p. 8). By adding up the daily visitor numbers for the individual sites, the total number of visitors in a survey area on a survey day was finally determined. The daily values served as the basis for calculating the annual number of visitors. For this purpose, nine different day types were defined, which considered the season, the day

of the week, and the weather (see Figure 5.1). Average values for the respective day types were then calculated from the daily values. To take the weather into account, weather data from the German Weather Service for the weather station Angermünde was integrated into the calculation on a daily basis. For the calculation of the variables of "good" and "bad" weather, the three parameters of temperature, sunshine duration, and precipitation, were included. These values were transformed and indexed using the moving average of each season. The weather index thus categorised each survey day according to the categories of "good" weather and "bad" weather during a specific season. The three characteristics of "season", "day of the week" and "weather" allowed for assigning each survey day to one of the nine typical day types, which served as the basis for extrapolating the total visitor numbers. The average values for each of these day types were then extrapolated according to the overall number of each day type (see also Staab et al., 2021). For the survey day during Easter 2021, weather categorisation was excluded, as there was no further survey day and because of the uncertain visitor behaviour during the time of a COVID-19 lockdown.

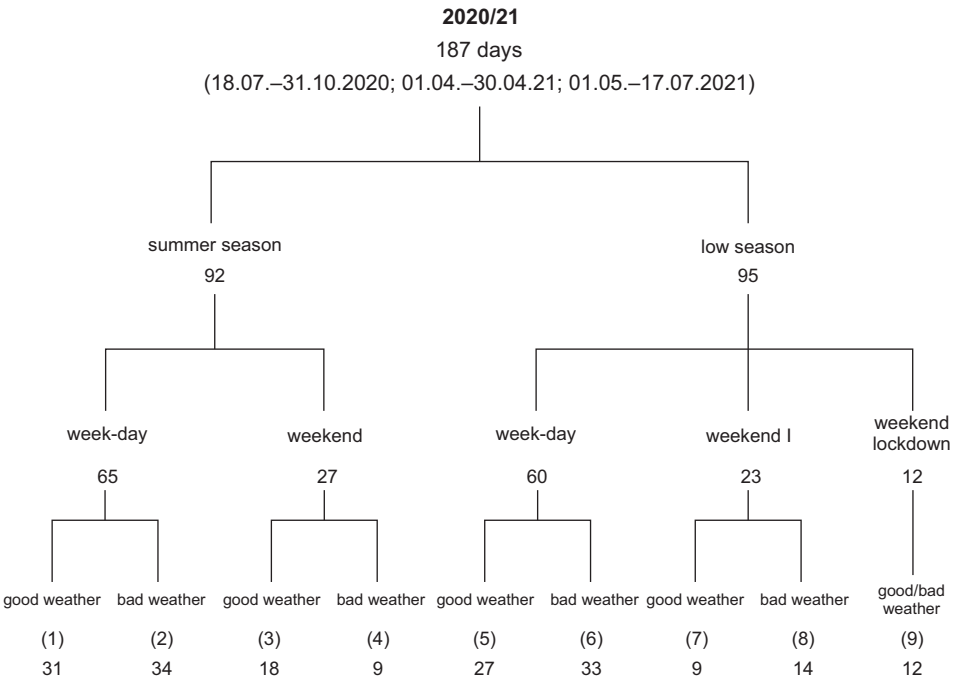

Figure 5.1. Categorisation of day-types (in brackets) and number of days for each category
Source: own elaboration.

The calculated visitor number only corresponds to the representation of visitors at the specific ten sites and during the analysed period. Due to the size, different settlement areas and traffic routes in the biosphere reserve, and the uncertainties around visitor behaviour during the COVID-19 pandemic, these estimations could hardly be a basis for robust conclusions about the total number

of visitor days in the area during one year. Hence, we extrapolated the data with the help of official tourism statistics, as recommended in Job et al. (2013, 2021).

Up to this point, the visitor numbers corresponded to the "extrapolation of the counting" stage and reflected representative ratios of different visitor groups.

To complement the figures, official municipal statistics of the survey-time were used. As the area of the Biosphere Reserve is not entirely coherent with the municipal borders, tourism figures were only calculated proportionally according to the actual area shares of the Biosphere Reserve. This approach prevented an overestimation of values, e.g. the number of overnight stays in tourist centres outside a biosphere reserve is not included in the analysis. We applied the same delineation of the area as in the previous study from 2017/18.

To complement the generated data, ratios of the shares between day-trippers and overnight visitors, as well as the accommodation categories, were used. For this purpose, we used the (extrapolated) shares of visitors staying in accommodation types that are not included in official statistics, such as apartments, visits at friends' and relatives'. This step was an attempt to minimise the inaccuracy of the official tourism statistics with regard to non-commercial overnight stays. Subsequently, the share of day-trippers and residents was added to the number of overnight visitors according to the empirically collected ratios. In total, the number of visitors corresponded to the overnight stays recorded in official statistics, the non-commercial overnight stays, and day-trippers and residents, whereby the proportions were derived from the empirical surveys in the study areas. This methodological procedure aimed to determine a representative, valid and reproducible number of visitors in the biosphere reserve.

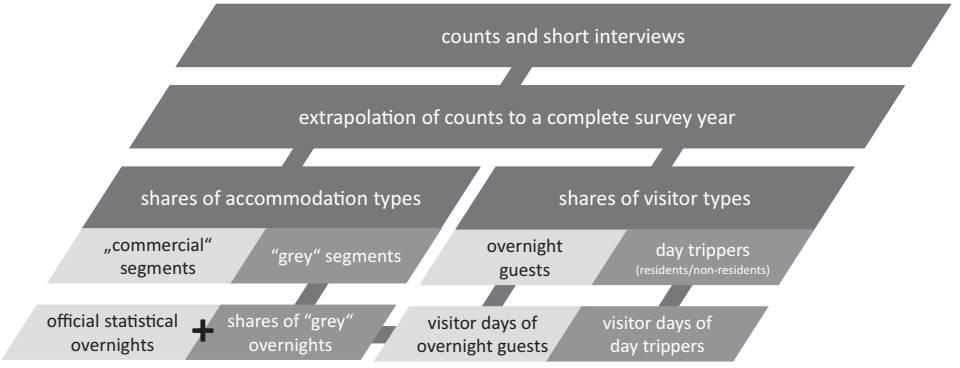

Figure 5.2. Approach of estimating final visitor numbers.
Source: own elaboration, based on Job et al. (2013, p. 52).

5.3.2.2. Economic impact estimation of PA visitation

As discussed previously, the visitors' motivation needs to be known to be able to attribute the adequate share of regional income to tourism because of the existence of the PA. Visitors that make a trip or a day excursion solely because of the biosphere reserve add value that would not exist without the protected area.

This classification is of particular importance. Biosphere reserves pursue the goal of a harmonious combination of nature conservation and economic development (Kraus, 2015; Merlin, 2017). Specific biosphere reserve visitors know the status of the PA and visit it because of its protection status. Accordingly, these visitors have a specific demand behaviour that has to be addressed differently than that of the group referred to as "other biosphere reserve tourists".

For the classification into these groups, a stepwise sequence of three partly redundant questions was run through on the survey instrument, analogous to Job et al. (2003, p. 127 and 2005, p. 61). Only if these three questions were answered positively, were the respondents classified as specific biosphere reserve tourists and included as such in the further economic impact analysis.

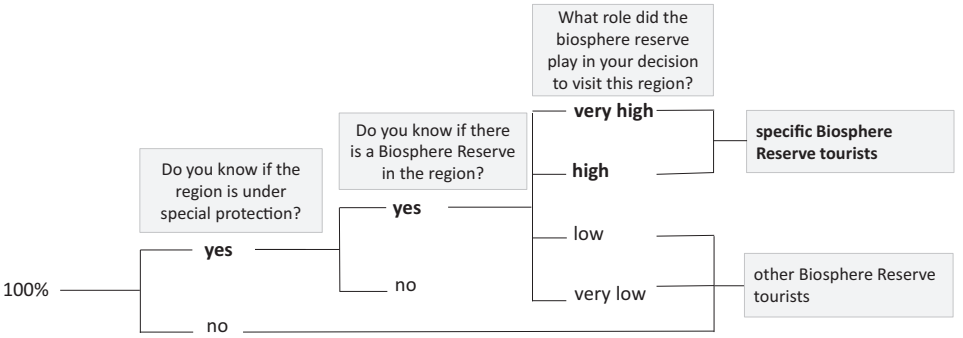

Figure 5.3. Approach of determining visitors with high biosphere reserve affinity.
Source: own elaboration, based on Job et al. (2003, p. 127) and Job et al. (2005, p. 61).

In order to calculate the regional economic impact, the expenditure structure of all relevant visitor groups had to be determined. The expenditure was differentiated according to day-trippers, residents and overnight visitors, and was also segmented into "specific biosphere reserve tourists" and "other biosphere reserve tourists". Expenditures of overnight guests were combined with the results of the short interviews that provided extensive information on different expenditure groups for all accommodation types (e.g. less than EUR 30 per night in a hotel, EUR 30–EUR 60 in a hotel etc.). The long interviews provided information on the average daily expenditures of respondents belonging to these accommodation types. This data was weighted with the average shares of each expenditure group provided in the short interviews. As proposed in Job et al. (2005, p.65), this was done to get as accurate information as possible for the average expenditures of different accommodation types.

Beyond these visitor groups, expenditures were distributed among different sectors. The types of expenditure were asked for in detail in the long interviews, to enable an in-depth breakdown of the data for all further calculations. In total, ten expenditure types were asked for that could be divided into three main expenditure groups:

- Hospitality, which includes expenditures on restaurants and accommodation (weighted results)

- Retail trade, with expenditures on food and other goods
- Services, which include expenditure on transport, sports, leisure and admissions, as well as the visitor's tax and conference fees and others.

The in-depth differentiation of expenditures was maintained throughout the overall calculations of VAT deductions and the calculation of economic impact. For the first multiplier round, all income effects resulting from the direct expenditure of tourists were recorded. The value-added quotas vary considerably from sector to sector. For this study, as in the previous study, average tourism-specific value-added quotas were used, based on national data and according to the type of service (based on data by Harrer & Scherr, 2002; Maschke, 2005). The calculation was done separately for each expenditure category. Therefore, the overall income structure represents the specific spending behaviour of visitors in the Biosphere Reserve. Exact value-added quotas of the companies benefiting from the second multiplier round could not be used in this study. For this reason, the widely used average of 30% was applied as a value-added quota for the indirect income effect. To determine income equivalents, the average primary income of the region was determined (official statistics) and divided by the tourism income contribution. The calculation procedure was based on the method by Job et al. (2003 and 2005) and Mayer et al. (2010), and is summarised by Figure 5.4:

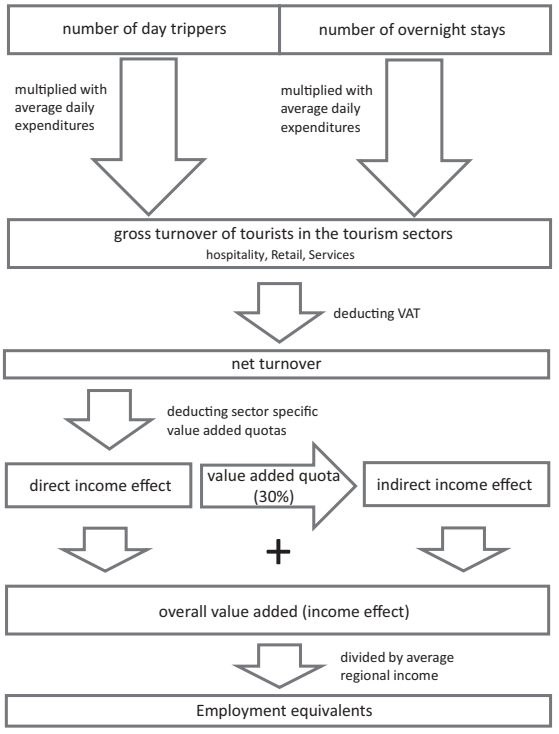

Figure 5.4. Approach of estimating regional economic impacts of PA tourism.
Source: own elaboration, based on Job et al. (2003, p. 127) and Job et al. (2005, p. 61).

Some alterations to the calculations had to be made due to methodological challenges with the mobile questionnaire application. A technical bug excluded the expenditure questions for day-trippers in the summer season I. In order to prevent data skewing, the daily expenditures of day-trippers for the summer season were imputed with the total daily expenditures of the survey days in the summer season II. The calculations showed only slight deviations of the expenditures, which were adjusted in the overall expenditures.

Additionally, VAT rates were reduced from July-December 2020 as measures for supporting the German economy during COVID-19. These reductions were taken into account within the calculations.

5.4. Economic impact of tourism in protected areas in the Pomerania region

5.4.1. Economic impact of tourism in Polish protected areas – the example of Wolin National Park

We present the number of visitor days and the visitors' yearly spendings in Table 5.4.

Table 5.4. The annual number of visitor days and the visitors' total net expenditure.

Groups of visitors	Fraction [%]	Net expenditure per person [PLN]	Annual number of visitor days	Annual total expenditure [PLN]
Day-trippers	8.6	110	59,490	6,543,900
Overnight visitors	91.4	277	632,251	175,133,527
Total	100.0		691,741	181,677,427

Source: own elaboration.

Over 91% of visitor days were generated by overnight visitors. They also contributed the largest part of the total expenditure (over 96%). All the expenditure was net of tax, because the VAT is a tax that flows to the central government and therefore does not contribute to the local economic effects.

The visitor expenditure could be differentiated into four groups of expenses, supplying four industries (Table 5.5).

Table 5.5. Visitor expenditure structure.

Groups of expenses	Day-trippers	Overnight visitors
Accommodation and food services	33.0%	56.5%
Retail trade	55.5%	39.5%
Arts, entertainment, recreation and other service activities	6.5%	2.3%
Transportation and storage	5.0%	1.7%

Source: own elaboration.

The largest share of day-trippers' expenses were the expenses on retail trade, while for overnight visitors the expenses on accommodation and food services were the most important.

We merged the I/O table to obtain the following sections:

- Section A: Agriculture, forestry and fishing,
- Section B+C+D+E: Mining and extraction of energy producing products, electricity, gas, water supply, sewerage, waste and remediation services,
- Section F: Construction,
- Section H: Transportation and storage,
- Section G: Wholesale and retail trade; repair of motor vehicles,
- Section I: Accommodation and food services,
- Section J: Telecommunications, IT and other information services,
- Section K: Financial and insurance activities,
- Section L: Real estate activities,
- Section M+N: Professional, scientific and technical activities; administrative and support service activities,
- Section O: Public administration and defence; compulsory social security,
- Section P: Education,
- Section Q: Human health and social work,
- Section P+R: Arts, entertainment, recreation and other service activities.

The estimated visitors' expenses (final demand) and the global regional production (economic impact) in 2020 are presented in Table 5.6.

Table 5.6. Estimated economic impacts of tourism in Wolin National Park in 2020 (in PLN thousand).

Sections	Day-trippers		Overnight visitors		Total
	Expenses	Production	Expenses	Production	Production
A	0.0	504.7	0.0	15,923.8	16,428.5
B+C+D+E	0.0	3,106.1	0.0	90,486.3	93,592.4
F	0.0	265.2	0.0	6,474.0	6,739.2
G	3,631.9	4,521.3	69,177.7	93,722.7	98,244.0
H	327.2	849.2	2,977.3	14,543.6	15,392.9
I	2,159.5	2,226.4	98,950.4	100,674.6	102,901.0
J	0.0	122.9	0.0	2,880.8	3,003.7
K	0.0	100.1	0.0	2,401.9	2,502.0
L	0.0	188.6	0.0	4,694.1	4,882.7
M+N	0.0	379.8	0.0	9,200.7	9,580.5
O	0.0	7.8	0.0	183.3	191.1
P	0.0	11.2	0.0	267.2	278.4
Q	0.0	166.5	0.0	3852.3	4018.8
R+S	425.4	523.5	4028.1	6369.5	6893.0
Total	6,543.9	12,973.3	175,133.5	351,674.9	364,648.3

Source: own elaboration.

As every sector influences all other sectors in the I/O model, the four groups of expenses caused production in all the other sectors. The visitors' final demand caused the highest increase in production in sectors B+C+D+E (mining and extraction of energy producing products, electricity, gas, water supply, sewerage, waste and remediation services), G (wholesale and retail trade; repair of motor vehicles) and I (accommodation and food services). The estimated number of day-trippers and their expenses brought nearly PLN 13 million (2.78 million Euro) of total value of production in the region. The effect of the overnight visitors' expenses was much higher – over PLN 351 million (over 75 million Euro), which brought the total economic impact to the level of PLN 364.65 million (almost 78 million Euro).

The equivalent number of jobs in Wolin National Park in 2020 is presented in Table 5.7.

Table 5.7. Estimated equivalent number of jobs in Wolin National Park in 2020.

Sections	Mean wages [PLN]		Jobs		
	Monthly	Yearly	Day-trippers	Overnight visitors	Total
A	5,398.38	64,780.56	8	246	254
B+C+D+E	4,877.44	58,529.28	53	1,546	1,599
F	3,729.41	44,752.92	6	145	151
G	3,954.14	47,449.68	95	1,975	2,070
H	4,269.26	51,231.12	17	284	301
I	3,243.33	38,919.96	57	2,587	2,644
J	7,605.96	91,271.52	1	32	33
K	6,090.66	73,087.92	1	33	34
L	5,111.57	61,338.84	3	77	80
M+N	4,606.94	55,283.28	7	166	173
O	6,337.05	76,044.60	0	2	2
P	5,267.10	63,205.20	0	4	4
Q	4,845.95	58,151.40	3	66	69
R+S	4,323.29	51,879.48	10	123	133
Total			261	7,286	7,547

Source: own elaboration.

The equivalent of total production in the number of jobs can be obtained by dividing the estimated total production in every sector by average yearly wages in this sector. We estimated the number income equivalents generated by the expenditures of day-trippers at 261 and for the overnight visitors at 7,286. The total equivalent of production in the region of Wolin National Park in the number of jobs was 7,547. In some sectors (O and P – public administration and defence; compulsory social security and education, respectively), the increase in the number of jobs was hardly visible (these sectors depended on tourism to a very small degree). The highest increase in the number of jobs was visible in the case of the same sectors, as presented in the previous table – B+C+D+E (mining and

extraction of energy producing products, electricity, gas, water supply, sewerage, waste and remediation services), G (wholesale and retail trade; repair of motor vehicles) and I (accommodation and food services).

5.4.2. Economic impact of tourism in Schorfheide-Chorin Biosphere Reserve, Germany

In total, 28,593 persons could be reached by the counts (21,493) and short surveys (7,100) during the 16 survey days in Biosphere Reserve Schorfheide-Chorin. In addition, 1,171 long interviews were conducted, reaching a total sample of 29,764 visitors to the Biosphere Reserve during the survey time.

5.4.2.1. Visitor structure

The empirical results together with the data from official tourism statistics resulted in a total number of 2,540,000 visitor days within the boundaries of Schorfheide-Chorin Biosphere Reserve from July 2020 to June 2021. This marked a decline of 21% in comparison to 2017/18, with overnight visitors reaching 840,000 (–12%), and 1,650,000 day trips (–26%) and 51,000 residents[22].

This decline is explained by the COVID-19 lockdown of almost seven months during the surveyed period of 2020–2021 (197 lockdown days). An estimation of the average number of visitor days per day during the surveyed seasons (187 days) shows that visitor frequentation during that time was higher with 13,600 visitors per day than in the previous survey time of 2017/18 with an average of 8,800 visitors per day. Therefore, the decline in the total visitor number was not necessarily an indicator of a reduced visitor demand in the region; it must be assumed that it resulted in an even higher tourist pressure during times of the officially open days.

Visitor days of people staying overnight accounted for a share of 33%. The Biosphere Reserve received a larger influx of day-trippers, who accounted for a share of 67%. This structure is similar to most other examined biosphere reserves in Germany (Merlin, 2017) and it can be assumed that this biosphere reserve is particularly suitable for local, short-distance recreation.

Not all visitors came to the region because of the Biosphere Reserve. To find out the importance of the Biosphere Reserve for the motivation to visit the region, the affinity of the visitors and the awareness of the protection status were examined. Furthermore, other characteristics and preferences were determined.

For the region, a share of 20.4% of visitors with a high biosphere reserve affinity could be revealed, which was a decrease of 1.1%, compared to the previous study from 2017/18. Still, this percentage was significantly higher than the average of 10.5% of the six biosphere reserves studied in Germany in 2013 (Job et al., 2013, p. 76). A protected area status such as that of a national park can create a significant incentive to visit, especially in new destinations or those

[22] Residents that were in the region because of leisure purposes, were counted as day-trippers, whereas all other residents (just crossing the counting locations) were excluded in further calculations.

that are not very developed in terms of tourism. This is particularly interesting against the background of the COVID-19 pandemic, which was accompanied by a change in the tourism demand structure in many rural tourism regions in Germany (see details in Chapter 6 of this publication).

For Schorfheide-Chorin Biosphere Reserve, the visitor structure in the survey period 2020/21 was as follows: of the approximately 2,540,000 visitor days, approx. 519,100 were due to specific Biosphere Reserve visitors. Of these, approx. 294,600 were day-trippers and approx. 224,500 were visitor days of people staying overnight. The distribution of visitor types was almost identical with the structure in 2017/18, with a slight shift towards overnight visitors for both PA affinity types.

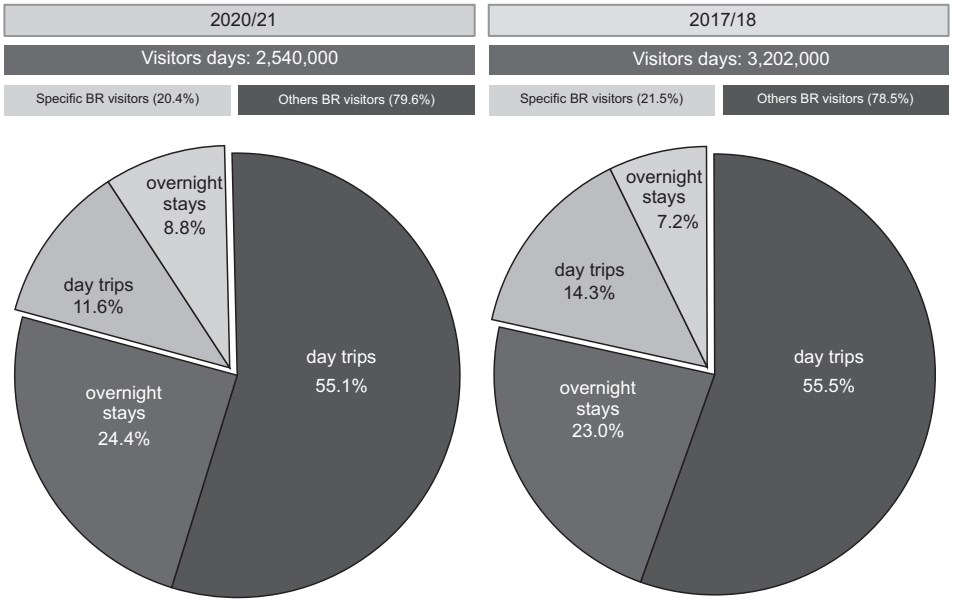

Figure 5.5. Visitor structure in Schorfheide-Chorin Biosphere Reserve 2020/21 in comparison with the previous study from 2017/18.
Source: own elaboration based on Job et al., 2023 (right part of the figure).

Overnight visits were clearly dominated by stays in holiday apartments (38%) followed by camping (19%) and hotel (14%). Compared to 2017/18, there was a shift from hotel stays to holiday apartments, whereas all other shares of accommodation categories were very similar. Only about one fifth of the overnight guests (19%) opted for catering services, especially breakfast - mainly in hotels. Only 3% of the guests who did not stay in hotels took advantage of catering services provided by the accommodation. 35% of overnight guests spent up to EUR 30 per person per night. Approx. another third of overnight guests (31%) spent up to EUR 50 per person for an overnight stay and another quarter (23%) spent between EUR 51 and EUR 75 per overnight stay. These values also reflected an increase in the total daily visitor expenditures compared to 2017/18.

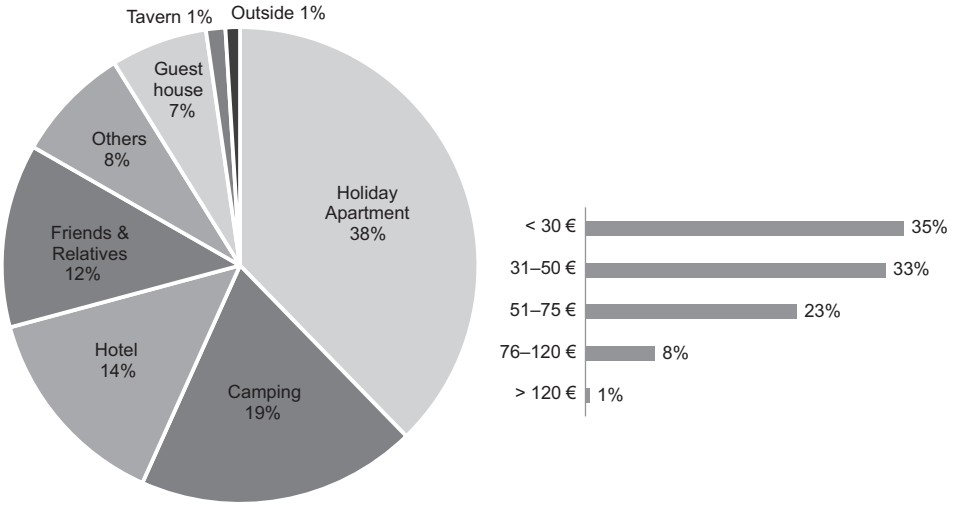

Figure 5.6. Choice of accommodation types and average spending per night in the Schorfheide-Chorin Biosphere Reserve.
Source: own elaboration.

The majority of guests (90%) came to the region for holidays and leisure. The main reasons for visiting were hiking (47%), cycling (29%), and visiting cultural sites (29%), as well as farm shops (24%). For as many as 27% of the visitors, activities such as sunbathing or water sports were decisive for their visit. Overall, the activities were quite balanced in popularity, which indicates a diverse tourism portfolio; hence, the region is attractive for pursuing various activities.

The majority of tourists arrived by their own or rented car (67.2%) or motorbike (12.2%). The region is especially well known for motorbike trips by Berliners. However, public transport also had quite a relevant significance as a mode of transport to the region, with a share of 12.9%. This is reasonable, as many starting points for hiking and cycling in the Biosphere Reserve are connected to the public transport network – especially for visitors from Berlin. Interestingly, the share of arrivals by train doubled over the last three years (2017/18: 5.7%). Another considerable proportion of visitors arrived on foot as hikers (5.5%). Arrival by bicycle, on the other hand, was extremely low at only 0.4%, although the Biosphere Reserve is crossed by some significant cycle routes. However, visitors also often took their bicycles on the train or car for cycling within the area. The importance of buses can be estimated somewhat higher than reported, especially at the site of the Niederfinow, as participants of group tours were underrepresented in the long interviews.

By asking for the zip-code during the short interviews, the origins of the visitors to the Biosphere Reserve could be mapped very precisely, as presented in Figure 5.8. Overall, visitors from Germany predominated (98%), with a very small proportion of visitors from abroad and no dominant foreign source markets. About two thirds of the visitors came from the Berlin-Brandenburg region (65.4%). Of course, this included a large proportion of day-trippers who came

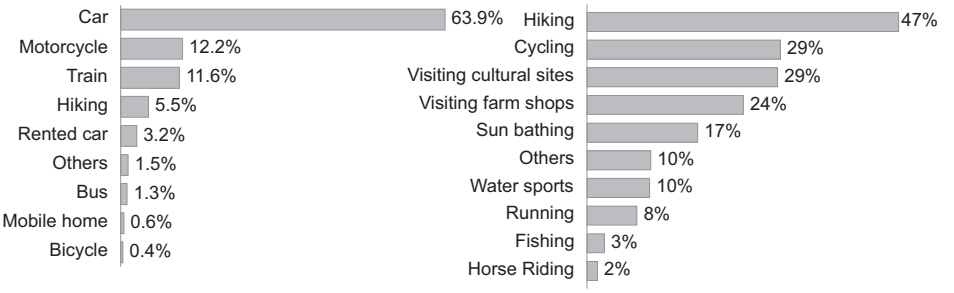

Figure 5.7. Activities (right) and mode of transport (left) for arrivals at Schorfheide-Chorin Biosphere Reserve.
Source: own elaboration.

mainly from Berlin and the immediate surrounding of the Biosphere Reserve (Barnim county). Besides the surrounding federal states, all other source markets were more regularly distributed among the other federal states, with a surprisingly low proportion of visitors from Mecklenburg-Vorpommern (2.3%).

Visitors between the ages of 31 and 45 were the biggest group with 30%. The 46–65 year old were the second largest age group with 29%. More than half of the visitors were below the age of 50 (56%). About a quarter of visitors (26%) were under 30 years of age, of which 17% were children and young people under 18 years of age. The age category of older adults over 65 years was represented by 15% of the visitors. Compared to the age group structure in Germany, the

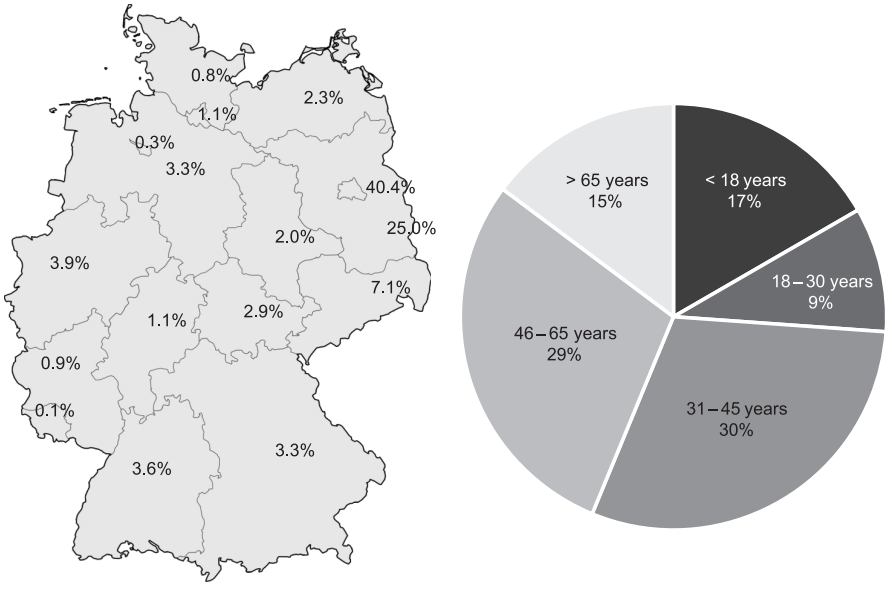

Figure 5.8. Source markets and age-groups of visitors in Schorfheide-Chorin Biosphere Reserve.
Source: own elaboration.

disproportionate share of visitors aged 31 to 45 was noticeable. The proportion of children and adolescents was also slightly higher than the proportion of this age group at the national level.

Regarding their educational status, the visitors to the Biosphere Reserve had a disproportionately higher educational background than the German average population, with 48% having a University degree and another 20% with A-levels / High-School diploma.

5.4.3.2. Economic impacts

According to a national study (BMWi, 2013), a day-tripper in Germany spends an average of EUR 28.30 per day, whereas the expenditure for day trips in urban areas is considerably higher at up to EUR 34.70 than in rural areas, with day-tripper spendings at an average of EUR 19.0.

The expenditure of day-trippers in Schorfheide-Chorin Biosphere Reserve was significantly above that average with EUR 27.80. This also marks a remarkable increase compared to 2017/18, where day-visitor expenditures were about EUR 18.0. Reasons for this increase might partly be connected to increased prices of the tourism offer and inflation, and a change of the target groups due to COVID-19 (see Chapter 6). When grouping the expenses into the three expenditure types of hospitality, retail and services, it becomes obvious that about one third of the daily expenses were earmarked for the service sector with transport in the region being the highest cost type. About half of the expenses were used for hospitality, in the case of day trips this means gastronomy services. The results also show that visitors with a high biosphere reserve affinity spent less money overall during a day trip. A national study of expenditure structures in German biosphere reserves (Job et al. 2013, p. 77) concluded that biosphere reserve affinity does not influence the level of expenditure. Instead, it states that the average expenditure values in biosphere reserves have a wide range between EUR 23.00 and EUR 71.40 and are very strongly influenced by regional conditions and tourism structures.

On a national average, overnight guests in Germany spend an average of EUR 131.60 per person and day in commercial accommodation establishments (Harrer & Scherr, 2010), with a very wide range of expenditure depending on the type of accommodation (youth hostel, inns, guesthouses, hotels, spas etc.).

The average expenditure of overnight guests visiting Schorfheide-Chorin Biosphere Reserve was EUR 65.50 per day, hence, it was considerably lower than the national average. This essentially depended on the choice of the respective types of accommodation by the visitors and thus also on the accommodation structure in the region. The Biosphere Reserve is located in a rural region, where – compared to cities – rather low-price forms of accommodation prevail, with only a few high-priced hotels. Moreover, the visitors did not only stay in commercial accommodation establishments. Approx. 38% of all guests chose a holiday apartment as the type of accommodation for their visit. In this mostly non-commercial type of establishment, the daily expenditure was also significantly lower than in commercial accommodation establishments nationwide (Harrer & Scherr, 2010,

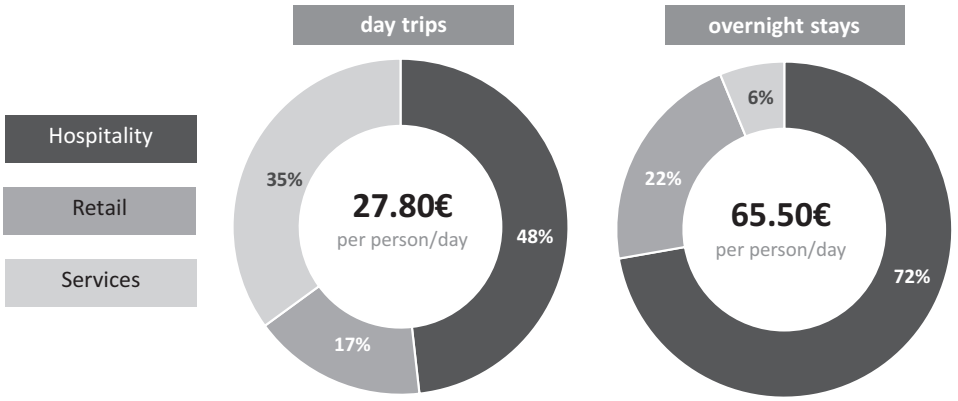

Figure 5.9. Daily expenditures of visitors in the Schorfheide-Chorin Biosphere Reserve.
Source: own elaboration.

p. 77). In addition, approx. 12% of the guests also visited friends and relatives and thus principally did not have any accommodation costs.

A differentiation of the overnight guests among the Biosphere Reserve visitors showed that visitors with a high biosphere reserve affinity spent less (EUR 53.00 per person and day) than other Biosphere Reserve visitors (EUR 70.00); with almost identical shares amongst the profiting economic sectors (71–72% hospitality, 21–22% retail, 6–7% services).

The gross tourism turnover can be calculated by multiplying the average expenditure per day by the length of stay of the day-trippers and overnight visitors. In 2020/21, a total gross turnover of EUR 101,146,900 was generated by visitors to the Biosphere Reserve. Of this, EUR 19,084,800, or approx. 19%, was generated by visitors with a high biosphere reserve affinity, and EUR 82,062,100, or about 81%, was generated by other biosphere reserve visitors.

As visitors of all types spent significantly more during their visit, the gross turnover compared to 2017/18 increased by 12%. Hence, fortunately the decrease of visitors since 2017/18 (–21%) did not have an impact on the overall gross turnover of tourism in the biosphere region.

The net turnover was calculated by deducting VAT from the gross turnover. The calculations were carried out separately for all relevant target groups (day trips, overnight stays, as well as visitors with a high biosphere reserve affinity and other biosphere reserve visitors). All types of expenditures were considered individually to estimate the VAT rate as precisely as possible. Based on the expenditure structure of the guests, the total average VAT rate was 14.2% with a day-tripper rate of 17.1% and an overnight visitor rate of 11.7%. In total, a tourism-related VAT amount of EUR 14,316,000 was incurred in the Biosphere Reserve. A subtraction of this amount from the gross turnover resulted in a net turnover of EUR 86,822,000.

	Segment	Visitor days		Daily expenses		Turnover (rounded)
Specific Biosphere Reserve visitors	Overnight stays	224,554	x	52.98 €	=	11,896,900€
	Day trips	294,587	x	24.40 €	=	7,187,900 €
		=				=
	TOTAL	519,141				**19,084,800 €**
Other Biosphere Reserve visitors	Overnight stays	621,661	x	70.03 €	=	43,534,900 €
	Day trippers	1,351,359	x	28.51 €	=	38,527,200 €
		=				=
	TOTAL	1,973,020				**82,062,100 €**

Total **101,146,900 €** in 2020/21

Figure 5.10. Tourism turnover in the Schorfheide-Chorin Biosphere Reserve[23].
Source: own elaboration.

In terms of the value added, all income effects resulting from the direct expenditure of tourists were recorded (see section 5.3.2). In this context, income or value added refers to salaries and profits. The value-added ratio in the Biosphere Reserve for day trips was approx. 38.9% and overnight visits approx. 39.6%. These average values were based on the expenditure structures of the visitors and thus corresponded to the individual economic conditions in the Biosphere Reserve.

Linking the value-added ratio with net turnover resulted in a direct income of EUR 34,207,000.

After deducting the direct income effects from the net turnover, an amount of EUR 52,615,000 remained. This sum was spent by the direct suppliers of the tourism services for the purchase of inputs or for the use of these services. Exact value-added ratios of companies profiting from indirect impacts could only be estimated on a regional-specific basis with the help of detailed analyses, which were not yet available at the time of this study. However, such a business study has been undertaken and the results are expected in mid-2022. For this study, an average value of 30% was used. As explained in section 5.3.2, this resulted in an income of EUR 15,784,000 in indirect impacts. This means that input suppliers generated indirect effects of around 15.8 million euros in wages, salaries and profits.

To sum it up, the gross turnover from all visitors (EUR 101,146,900) generated an income of EUR 49,992,000 (first and second levels of turnover). Around

[23] Local inhabitants of the Biosphere Reserve were not included in the economic impact estimations. Therefore, the sum of visitor days varies between Fig. 5.5 and Fig. 5.10.

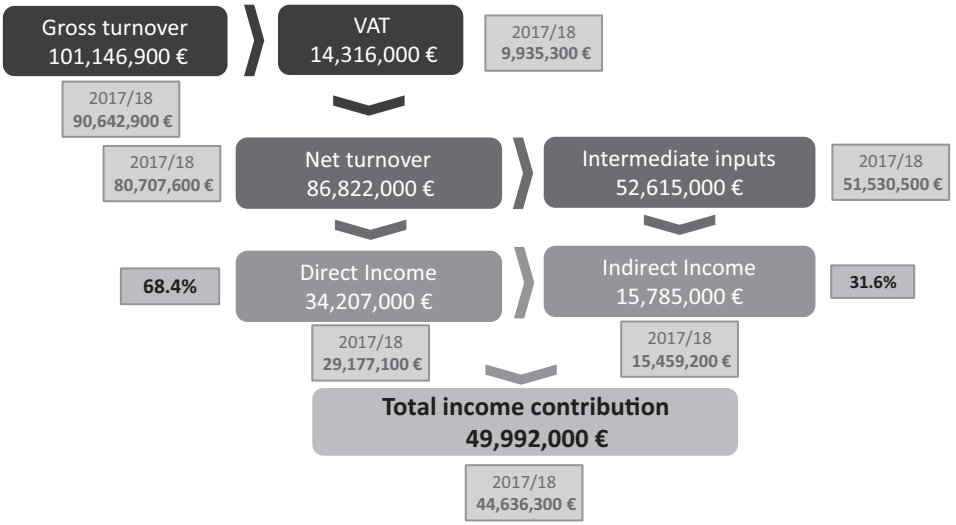

Figure 5.11. Value added of tourism activities in the Schorfheide-Chorin Biosphere Reserve.
Source: own elaboration.

68% of this was accounted for by the direct income and 32% by the indirect income.

In comparison to 2017/18, the overall income contribution increased by 12%, which was an impressive result, as there was a deep drop in the overall visitor numbers of 21% because of the COVID-19 pandemic. This positive result was derived from the overall higher visitor expenses and a higher value-added quota (39% compared to 36% in 2017/18). In total, the tourism income also increased by 12 per cent, reaching almost 50 million Euros. However, the spending categories were different to the previous study, with higher expenditures for services during the period 2020/21, which resulted in higher VAT rates (14% in comparison to 11% in 2017/18) and therefore a lower increase in the net turnover rate compared to 2017/18 (+8%), despite the VAT cut in mid-2020.

In order to determine income equivalents, the tourism income contribution (EUR 49,992,000) was divided by the average primary income per capita in the Biosphere Reserve (EUR 21,633). Accordingly, this resulted in an income equivalent of 2,311 persons whose income could be financed by tourism and day trips in the Biosphere Reserve. This meant a slight decrease of 0.2% that was due to the increase of the average primary income per capita (from EUR 19,276 in 2016 to EUR 21,633 in 2019). Differentiated according to the visitor types, 432 income equivalents were generated due to visitors with a high biosphere reserve affinity and 1,879 income equivalents due to other biosphere reserve visitors.

The recent economic impact assessment of visitors to Schorfheide-Chorin Biosphere Reserve showed a development clearly characterised by the COVID-19 pandemic with surprising results, compared to the previous study of three years ago:

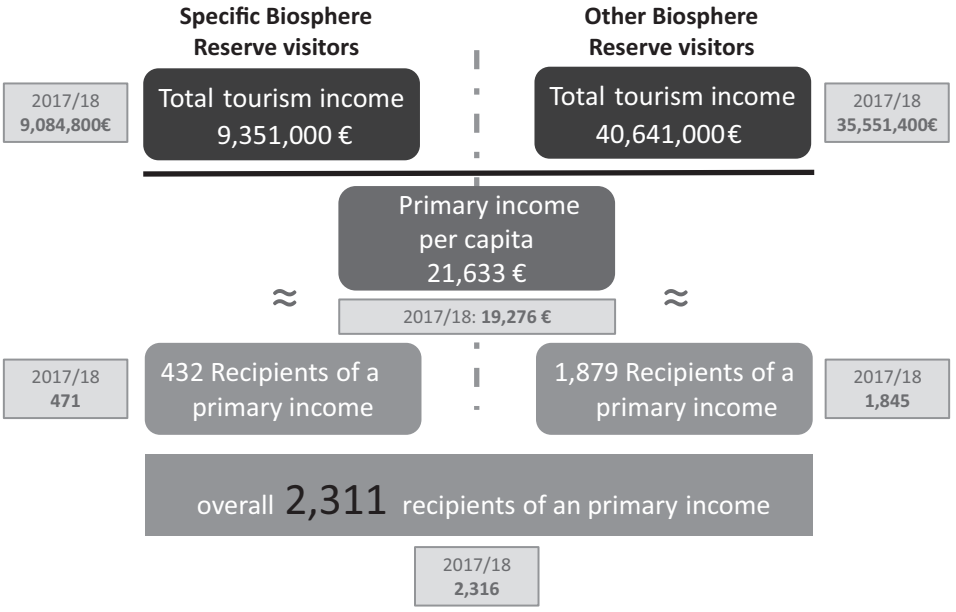

Figure 5.12. Income equivalents by tourism activities in the Schorfheide-Chorin Biosphere Reserve.
Source: own elaboration.

- The total number of visitors decreased tremendously by 21% since the last survey from 2017/18. This was mainly due to the COVID-19 lockdowns, where no tourism activities were officially allowed. However, the visits per day outside the lockdown increased significantly in comparison to 2017/18. Hence, the visitor pressure in the Biosphere Reserve rather increased in the years of the COVID-19 pandemic. The decrease in visitor numbers also reflected recent studies that showed very similar results for overnight stays (minus 25% and less) for the region (Dwif-Consulting GmbH, 2022).
- The daily expenditure of visitors increased very strongly overall, both for overnight visits and day trips.
- This resulted in an increase in gross turnover (+11.6%), which was due to the significantly increased daily expenditures.
- Therefore, the income effects also increased by 12%, with VAT rates increasing compared to 2017/18. Another positive development was that the value-added ratios increased compared to the previous study. 68% of the tourism income was distributed to direct tourism businesses and 32% to indirect suppliers.
- Out of the total of 2,311 employment equivalents, 432 equivalents could be attributed to the demand of visitors with a high biosphere reserve affinity. This number slightly decreased (by 8%), mainly because of the different expenditure structure of visitors that resulted in different VAT structures.

Table 5.8. Summary of economic impacts effects of visitors to Schorfheide-Chorin Biosphere Reserve in 2020/21 in comparison to 2017/18.

	Total			Specific Biosphere Reserve visitors			Other Biosphere Reserve visits		
	2017/18	2020/21	21/18	2017/18	2020/21	21/18	2017/18	2020/21	21/18
	[euro]	[euro]	[%]	[euro]	[euro]	[%]	[euro]	[euro]	[%]
Daily expenses	28.31	40.58	145	n.a.	36.76	–	n.a.	41.59	–
Daily expenses day-trips	18.63	27.77	149	17.20	24.40	142	19.00	28.51	150
Daily expenses overnight stays	50.68	65.50	129	47.70	52.98	111	51.60	71.03	136
Gross turnover	90,642,900	101,146,900	112	18,818,100	19,084,800	101	71,824,800	82,062,100	114
Gross turnover day trips	41,638,800	45,715,100	110	7,894,800	7,187,900	91	33,744,000	38,527,200	114
Gross turnover overnight stays	49,004,100	55,431,800	113	10,923,300	11,896,900	109	38,080,800	43,534,900	114
Tourism income	44,636,300	49,991,776	1112	n.a.	9,351,125	–	n.a.	27,916,483	–
Direct tourism income	29,177,100	34,207,346	117	n.a.	6,290,864	–	n.a.	12,724,169	–
Indirect tourism income	15,459,200	15,784,430	102	n.a.	3,060,261	–	n.a.	8,354,900	–
Income equivalent	2,316	2,311	100	471	432	92	1,845	1,879	102

Source: own elaboration. based on Job et al., 2023.

Table 5.8 summarises the most important economic impacts in comparison to 2017/18.

5.5. Discussion: Towards a cross-border methodology to assess economic impacts of protected area tourism?

The economic impact of PAs lies at the heart of the global discussion on nature conservation (Phillips, 1998; Emerton et al., 2006; Mayer, 2013). Therefore, one of the aims of the Polish-German REGE project research team was to adapt a methodological approach for estimating the regional economic impact of tourism in protected areas, while keeping in mind that the method should above all be applicable internationally, especially in the Pomerania Euroregion, that it should be simple, affordable, and that the results of studies carried out in different countries based on this method should be comparable. To ensure international comparability of the results, it is necessary to consider global methodological standards, above all those regarding PA visitor counting and economic impact estimation. Global guidelines for this purpose have been published recently by the UNESCO together with the German Federal Agency for Nature Conservation (Spenceley et al., 2021).

A method commonly used in German protected areas was taken as the starting point for our attempt to adapt existing methodological approaches for estimating the regional economic impact of PA tourism. Since 2006, numerous studies on economic impact data collection, estimation and assessment for German large-scale PAs have been carried out during several long-term research projects with strong financial support from ministries and authorities at the national and federal states level but also from the PA administrations. The economic impacts of German national parks (Job et al., 2005, 2009, 2016), biosphere reserves (Job et al., 2013), and some nature parks (Job et al., 2005), have been estimated. This is very comprehensive and utilises an extensive database (as presented in more detail in section 5.3). Overall, the economic impact of tourism can only be estimated using this approach if the number of visitor days and the visitor expenditure structure are known, and as long as for the identified expenditure groups the regional multipliers (in the form of value-added ratios) for businesses handling the visitor flows are available. Such data should be obtained through statistically based visitor counting and surveying throughout the year (due to the seasonal variability of tourism). As such studies are costly (due to the required man power and the necessary acquisition of the regional multipliers), the application of this approach may be beyond the financial capabilities of protected area administrations since PAs typically face the need to finance numerous tasks with severely limited funding (Emerton et al., 2006). At the same time in Poland, in contrast to Germany, no standard method for estimating the economic impact of PA tourism has been established, and any effort undertaken so far should rather be regarded as pilot research (for details see section 5.2.1.).

The methodological approach established in the German PAs was used as the starting point and a reference for the intended adapted regional impact estimation method, also because it was already in widespread use in numerous German PAs and enabled PA stakeholders to easily understand and interpret the results.

One of the key elements affecting the costs of conducting surveys based on the German approach is the need to count visitors. According to the project team, an opportunity to reduce the cost of visitor counting lines in the use of automatic counting devices. In this way, complete visitor-day data could be obtained instead of only acquiring information for selected days on which visitors are counted, as is the case with the German approach. At the same time, the data from automatic counters could be used not only for estimating the economic impacts, but also for an ongoing monitoring of tourist flows. Of course, all automatic counters must be calibrated empirically through observations and manual counts, because correction factors provided by the device manufacturer deliver a first orientation only. Especially where the natural conditions do not allow for leading all visitors past an automatic counter, visitors can often walk right past the devices without being detected. For such locations, the number of people counted by automatic counters must be increased by a correction factor to be determined empirically (see also the deviations Staab et al., 2021 revealed between automatic and manual counting approaches).

However, since not all PAs operate visitor counting devices the project team suggests that – in methodological terms – the counting procedure should have the following characteristics:

- a year-round study period,
- if no data from automatic counters can be obtained, visitor days should be estimated empirically by a combination of sampling and existing secondary data (e.g. overnight statistics from the PA municipalities). For this purpose, sampling days distributed over the whole year and covering all relevant seasons are required.

Another key issue with the German approach is the visitor surveys: the surveys make use of a) an extended questionnaire (the so-called long interviews) and b) the so-called short interviews. In previous research based on this method, the long questionnaire included questions about the structure of the visitor expenditure and educational background or enquired on their environmental awareness, the frequency with which they visited the PA, their reasons for coming, the type of transport means they used, the type of their activity in the PA, and more. Based on our overview of the literature, the experience gained, and an exchange of views and opinions, the project team proposes that the research should be conducted using only one survey template with a modular structure. As the primary objective of this method is to estimate the regional economic impacts of PA tourism, questions about the structure of expenditures are of pivotal significance. The remaining questions may be clustered into modules to be used on an as-needed basis. This structure allows for adding or removing individual modules. Apart from enabling a better adaptation of the questions to the needs of the stakeholders, this allows for reducing the costs of the study as the potentially

smaller number of questions asked makes it possible to reach the aspired sample size in a shorter time.

The third element required by the German approach are the regional multipliers. This project developed a questionnaire to measure these value-added ratios, and a pilot study was conducted in 2021 using the CATI method in the Wolin National Park region using the mentioned questionnaire. The survey included a group of 20 randomly selected enterprises among micro-, small- and medium-sized enterprises which were classified as belonging to one of the characteristic tourism activity types. According to the report of the survey carried out by a professional company specialising in such studies, the respondents indicated, among other things, that the data sought from them were too confidential to share or too intrusive into the situation of their enterprise, and thus the vast majority refused to answer such questions. As a result, the pilot study failed to provide any basis for estimating the value-added ratios in any recognised way and for continuing the study in this regard on a larger scale.

Therefore, the project team proposes that the regionalised input-output method should be applied (for details see section 5.3.1), which makes use of widely available national input-output tables to estimate the multiplier effects of PA tourism instead of using value-added ratios which are obviously very difficult to obtain for Polish PA regions[24]. As a next step, the regionalised input-output approach could also be applied in the future for some parks in the German part of the Euroregion or in Poland's Drawa National Park where the German methodological approach has already been employed. This would allow for comparing both approaches in more detail and assessing the comparability of their results. Majewski (2022) has already showed that input-output approaches are a valuable alternative for German PAs, although not a necessarily more affordable one as regards the costs for obtaining the secondary data.

During our project, the approach presented above could not be tested to its full extent, primarily with regard to the modular construction of the questionnaire, because of the numerous restrictions imposed during the COVID-19 pandemic in 2020 and 2021. It is therefore fully justified that research about the development of a more affordable approach for estimating the regional economic impacts of PA tourism in Poland that will provide internationally comparable results should continue.

5.6. Interim summary

The regional economic impact of protected area tourism is an important indicator of the recreational function of protected areas as well as their contribution to regional development and job creation in the often structurally weak, peripheral,

[24] These negative experiences notwithstanding the results of our business survey in the Biosphere Reserve Schorfheide-Chorin (see Chapter 6) are more promising, reaching a response rate of at least 14%. Similarly, the postal enterprise survey of Mayer and Woltering (2008) in the environs of the Bavarian Forest National Park also turned out satisfactory. However, both surveys required the cooperation of many local stakeholders and lots of organisational and logistical efforts.

rural protected area regions. These economic impacts provide substantial arguments in favour of protected areas and also positively influence the local populations' attitudes towards protected areas. For these reasons, these values are of great relevance for political decision makers and protected area administrations alike. However, due to the complexity of their estimations and the required datasets which mostly need to be generated separately for each protected area the assessment of the regional economic impact of PA tourism is far from straightforward. The state of research concerning these values varies between Poland and Germany: while especially Polish national parks (among other things – due to required entrance fees to some parks) have a relatively good database concerning their visitation, these numbers are usually non-existent for German protected areas. In contrast, these existing visitation data have not yet been used for the estimation of the economic impact of park tourism in Poland, except for a pilot study, while in Germany a standard methodology has been established in the last two decades (mostly by Job et al.), which has been applied to basically all national parks and biosphere reserves and even some nature parks by 2022. Thus, this research adapted the German estimation approach to the conditions in Polish PAs and estimated the regional economic impact of tourism to Wolin National Park for the first time using a regionalised input-output-table for the estimation of the multiplier effects in contrast to the German approach of value-added quotas. In Wolin National Park, we recorded 691,741 visitor days/year, strongly dominated (91.4%) by overnight visitors. Overnight visitors spent 2.5 times more per person and day compared to day-trippers (PLN 270 vs. 110 or EUR 59.2 vs. EUR 23.5). This led to a gross turnover of PLN 181.68 million (EUR 38.85 million), which generated a regional income derived by the input-output estimations of PLN 364.65 million per year (EUR 77.98 million) and which equaled an income equivalent of about 7,500 persons. These results highlight the regional economic importance of visitation in Wolin National Park for its surrounding region.

In the German part of the Euroregion, we estimated the economic impact of visitation to Schorfheide-Chorin Biosphere Reserve. This provided the opportunity to compare these results with a relatively recent assessment from 2017/18 which was done using the same methodological approach. This also allowed for estimating the effects of the COVID-19 pandemic on the visitation structure of the Biosphere Reserve and the economic impact of its visitation (see Chapter 6). Our estimations revealed 2.54 million visitor days for Schorfheide-Chorin Biosphere Reserve. Regarding the visitor types, 33.1% of the visitor days were generated by overnight visitors, 64.0% by day-trippers and 2.0% by local residents living inside the Reserve. Day-trippers spent, on average, EUR 27.80 per person and day in the Biosphere Reserve, while overnight visitors spent EUR 65.50 per person and day. The average daily expenditures of specific biosphere visitors were lower compared to other visitors. The combination of visitor days and visitor-type-specific expenditure patterns led to a total gross turnover of EUR 101.14 million generated by visitors to the Biosphere Reserve and a regional income of EUR 49.99 million per year, which corresponded to an income equivalent of 2,311 persons. These numbers underlined the considerable regional economic relevance

of tourism and recreation in Schorfheide-Chorin Biosphere Reserve, especially as around one fifth of these economic impacts could be attributed to visitors with a high biosphere reserve affinity, i.e. those that would not occur if the protected area did not exist.

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Chapter VI

Analysis of park-people relationships

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Socio-economic research in protected areas of the Euroregion Pomerania: Visitor satisfaction, economic impacts and park–people relationships

Bogucki Wydawnictwo Naukowe • Poznań 2022

This monograph was produced as part of the project INT107 (acronym: REGE), which was carried out under the title "Cross-border cooperation between universities and large-scale protected areas in the Pomerania Euroregion" (Ger.: "Grenzüberschreitende Zusammenarbeit von Hochschulen und Großschutzgebieten in der Euroregion Pomerania", Pol.: "Współpraca transgraniczna między uczelniami i dużymi obszarami chronionymi w Euroregionie Pomerania"). The project was co-financed by the European Union from the European Regional Development Fund (ERDF) as part of the Interreg V-A Mecklenburg-Vorpommern/Brandenburg/Poland Cooperation Programme.

Reviewer: Prof. dr hab. Dariusz Pieńkowski

Citation suggestion:
Zbaraszewski, W., Balas, M., Dmytrów, K., Majewska, A., Mayer, M., & Steingrube, W. (2022). Socio-economic research in protected areas of the Euroregion Pomerania: Visitor satisfaction, economic impacts and park–people relationships. Poznań: Bogucki Wydawnictwo Naukowe. https://doi.org/10.12657/9788379864201

ISBN 978-83-7986-420-1

Bogucki Wydawnictwo Naukowe
ul. Górna Wilda 90, 61-576 Poznań
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Printed and bounded in Poland by CER Druk

5. Economic impact analysis of tourism in protected areas of the Pomerania region

5.1. Introduction

Protected areas (PAs) provide important benefits for humankind including conservation of biodiversity, landscape integrity, carbon sequestration, and water and air purification, as well as the possibilities for nature-based recreation (Leung et al., 2018; Naidoo et al., 2019; Juffe-Bignoli et al., 2014; Worboys, 2015). Despite these benefits, PAs are often underfinanced, are under pressure to be converted/opened to conventional land uses, or lack public support, especially among local people living in or nearby them (see Chapter 4). One important reason for this situation is that the economic benefits of PAs are often not recognised or are at least contested, and PAs are consequently regarded as loss-making businesses (Mayer, 2013, p. 28). Eagles (2007, p. 6) put it like this:

> "Any phenomenon that is not measured and reported does not exist politically. Governments, societies, communities and individuals place more value on that which is documented."

This undervaluation, in turn, is based on the public good characteristics of many benefit components of PAs, i.e. there are no market prices available, in contrast to conventional land-uses such as mining, agriculture or forestry (Dixon & Sherman, 1990, p. 24 f., 32). One of the PA benefits that is tangible and rather straightforwardly measurable is the economic impact of tourism activities in PAs generated by visitor expenditure in and around PAs (Hanley & Barbier, 2009).

> "Tourism in protected areas has the potential to generate tangible economic impacts, mainly from the money that visitors spend. Their expenditure … can be substantial. By establishing the level of visitor spending, evidence can be gathered to illustrate the economic contribution and impact of protected area tourism." (Spenceley et al., 2021, p. 18)

To sum up, the economic valuation of PA tourism is worthwhile for the following reasons (Pascual et al., 2010, p. 190; Rommel, 1998, p. 21f.; Flückiger, 2000, p. 18; Hornback & Eagles, 1999; Job, 2008; Job et al., 2021; Mayer & Stoll-Kleemann, 2016; Spenceley et al., 2021): it somewhat compensates for the missing/contested valuation of PAs' public goods; it puts PAs on the economic playing field by providing comparability through monetisation; it closes information gaps, objectifies debates, and therefore contributes to avoiding misallocations of

resources; it makes a strong argument for the existence of PAs, justifies their budgets and argues for their better financial support; its results can be used for self-evaluation and benchmarking, as well as internal and external marketing/communication; finally, its results can contribute to improving the attitudes of local people towards PAs with assumed positive consequences for nature protection outcomes.

However, what exactly is meant by economic impact and how is it measured? Watson et al. (2007) provide two related definitions:

> "Economic impacts are the net changes in new economic activity associated with an industry, event, or policy in an existing regional economy" (p. 142). "Economic impact is the best estimation at what economic activity would likely be lost from the local economy if the event, industry, or policy were removed" (p. 143).

Thus, economic impacts describe the net effects of policies that bring new revenues into the PA region that would otherwise not occur, or policies that keep revenues in a PA region that would otherwise be lost (Spenceley et al., 2021). That means the difference between the analysis of the economic contribution and the impact of tourism lies in the scope of the analysis (overall significance vs. the effect of "shocks"/"changes") and not in the methods (Mayer & Vogt, 2016). In this way, economic impacts of PA tourism are part of the tangible, direct, non-consumptive use values of PAs (Mayer, 2013; Barbier, 1991; Munasinghe, 1992).

Economic impact analyses are most often used to estimate how changes in visitation or visitor spending might affect local economies. Economic impacts describe the economic activities that are either brought into a region because of a PA designation or describe the economic activity that would be lost from the region if the PA designation was removed. Therefore, economic impact studies do not include spending by locals (Spenceley et al., 2021, p. 26) and must account for the visitors' motivation (in contrast to the economic contribution of PA tourism) (Mayer et al., 2010).

An estimation of the regional economic impact of PA tourism requires four main steps (see Spenceley et al., 2021 for details[15]): 1) The number of visitors or visitor days needs to be determined, differentiated between different visitor types with likely deviations regarding their spending patterns such as, for instance, overnight visitors vs. day-trippers, or domestic vs. foreign guests, or combinations of both and other characteristics. Staab et al. (2021) and Job et al. (2021) provide recent literature overviews for visitor counting and monitoring approaches. However, for PAs with required entry fees, such as some of the Polish national parks, there are usually relatively reliable visitation numbers, while for free-access PAs such as all German PAs and the Polish landscape parks, there are not any official visitation data available. 2) The expenditure behaviour of visitors to the PA and the PA region (which often needs to be defined first) needs to be differentiated within the same visitor groups as the visitation data, so that both data sets can

[15] This work is a recently published international guideline (approved by the UNESCO) about measuring the economic impacts of PA tourism.

be combined to calculate the gross turnover of PA tourism. The contribution by Stynes and White (2006) sums up the dos and don'ts in expenditure surveys, while Mayer and Vogt (2016) include a comprehensive review on the factors influencing spending behaviour. 3) An economic model or multipliers to determine how much of the gross turnover (i.e. visitor spending times visitor number) actually stays in the PA region (and does flow out of the region as leakage, e.g. to pay for imports, taxes to the government, transfer of profits) and how much direct, indirect and induced economic impact it generates (depending e.g. on the regional economic structure, the size of the PA region, see Archer & Fletcher, 1996). These models include (see Dwyer et al. 2010, Chap. 7–9 for an overview), for example, regional multipliers (Archer, 1977), input-output-models (Fletcher, 1989), social accounting matrices (Wagner, 1997), and computable general equilibrium models (Zhang et al., 2007). 4) Finally, the PA visitors' motivation needs to be known to be able to attribute the adequate share of regional income to PA tourism, because if visitors were to come to the region regardless of the existence of the PA, their spending cannot be attributed to the PA and should not be treated as part of the economic impact. Küpfer (2000), Job et al. (2003), Wall Reinius and Fredman (2007), Mayer et al. (2010), Arnberger et al. (2012, 2019) and Backhaus et al. (2013) came up with or used slightly differing schemes to assess PA visitors' motivation and to identify so-called visitors with a high PA affinity, i.e. visitors who most likely would not have come if the PA had not existed – Bayer et al. (2017) provide a review of these approaches.

On the international level, a few countries have set up compelling economic impact monitoring systems of PA tourism, especially the USA[16] and Finland (see Huhtala et al., 2010)[17]. For example, the US National Park Service (NPS) has been monitoring the yearly visitor numbers of the NPS units since 1904, on a monthly basis since 1979. Furthermore, there is a high level of consistency and reliability of the data for the NPS units. Since 1988, visitor spending and economic impacts have been measured and reported (Koontz et al., 2017).

This chapter is structured as follows: in the next section (5.2), an overview is provided of the state of research about tourism economic impact analyses in Polish and German PAs, while section 5.3 presents the methods used to assess the economic impact of tourism in the PAs of the Pomerania region. Section 5.4 shows the results of these analyses for the Polish and the German PAs, respectively, followed by a discussion (5.5) of these results. A short interim summary (5.6) closes this chapter.

5.2. State of Research

Below, overviews of tourism economic impact analyses in protected areas in Polish (5.2.1) and German (5.2.2) PAs are presented.

[16] See https://www.nps.gov/subjects/socialscience/vse.htm. (accessed on April 12, 2022).
[17] See https://www.metsa.fi/en/economic-benefits-of-national-parks/ (accessed on April 12, 2022).

5.2.1. Poland

In Poland, as elsewhere globally, an increasingly important role is being attributed to the socio-economic issues of operating PAs. This transformation is a slow process, though. The public opinion perceives Polish national parks as nature conservation areas to which humans and their activities are a threat (Mika et al., 2015, p. 9), while the Polish literature – compared to the multitude and scopes of studies in the USA, Finland and Germany (see 5.2.2.) – suffers from a shortage of publications describing and evaluating economic impacts in PAs. Notably, the situation in Poland corresponds to the situation in the entire Central and Eastern Europe. However, this subject is gradually attracting more interest (Bodnár, 2006; Cihar & Stankova, 2006; Harmáčková et al., 2016; Moraru et al., 2021; Nestorová Dická et al., 2020; Schneider et al., 2021).

Despite these general observations, it is important to stress that the Polish literature on the subject makes several references to the impact generated by PAs on the economy of the region and the country. Multiple studies have dealt with social conflicts, which are frequently caused by economic aspects (as discussed in more detail in subsection 4.2.1.).

A large proportion of publications have been devoted to tourism in all Polish national parks. Research has mainly focused on the effects of the anthropogenic impact (Bożętka, 1995; Macias et al., 1995; Michniak, 2018; Sikorski, 2009; Soltys-Lelek et al., 2010) and the volume of tourism, as well as its structure, spatial and temporal distribution, and intensity (Janowski, 2005; Miazek, 2020; Prędki & Demko, 2021; Rogowski, 2018a, 2019; Semczuk et al., 2014; Zawilińska, 2021).

Issues concerning systems for monitoring tourist traffic in protected areas have been widely discussed in the Polish literature, as well. Tourism intensity is mainly judged by the number of admission tickets sold by Polish national parks[18] (Pociask-Karteczka et al., 2002; Wieniawska-Raj, 2010) or based on pyroelectric detectors in use in most national parks in Poland (Buchwał & Fidelus, 2010; Spychała & Graja-Zwolińska, 2014; Rogowski, 2018b, 2020; Rogowski & Piotrowski, 2022; Rogowski & Rusztecka-Rodziewicz, 2021).

We assume the notion that national parks play a role in the local economy is gaining popularity in Poland. Research implicating a comprehensive role fulfilled by a national park, i.e. that of an employer, contractor, investor and customer, should be mentioned in this context (Bołtromiuk, 2010, 2011; Walas, 2019). The financial aspects of the functioning of Polish national parks have also been examined (Kulczyk-Dynowska, 2015b, 2015a; Pater, 2020; Pater & Zawilińska, 2014; Zbaraszewski, 2013, 2016).

In Poland, in-depth research has been initiated after 2010 into PA visitor expenditure, and the results have been used to estimate the socio-economic effects

[18] Until 2022, the requirement to pay an admission fee in Poland was mostly limited to mountain parks. According to the discussions held at the turn of 2021/22 on a new bill on national parks, plans are being made to charge for admission to all twenty-three Polish national parks.

of tourism on such places. Pilot studies aimed at estimating visitor spending were conducted in, among others, Tatra National Park in 2013 (Urbaniak & Mazur, 2014) and Wolin National Park (Zbaraszewski et al., 2014, p. 95–118). Research carried out in Babia Góra National Park in 2012–2015 (Mika et al., 2015) can be regarded as an extensive study of the economic impact of a Polish national park on the socio-economic development of the park's municipalities (towns). The study helped to identify, among other things, the size and structure of the national park's budget, the financial links that the national park had developed, the extent to which the park exerted economic effects, and the volume and structure of the park's visitor expenditure. It also considered the scope of the economic connections resulting from these expenses flowing into the immediate vicinity of the national park. As for assessing the economic effects of tourism in Babia Góra National Park, an assumption was made that the estimation should cover the entire tourist traffic in the park region regardless of the visitors' motivation for arrival. Thus, a 'wider' approach to defining national park tourism was adopted, one that did not limit tourism to those people whose sole objective was to visit the park (the 'narrow' definition of national park tourism). Studies of the volume and structure of tourist expenditure were carried out in 2012 and 2013. The survey days were chosen so as to match the distribution of tourist traffic within the park, as recorded by the park's administration. The interviews were conducted with 1,215 respondents (N = 1,125), but as some of them spoke for their whole families or groups, conclusions could be drawn for as many as 2,912 people. When asked whether their visit to Babia Góra National Park was their main objective, as many as 82.3% from this group answered that it was, while this figure rose to almost 90% for day-trippers and dropped to 75.4% for those who stayed there for the night (Mika et al., 2015, p. 129). The respondents were asked about their expected costs of the trip, including the expenses they had already incurred. In this way, information was gathered on the volume of both total expenditure and expenditure broken down into the categories of "overnight accommodation", "food", and "other". Verification and supplemental surveys were also carried out among these tourists as soon as they returned home. A *post factum* data analysis was performed based on the information collected from a group of 351 persons (n_2 = 351) who agreed to be involved. Since the value differences between the expenditure declared and the actual spending in our study group were relatively small, it was assumed that the information drawn from the actual tourist expenditure data for the n_2 group reflected the expenditure structure for the whole (N) study population. The total declared expenditure for the whole sample of 2,912 tourists amounted to PLN 435,000, with accommodation costs accounting for 36.3%, food expenses for 41.7%, and other expenditure for 22.0% (Mika et al., 2015, p. 135). The study estimated the economic benefits (as this is the term used in the study) gained by the municipalities from inbound tourism directly and indirectly linked to the national park. These were calculated by adding together the expenses of day-trippers and overnight visitors and then deducting the VAT imposed on the particular types of services and goods purchased (Mika et

al., 2015, p. 147). The following assumptions were made for the purpose of the calculation:

- the annual number of visitors to Babia Góra National Park was 100,000. The authors noted that although an electronic monitoring system (pyroelectric detectors) was in use in the park, the data obtained was so inaccurate that it could not constitute a reliable source of scientific information (Mika et al., 2015, p. 123). Therefore, the number of visitors used to estimate the economic effects was based on data from reports on tickets sold in 2014 (76,000 people) and observations by park staff, who assessed that the actual number of people entering the park was approx. 25–30% higher than the number of tickets sold.
- the results of the research reflected the relationship between day-trippers and overnight visitors visiting the park during the year,
- the 8% VAT on accommodation services was only taken into account in the case of hotel facilities, i.e. hotels, guest houses, tourist shelters, holiday centres, leisure and training facilities, and other so-called group accommodation facilities; the VAT was not accounted for in other categories of accommodation such as guest rooms and agritourism farms; with this assumption, the VAT was taken into account for 42.9% of the expenses incurred for accommodation (Mika et al., 2015, p. 147).

The calculated annual amount of visitor expenditure amounted to PLN 15.952 million (EUR 3.545 million[19]) of which 1.671 million (EUR 371,000) came from day-trippers and PLN 14.280 million (EUR 3.173 million) from overnight visitors. The largest share of the economic benefits generated by tourism in Babia Góra National Park was realised by the accommodation sector (42.9%), followed by catering and retail trade, with 28.2% and 23. 5%, respectively (Mika et al., 2015, p. 149).

An attempt to assess the economic impact on the region's economy was also undertaken for Góry Stołowe National Park in 2018. The studies based on visitation data from pyroelectric automatic counters and on surveys helped estimate the volume of the visitors' gross expenditure at PLN 359 million, or EUR 79.80 million (Rogowski et al., 2019).

The regional economic effects of tourism in a protected area have also been estimated for Drawa National Park. The study used the method for estimating regional economic impacts effects established in Germany by Prof. Hubert Job (Job et al., 2005; Job et al., 2009). The number of visitor days to this national park in 2018 was estimated at 38,200. Visitor days were calculated using a mixed method, i.e. on the basis of two data sources. The main source of information involved counting the visitors at seven locations selected by the park administration staff that could be regarded as unofficial entrances. The counting was carried out on 24 days, i.e. usually on a single weekday and a single day off work between 9 o'clock and the sunset, not later than 6 pm, in every month of 2018. At the

[19] For the purposes of comparison, the following exchange rate was adopted further in this Chapter: PLN 4.50 (PLN) = EUR 1 (EUR).

same time, the visitors were surveyed in order to estimate the size and structure of their expenditure. Visitors from outside the park region were distinguished from locals using postal codes provided by the respondents. Drawa National Park charges fees for using its water areas for amateur angling and for kayaking on the River Drawa. The park's database of tickets sold, adjusted for errors, was the second source of data used to estimate tourist traffic. By comparing the number of tickets sold and the number of visitors on the counting days, discrepancies were identified, in particular in the peak of the season, since it turned out that there were actually approx. 24% kayakers more than indicated by the number of tickets sold. Therefore, the extrapolation of the total number of visitor days used data derived from counting the visitors (for pedestrians, horse riders, and cyclists) and from the number of tickets sold (for kayakers and anglers), which were then adjusted for the identified discrepancies between the number of tickets sold and the number of visitors counted on the survey days.

Based on short (589) and long (394) interviews at seven selected locations within the park, it was concluded that 40.4% of the visitors were day-trippers (59.6% overnight visitors), while as many as 74.6% of the remaining visitors were tourists staying in the park (the park municipalities) for only one or two nights. Tourism in Drawa National Park was characterised by the tourists' high affinity to the place, since as many as 54.7% of the guests were visitors with a high national park affinity, i.e. they were not only familiar with the protected area status of the park but also came to the park as their primary destination. The study estimated value added ratios in the region concerned (broken down into accommodation, catering, retail trade, services, and park charges). According to the method adopted, which employed deducting the VAT from the tourist expenses and taking into account both value added ratios and indirect income generated in the region from intermediate consumption with the average daily expenses (derived from the study) of PLN 48.79 (EUR 10.84) as incurred by day-trippers and PLN 98.08 (EUR 21.80) as incurred by overnight visitors, the total tourist income (the regional economic impact) was estimated at PLN 1.678 million (EUR 372,900). Considering the region's average salary, this value represented an equivalent of 49 people receiving the regional average salary (Zbaraszewski & Pieńkowski, 2022).

In our literature overview, we came across a paper made as part of a Polish-Czech project realised under the Interreg V-A – Czech Republic-Poland programme that included sociometric studies carried out in the two Karkonosze national parks, i.e. both in Poland and Czechia (Kravka et al., 2019). It was found that the average spending per person and day was CZK 749 (EUR 30)[20], with Czech guests spending on average CZK 604 (EUR 24.20), Poles spending CZK 695 (EUR 27.80), and Germans spending CZK 1,280 (EUR 51.20). The study's estimates of visitor expenditure between July 2018 and June 2019 allowed for their gross values to be determined at approx. CZK 4 billion (EUR 160 million)

[20] The 25 CZK (Kč) = EUR 1 (€) exchange rate was adopted (a single fixed exchange rate has been assumed for illustrative purposes).

for the Czech national park and CZK 1.2 billion (EUR 48 million) for the Polish national park (Kravka et al., 2019, p. 35).

Our overview of research about Polish PAs showed that there had been attempts at estimating the economic impacts, although such studies had concentrated on a very limited number of national parks. In addition, the research so far had disregarded other forms of territorial nature conservation. In most of the reviewed studies, the economic impact of tourism in protected areas was – incorrectly – understood as gross expenses incurred by visitors to the given protected area, i.e. expenditure not adjusted for the VAT paid to the State Treasury, and leakages. Moreover, most of such studies failed to translate the economic effects into the hypothetical number of people employed in the protected area region thanks to the expenditure of the visitors in the region. It appears that there is a need for Polish scientists to develop a single method for estimating regional economic impacts of PA tourism, which will allow for the benchmarking of the results obtained over time and between individual protected areas.

5.2.2. Germany

Economic impact studies for protected areas in Germany face several difficulties (Mayer & Woltering, 2017; Job et al., 2021): Firstly, Germany has a free access policy for PAs resulting in a lack of visitation data. Especially in biosphere reserves and nature parks, such figures are even harder to obtain due to locals living inside the PA. Secondly, data on tourism expenditures are rare and those available are not representative of PAs but rather of urban areas, as they are strongly influenced by the retail spending behaviour of the visitors (as a trip to the next largest city is interpreted as a shopping tourism trip). Thus, costly field research including extensive visitor counting and surveying is required. Thirdly, regional economic models do not exist in the form of regionalised input-output-tables but only in the form of regional multipliers. However, these latter ones are not publicly available as they are the product of private consultancy.

Thus, with the notable exception of Kleinhenz' (1982) study about the economic impact of the first German national park in the Bavarian Forest, there were not any economic impact studies of park tourism until the early 2000s. Until then, visitor numbers of national parks were only available as rough estimations without transparent assumptions (see Bibelriether et al., 1997). It was not until a pilot study in Berchtesgaden National Park (2002/03) by Job et al. (2003) and a following larger pilot project 2004/05 in Müritz National Park and the Nature Parks Altmühltal and Hoher Fläming (Job et al., 2005) accompanied by guidelines to estimate the economic impact of tourism in protected areas (Job et al., 2006) that the economic valuation of protected area tourism in Germany took off. Since then, the regional economic impact of tourism has been estimated for 15 out of now 16 German national parks including some replication studies, for nearly all biosphere reserves (to be completed in 2022), and for four of the 104 nature parks. Funded by the German Federal Ministry of Environment, the Federal Agency of Nature Protection (BfN) and several of the PAs, most of these

studies were conducted by the working group of Hubert Job (Job et al., 2003, 2005, 2009, 2013, 2016, 2021), which established a standardised procedure for estimating the economic impact of tourism in large-scale PAs and undertook various case studies in all types of PAs. Meanwhile, other researchers used basically the same approach to estimate these values for other PAs (Rein & Schneider, 2009; Rein & Balas, 2015 for Lower Oder Valley National Park) and in replicated studies (Steingrube & Jeschke, 2011 for Müritz National Park, Rein et al. 2017/18 for Hainich National Park, see Nationalpark-Verwaltung Hainich, 2019), while others used a differing approach, which makes comparisons difficult, especially regarding the size of visitation (Wölfle et al., 2016 for Eifel National Park, Arnberger et al. 2013/14 and Allex et al., 2018 for Bavarian Forest National Park, see Arnberger et al., 2019 and Nationalparkverwaltung Bayerischer Wald & Nationalparkverwaltung Šumava, 2020). Thus, not all economic impact studies in German PAs are completely comparable, due to the differing methodologies adopted, especially regarding the crucial step of visitor day number estimation[21] (Job et al., 2021). To sum up, the degree of knowledge about visitation and the resulting regional economic impact of PA tourism in Germany has improved considerably in the last two decades. However, nothing in the line of a national monitoring program, such as in the USA or Finland, has been established so far.

Table 5.1 gives an overview of the key findings of the available regional economic impact assessments of German PAs. The results show that many large-scale PAs in Germany are important tourism attractions generating considerable regional economic impacts (see Mayer & Woltering, 2017, which is also the basis for the following, updated paragraphs).

The visitor days and structure as key parameters for economic impact studies are influenced by the location of the PAs with regard to the agglomerations: the distance between potential source regions and the PAs is crucial. For example, Bavarian Forest National Park with its long distances to major cities is dominated by overnight visitors, whereas Eifel National Park south of the Rhein-Ruhr megalopolis is highly frequented by day-trippers (Woltering, 2012). In total, for all German NLP there are an estimated 53.1 million visitor days per year (Job et al., 2016). The two Wadden Sea National Parks dominate accounting for approx. 80% of this visitation value. Based on the exactly replicated studies, there is no clear indication that the visitation to German national parks is indeed increasing, as is often suggested in the media – however, this does not include the situation during the COVID-19 crisis. The extrapolated results for all German biosphere reserves total 65.3 million visitor days per year (Job et al., 2013, p. 97; Mayer & Job, 2014, p. 83). For the 104 nature parks there are not even rough estimates of the total visitation volume available.

All German national parks generated a gross turnover of EUR 2.78 billion in 2016, showing huge variability and leading to an income equivalent of around 85,500 persons (Job et al., 2016, p. 24). All German biosphere reserves create an

[21] The study by Allex et al. (2019) also differs regarding the expenditure survey as spending for petrol is included, in contrast to all earlier studies by Job et al.

extrapolated amount of EUR 2.94 billion gross turnover with income equivalents of approximately 86,200 persons (Job et al., 2013, p. 97). The high values of the two Wadden Sea National Parks and Southeast Rügen Biosphere Reserve (part of the Pomerania region) can be explained by the fact that all three are coastal areas with a long tradition as destinations for beach/spa tourism and were designated as PAs only relatively recently. Therefore, it makes sense to assess the importance of the PAs for visitors' travel motivation. Knowledge about the status as a PA and its relevance for visitation is analysed with the help of several successive questions (see Job et al., 2005, 2009; Mayer et al., 2010).

Depending on a region's history of tourism development, the PA status represents the main visiting reason for a certain share of guests. These are usually termed as visitors with a high PA affinity. Among the national parks, Bavarian Forest achieved the highest value with a share of 57.9%, followed by Eifel (48.0%) and Müritz (47.7%), while Lower Saxony Wadden Sea and Black Forest reached only 10.9% and 9.3%, respectively, because of their respective beach/spa and hiking/spa tourism traditions. For the biosphere reserves, these results were a little lower: Schaalsee with its relatively short tourism history showed the highest share of visitors with a high PA affinity (21.5%). Rhön had a share of 13.7%, whereas Southeast Rügen reached only 4.9%. This means that only this small share of visitors would not come to the region if the biosphere reserve did not exist.

Regarding this core segment of visitors with a high PA affinity (who could also be interpreted as nature tourists in a stricter sense because they are motivated by the PA status), the results of the economic impact analysis must be adapted: overall, for all national parks, this segment attracted 9.51 million visitor days and a related gross turnover of EUR 431 million per year. The total economic impact of tourism in the 15 national parks analysed totaled EUR 252.1 million for the visitors with a high PA affinity and EUR 1.445 billion, respectively, for all national park visitors (Job et al., 2016, p. 24 f.).

For the biosphere reserves, the extrapolated results for all German biosphere reserves reduce to 4.2 million the visitor days motivated by the biosphere reserve status, generating a yearly gross turnover of about EUR 181.5 million and 5,261 income equivalents (Job et al., 2013, p. 97). Overall, the large gap in the results for both PA categories indicates that there was still a huge tourism potential, especially looking at those visitors who were attracted mostly by the PA. This also held true for the two nature parks analysed, where the share of visitors with a high PA affinity was very low (only 4.1% in Hoher Fläming) or limited (15.3% for Altmühltal, presumably a rather high value for nature parks).

Table 5.1 also highlights the mostly marginal shares of foreign visitors to German large-scale PAs. Only Berchtesgaden, Black Forest and Eifel National Parks registered more than 10% of incoming guests due to the proximity to Austria, France and Switzerland, and Belgium and the Netherlands. The shares were even lower in BR, potentially due to their limited prominence.

In addition to the economic impact of national park tourism, Mayer and Woltering (2018), as well as Sinclair et al. (2020), estimated the consumer surplus

Table 5.1. Regional economic impact of tourism in selected German protected areas

Name	Area [ha]	Designation Year	Survey Year	Visitor Days [Million]	Share of Day-trippers [%]	Share of Foreign Visitors [%]	Share of Visitors with High PA Affinity [%]	Average Spending per Person and Day [€]	Gross Turnover all visitors [Million €]	Income all visitors [Million €]	Income Equivalent all visitors [Person]
National Park											
1 Bavarian Forest	24 217	1970	2007	0.76	33.0	3.8	45.8	36.57	27.8	13.5	904
			2018	1.36	58.6	–	57.9	38.49	52.4	26.1	–
2 Berchtesgaden	20 804	1978	2002	1.13	23.0	–	10.1	44.27	8.2*	4.6*	206*
			2014	1.58	25.4	15.6	27.7	59.35	93.8	47.5	2103
3 Eifel	10 770	2004	2007	0.45	76.0	11.7	27.3	19.31	8.7	4.3	251
			2014/15	0.87	64.5	10.3	48.0[a]	46.42	30.2	15.2	674
4 Hainich	7 513	1997	2007	0.29	76.0	1.4	40.7	17.25	5.0	2.5	168
			2017/18	0.30	60.0	7.0	40.0	28.83	8.5	5.2	266
5 Harz	24 732	1990/ 1994	2012/13	1.75	49.8	4.9	24.4	42.57	74.3	39.6	2312
6 Kellerwald-Edersee	5 738	2004	2007	0.20	59.0	5.8	25.8	19.48	3.9	1.9	111
7 Lower Oder Valley	10 323	1995	2007/08	0.21	92.0	–	32.1	9.45	1.9	0.9	61
			2013/14	0.14	83.9	3.0	39.0	14.85	2.1	1.0	63
8 Lower Saxony Wadden Sea**	345 000	1986	2007	20.65	15.0	1.5	10.9	50.37	1040.2	525.1	34525
9 Müritz	32 200	1990	2004	0.39	39.0	–	43.7	34.30	13.4	6.9	628
			2010	0.38	9.2	4.0	47.7	53.96	20.2	10.4	768
10 Saxon Switzerland	9 350	1990	2009	1.71	46.0	6.3	28.8	34.30	58.7	29.3	1878
11 Schleswig-Holstein Wadden Sea***	441 500	1985	2012/13	18.80	18.5	1.8	17.1	57.19	1065.6	572.1	30401

Name	Area [ha]	Designation Year	Survey Year	Visitor Days [Million]	Share of Day-trippers [%]	Share of Foreign Visitors [%]	Share of Visitors with High PA Affinity [%]	Average Spending per Person and Day [€]	Gross Turnover all visitors [Million €]	Income all visitors [Million €]	Income Equivalent all visitors [Person]
12 Black Forest	10 062	2014	2014/15	1.04	60.2	14.6	9.3	42.98	44.7	22.8	825
13 Jasmund	5 738	1990	2013/14	0.68	8.2	7.6	27.5	69.97	47.5	24.8	1583
14 Western Pomerania Lagoon Area	78 600	1990	2013/14	4.77	14.0	7.0	31.5	60.86	290.1	150.4	9582
Biosphere Reserves											
I Palatinate Forest	180 969	1992	2011/12	5.72	60.6	3.6	3.5	38.20	229.0	116.2	5271
II Rhön	243 323	1991	2010/11	6.37	68.1	1.0	13.7	45.57	185.6	94.6	4786
III Schaalsee	31 000	2000	2011/12	0.49	82.4	0.7	21.5	22.97	11.6	5.7	336
IV Southeast Rügen	22 800	1991	2011/12	5.29	6.7	2.8	4.9	71.43	379.3	203.9	14281
V Spree Forest	47 509	1991	2011/12	1.94	48.7	1.0	8.7	62.16	90.0	47.4	2971
VI Vessertal-Thuringian Forest	17 081	1979	2010/11	0.49	64.1	6.7	11.1	24.89	12.7	6.4	392
Nature Parks											
A Altmühltal	296 617	1969	2004	0.91	63.0	–	15.3	22.80	20.7	10.3	483
B Hoher Fläming	82 718	1997	2004	0.30	83.0	–	4.1	20.60	6.2	3.0	211

* Data available only for visitors with high national park affinity; only net turnover available; ** About 93.0% water surface; *** About 97.7% water surface; [a] without local visitors.

Source: adapted from Mayer & Woltering, 2017, pp. 140f. and Mayer & Stoll-Kleemann, 2020, pp. 489f., based on Job et al., 2003, 2005, 2009, 2013, 2016; Mayer & Job, 2014; Mayer & Woltering, 2018; Merlin, 2017; Nationalparkverwaltung Bayerischer Wald & Nationalparkverwaltung Šumava, 2020; Nationalpark-Verwaltung Hainich, 2019; Rein & Schneider, 2009; Rein & Baláš, 2015; Steingrube & Jeschke, 2011; Wölfle et al., 2016; Woltering, 2012.

of visitation to the German national parks – these benefits surpass the economic impact considerably, even using conservative assumptions. This indicates that the direct vicinity of national parks does not only bring economic profits from their visitation, but also the German society as a whole benefits from the recreational value of such sites.

5.3. Methods

5.3.1. Polish protected areas

The economic impact of tourism in protected areas (PAs) is analysed by considering the demand generated by visitors to such sites. This demand is satisfied by local companies. To meet the increased final demand (i.e. the demand that is not transferred between industries in the production process), companies need to increase production. As the output from each industry is sent to all other industries, there are multiplier effects in the economy, resulting in increased output in all industries (even if only some of them directly profit from visitor expenditures). We call the transfers of shares of production between industries inter-industry flows. Knowing the production volumes of each industry and their use for intermediate consumption in other industries, we create an input-output table, which is the basis of the input-output model.

Therefore, an assessment of the economic impact of tourism in PAs is conducted by means of the input-output (I/O) model. The basics of this method were proposed by François Quesnay (1759) in his *Tableau économique*, and by Léon Walras (1874). The matrix form of the input-output analysis was proposed by Wassily W. Leontief (1936).

The input-output model exists in two forms: natural and monetary. As production of different industries is measured in different units, the monetary form of the input-output analysis is much more widely used. The I/O table is presented in the monetary form in Table 5.2.

Table 5.2. The I/O table in the monetary form.

		Outputs				
		X_1	X_2	⋯	X_n	y_i
Inputs	X_1	X_{11}	X_{12}	⋯	X_{1n}	y_1
	X_2	X_{21}	X_{22}	⋯	X_{2n}	y_2
	⋮	⋮	⋮		⋮	⋮
	X_n	X_{n1}	X_{n2}	⋯	X_{nn}	y_n
	X_0	X_{01}	X_{02}	⋯	X_{0n}	y_0
	M	m_1	m_2	⋯	m_n	

where:
X_i – value of production (input) in *i*-th industry,
X_{ij} – value of production (input) in *i*-th industry and transferred to the *j*-th one,
X_0 – salaries in the industries,
y_i – final output (demand),
y_0 – salaries in the non-production sectors,
M – profits (value added) in the industries.

Output allocation equation:

$$X_i = \sum_{j=1}^{n} x_{ij} + y_i \quad i = 1,2, \ldots, n$$

Input allocation equation:

$$X_j = \sum_{i=1}^{n} x_{ij} + x_{0j} + m_j \quad j = 1,2, \ldots, n$$

Labour force equation:

$$X_0 = \sum_{j=1}^{n} x_{0j} + y_0$$

National income equation:

$$\sum_{i=1}^{n} y_i = \sum_{j=1}^{n} x_{0j} + \sum_{j=1}^{n} m_j$$

In real-life situations, it is much more convenient to analyse not the total value of production (input) in the *i*-th industry and transferred to the *j*-th one, but the cost coefficients (b_{ij}), denoting the input of resources from the *i*-th industry needed to produce a unit value of output in the *j*-th industry:

$$b_{ij} = \frac{x_{ij}}{X_j}$$

The output allocation equation with the use of cost coefficients is as follows:

$$X_i = \sum_{j=1}^{n} b_{ij} X_j + y_i \quad i = 1,2, \ldots, n$$

The input allocation equation with the use of cost coefficients is as follows:

$$X_j = \sum_{i=1}^{n} b_{ij} X_j + x_{0j} \quad j = 1,2, \ldots, n$$

We present the matrix of the cost coefficients (B), vectors of the value of global output (X) and final output (Y):

$$B = \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ b_{n1} & b_{n2} & \cdots & b_{nn} \end{bmatrix} \quad X = \begin{bmatrix} X_1 \\ X_2 \\ \vdots \\ X_n \end{bmatrix} \quad Y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix}$$

Because the values of vector Y are known and result from social demands, we must find the vector of global output needed to satisfy the final output. The output allocation equation in the matrix form is as follows:

$$X = BX + Y \tag{5.1}$$

Solving equation (5.1) with respect to X, we obtain:

$$X = (I - B)^{-1}Y \tag{5.2}$$

Where $(I - B)^{-1}$ is the matrix of additional input coefficients.

Since the input-output tables are available at the national level, we need to perform a regionalisation procedure in order to obtain the input-output table at the regional level. It is important to do this, because the economic impact of tourism is analysed here only for specific regions, and not for the whole country. Regionalisation is done by means of the *location quotients* (LQs). The simplest method of calculating the LQs is to use shares of regional output or employment in relation to the national share of output or employment in this industry – this way we arrive at the simple LQ (SLQ) (Arnegger, 2014):

$$ELQ_{ir} = \frac{\frac{O_{ir}}{O_r}}{\frac{O_{in}}{O_n}} \tag{5.3}$$

where:
O_{ir} – output (or employment) in the *i*-th industry in the analysed region,
O_r – total regional output (or employment),
O_{in} – national output (or employment) in the *i*-th industry,
O_{jr} – total national output (or employment).

However, formula (5.3) is suitable only for input-output within a given industry. In order to consider the transfers between various industries, we must introduce the *cross-industry location quotients* (CILQs) (Arnegger, 2014):

$$CILQ_{ij} = \frac{\frac{O_{ir}}{O_{in}}}{\frac{O_{jr}}{O_{jn}}} \tag{5.4}$$

where:
i – supplying (selling) industry,
j – purchasing industry,
O_{ir} – output (or employment) in the i-th industry in analysed region,
O_{in} – national output (or employment) in the i-th industry,
O_{jr} – output (or employment) in the j-th industry in analysed region,
O_{jn} – national output (or employment) in the j-th industry.
By means of the equations (5.2) and (5.3) we regionalise the cost coefficients matrix (B). Knowing the final demand in the analysed region, we can calculate the global output (production) for the analysed region needed to satisfy the final demand. When we divide the value of global production by the average wages in the area, we can calculate the equivalent of the additional employment needed to achieve the regional global output, thus, to satisfy the final demand. The global production and its equivalent in employment can be considered as the economic impact of tourism in PAs.

We conducted the analysis for Wolin National Park by using the input-output tables for Poland (OECD, 2022). The latest edition of these tables was available for the year 2015. By using the structure of employment for Poland and the region (Zachodniopomorskie Voivodship) in 2020 (Statistics Poland, 2022) we regionalised the input-output tables by using the formulas (5.2) – (5.4). In order to assess the equivalent of employment, we used the average wages in the industries in the region (Statistics Poland, 2022).

One very important step in the assessment of the economic impact of tourism in PAs is the calculation of visitor days and the assessment of the visitor expenditure in the sites. The visitor days were calculated on mixed bases of information. First, the data from 17 automatic counters (devices used for automatic counting of visitors that entered the park) were obtained. Next, the data was revised by the national park staff to account for dysfunctional devices and, additionally, an estimation was made of visitors entering the park on paths without automatic counters. There are two main entrances where people can enter the park area by different paths, but only one is checked by an automatic counter. These two locations were observed on eleven days by interviewers, who manually counted all the entering people, independent of the method they used for that purpose. This delivered a correction factor for the data from the automatic counting devices – the automatic counters recorded only about 80% of the true number of entrances.

We received the visitor expenditure values by means of 1440 face-to-face interviews at six entrances to the national park (for the questionnaire please see Appendix E, https://doi.org/10.12657/9788379864201-apps). We conducted the surveys on 17 days in the period from 25.01.2020 to 25.09.2021. This period was interrupted several times due to restrictions related to the COVID-19 pandemic, but all seasons were covered over two years. We divided the visitors into day-trippers (those who were in the area for only one day) and overnight visitors (those who stayed in the area for at least one night).

5.3.2. German protected areas

The research in Germany focused on the socio-economic monitoring in the UNESCO Biosphere Reserve Schorfheide-Chorin in the German Federal State of Brandenburg. The aim was to apply the method introduced for biosphere reserves by Job et al. (2013) in order to gain a profound understanding of this method and to identify potential adaptations for an optimised methodological approach applicable to the Pomerania region.

Especially visitor numbers and the specific structure of visitor expenditure were necessary to carry out the economic impact analysis of PA tourism. In order to determine these data, visitor counts as well as interviews were systematically conducted in the Biosphere Reserve at ten predefined locations over a period of 12 months in the years 2020/2021 (for the questionnaire please see Appendix F, https://doi.org/10.12657/9788379864201-apps). The surveys were carried out in the summer season between 10 am and 6 pm and in the low season between 10 am and 4 pm due to the shorter daytime and the reduced leisure behaviour of guests. All the surveys were carried out electronically via mobile phones with the app *mQuest traffic* that allowed for the surveys to be conducted offline.

Due to the COVID-19 pandemic, several methodological adaptations had to be made and will be explained within the following sections.

5.3.2.1. Visitor numbers

As there are no "entrances" to the Biosphere Reserve, there is no reliable information on the visitor numbers in the region. In order to determine the total number of visitors, visitor counts combined with short interviews were carried out throughout the Biosphere Reserve. The locations were identified with the support of the PA's administration and aimed to cover all the main visitor hotspots and other potential points of interests for different visitor types. A similar study with the same methodological approach had already been carried out in 2017/18 by the Institute of Geography and Geology at the University of Würzburg (see Job et al., 2023). The results are expected to be published in 2023, but preliminary results are already available, so that comparisons between our study and the analysis from 2017/18 can be drawn. In accordance with the previous study from 2017/18, five locations were not used during the low season and two other locations were staffed with two interviewers each because of high visitor frequencies. The approach was an attempt to replicate the previous study and aimed to represent the conditions on site in the best possible way.

The short interviews were conducted at a flexible frequency during the counts and provided information about overall visitor characteristics, such as whether they were residents, day-trippers or overnight visitors, as well as further information about overnight visitors. By adhering to a clear frequency, a true random sample was obtained and the representative structure of visitors could be determined.

Residents were identified by local zip-codes within the Biosphere Reserve and additionally by asking the purpose of the visit (leisure or transit/other daily

purposes) in the long interviews. Residents with leisure purposes were classified as day-trippers and included in the economic analyses, but residents that were in the area because of their daily-life routines were excluded (according to the definition of tourism visitors in UNSD, 2010, p. 12). For overnight visitors, the category of accommodation (hotel, camping, etc.) was determined and the range of money spent (e.g. up to EUR 30) was asked in order to be able to weight upcoming extrapolations. The short interviews, which were conducted in combination with the visitor counts, alternated with long interviews every half hour.

As visitor numbers tend to vary both temporally and spatially, and over the week and the single day, the survey days were divided according to specific seasonal periods, as suggested in Job et al. (2013) (Table 5.3):

Table 5.3. Survey days per season

Season	Amount of survey days
Summer season I (18/07/2020–14/09/2020)	6 survey days // 4 weekends, 2 week-days
Low season I (15/09/2020–14/11/2020)	3 survey days (COVID-19 lockdown from 01 November) // 1 weekend, 2 week-days
Winter season (15/11/2020–14/03/2021)	0 survey days (COVID-19 lockdown)
Low season II (01/04/2021–30/04/2021)	1 survey day // 1 weekend (during lockdown)
Low season III (01/05/2021–14/06/2021)	4 survey days (COVID-19 lockdown until 06 May 2021) // 1 weekend, 3 week-days
Summer season II (15/06/2021–17/07/2021)	2 survey days // 1 weekend, 1 week-day

Source: own elaboration.

Due to the COVID-19 pandemic, parts of the low season I (November 2020), the complete winter season, and parts of the low season II (until May 2021), were in lockdown with a total tourism-closure of 197 days, so that no survey days were undertaken during that time. An exception was Easter 2021, with a survey day carried out during the weekend in four main locations of the region which focused on visitor counts and short interviews. Hence, the weekends of April 2021 could be included in the visitor estimations. In total, 16 survey days with an even split between weekends and weekdays could be implemented, covering a period of 187 total days from 18 July 2020 until 17 July 2021.

The counts and short interviews of a survey day normally covered eight half-hour intervals between 10 am and 6 pm in a single day (or six half-hours from 10 am to 4 pm during the low season, respectively). The counted visitors were extrapolated site-specifically by calculating the average value to the minute and then extrapolating it to a full hour. The sum of the hourly values give the number of visitors during the survey period. However, this only covered part of the day, so that the result were extrapolated to an entire day, as per Job et al. (2006, p. 8). By adding up the daily visitor numbers for the individual sites, the total number of visitors in a survey area on a survey day was finally determined. The daily values served as the basis for calculating the annual number of visitors. For this purpose, nine different day types were defined, which considered the season, the day

of the week, and the weather (see Figure 5.1). Average values for the respective day types were then calculated from the daily values. To take the weather into account, weather data from the German Weather Service for the weather station Angermünde was integrated into the calculation on a daily basis. For the calculation of the variables of "good" and "bad" weather, the three parameters of temperature, sunshine duration, and precipitation, were included. These values were transformed and indexed using the moving average of each season. The weather index thus categorised each survey day according to the categories of "good" weather and "bad" weather during a specific season. The three characteristics of "season", "day of the week" and "weather" allowed for assigning each survey day to one of the nine typical day types, which served as the basis for extrapolating the total visitor numbers. The average values for each of these day types were then extrapolated according to the overall number of each day type (see also Staab et al., 2021). For the survey day during Easter 2021, weather categorisation was excluded, as there was no further survey day and because of the uncertain visitor behaviour during the time of a COVID-19 lockdown.

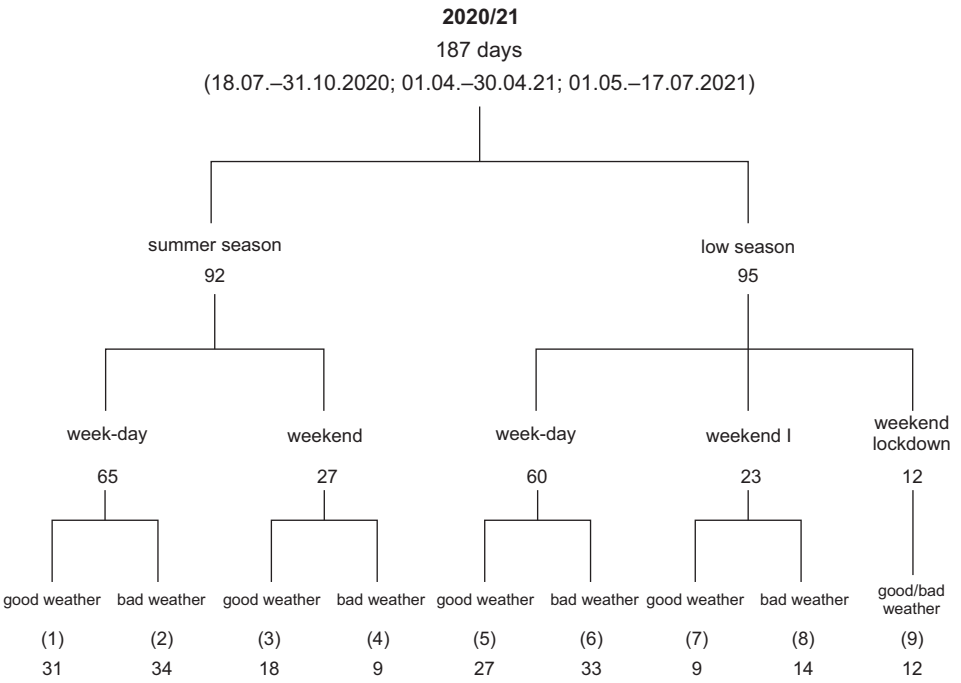

Figure 5.1. Categorisation of day-types (in brackets) and number of days for each category
Source: own elaboration.

The calculated visitor number only corresponds to the representation of visitors at the specific ten sites and during the analysed period. Due to the size, different settlement areas and traffic routes in the biosphere reserve, and the uncertainties around visitor behaviour during the COVID-19 pandemic, these estimations could hardly be a basis for robust conclusions about the total number

of visitor days in the area during one year. Hence, we extrapolated the data with the help of official tourism statistics, as recommended in Job et al. (2013, 2021).

Up to this point, the visitor numbers corresponded to the "extrapolation of the counting" stage and reflected representative ratios of different visitor groups.

To complement the figures, official municipal statistics of the survey-time were used. As the area of the Biosphere Reserve is not entirely coherent with the municipal borders, tourism figures were only calculated proportionally according to the actual area shares of the Biosphere Reserve. This approach prevented an overestimation of values, e.g. the number of overnight stays in tourist centres outside a biosphere reserve is not included in the analysis. We applied the same delineation of the area as in the previous study from 2017/18.

To complement the generated data, ratios of the shares between day-trippers and overnight visitors, as well as the accommodation categories, were used. For this purpose, we used the (extrapolated) shares of visitors staying in accommodation types that are not included in official statistics, such as apartments, visits at friends' and relatives'. This step was an attempt to minimise the inaccuracy of the official tourism statistics with regard to non-commercial overnight stays. Subsequently, the share of day-trippers and residents was added to the number of overnight visitors according to the empirically collected ratios. In total, the number of visitors corresponded to the overnight stays recorded in official statistics, the non-commercial overnight stays, and day-trippers and residents, whereby the proportions were derived from the empirical surveys in the study areas. This methodological procedure aimed to determine a representative, valid and reproducible number of visitors in the biosphere reserve.

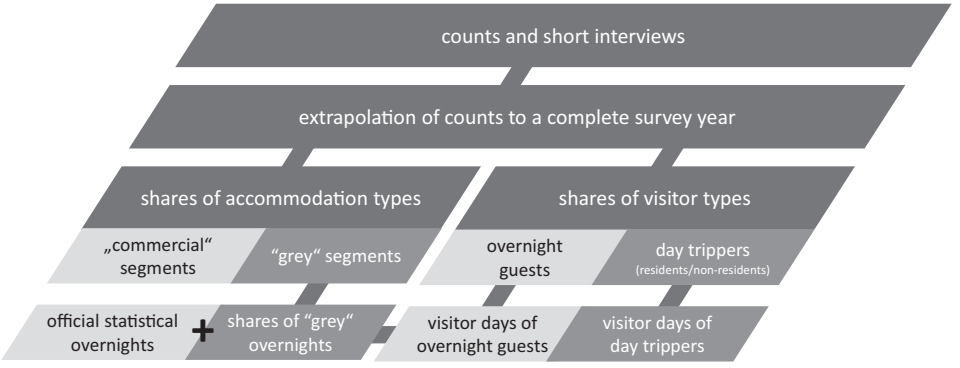

Figure 5.2. Approach of estimating final visitor numbers.
Source: own elaboration, based on Job et al. (2013, p. 52).

5.3.2.2. Economic impact estimation of PA visitation

As discussed previously, the visitors' motivation needs to be known to be able to attribute the adequate share of regional income to tourism because of the existence of the PA. Visitors that make a trip or a day excursion solely because of the biosphere reserve add value that would not exist without the protected area.

This classification is of particular importance. Biosphere reserves pursue the goal of a harmonious combination of nature conservation and economic development (Kraus, 2015; Merlin, 2017). Specific biosphere reserve visitors know the status of the PA and visit it because of its protection status. Accordingly, these visitors have a specific demand behaviour that has to be addressed differently than that of the group referred to as "other biosphere reserve tourists".

For the classification into these groups, a stepwise sequence of three partly redundant questions was run through on the survey instrument, analogous to Job et al. (2003, p. 127 and 2005, p. 61). Only if these three questions were answered positively, were the respondents classified as specific biosphere reserve tourists and included as such in the further economic impact analysis.

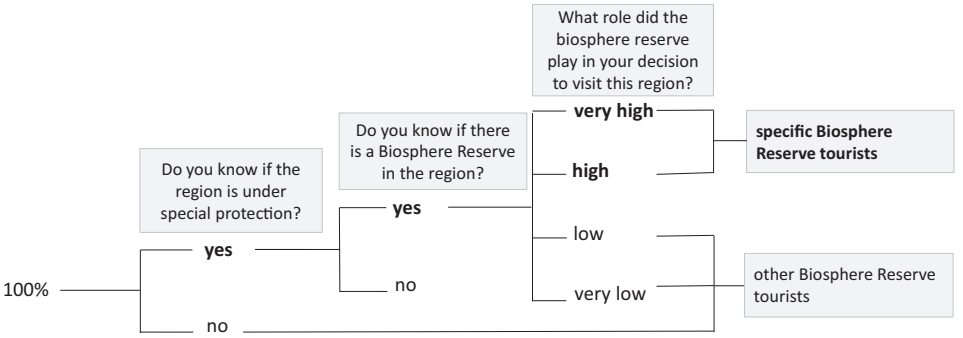

Figure 5.3. Approach of determining visitors with high biosphere reserve affinity.
Source: own elaboration, based on Job et al. (2003, p. 127) and Job et al. (2005, p. 61).

In order to calculate the regional economic impact, the expenditure structure of all relevant visitor groups had to be determined. The expenditure was differentiated according to day-trippers, residents and overnight visitors, and was also segmented into "specific biosphere reserve tourists" and "other biosphere reserve tourists". Expenditures of overnight guests were combined with the results of the short interviews that provided extensive information on different expenditure groups for all accommodation types (e.g. less than EUR 30 per night in a hotel, EUR 30–EUR 60 in a hotel etc.). The long interviews provided information on the average daily expenditures of respondents belonging to these accommodation types. This data was weighted with the average shares of each expenditure group provided in the short interviews. As proposed in Job et al. (2005, p.65), this was done to get as accurate information as possible for the average expenditures of different accommodation types.

Beyond these visitor groups, expenditures were distributed among different sectors. The types of expenditure were asked for in detail in the long interviews, to enable an in-depth breakdown of the data for all further calculations. In total, ten expenditure types were asked for that could be divided into three main expenditure groups:

- Hospitality, which includes expenditures on restaurants and accommodation (weighted results)

- Retail trade, with expenditures on food and other goods
- Services, which include expenditure on transport, sports, leisure and admissions, as well as the visitor's tax and conference fees and others.

The in-depth differentiation of expenditures was maintained throughout the overall calculations of VAT deductions and the calculation of economic impact. For the first multiplier round, all income effects resulting from the direct expenditure of tourists were recorded. The value-added quotas vary considerably from sector to sector. For this study, as in the previous study, average tourism-specific value-added quotas were used, based on national data and according to the type of service (based on data by Harrer & Scherr, 2002; Maschke, 2005). The calculation was done separately for each expenditure category. Therefore, the overall income structure represents the specific spending behaviour of visitors in the Biosphere Reserve. Exact value-added quotas of the companies benefiting from the second multiplier round could not be used in this study. For this reason, the widely used average of 30% was applied as a value-added quota for the indirect income effect. To determine income equivalents, the average primary income of the region was determined (official statistics) and divided by the tourism income contribution. The calculation procedure was based on the method by Job et al. (2003 and 2005) and Mayer et al. (2010), and is summarised by Figure 5.4:

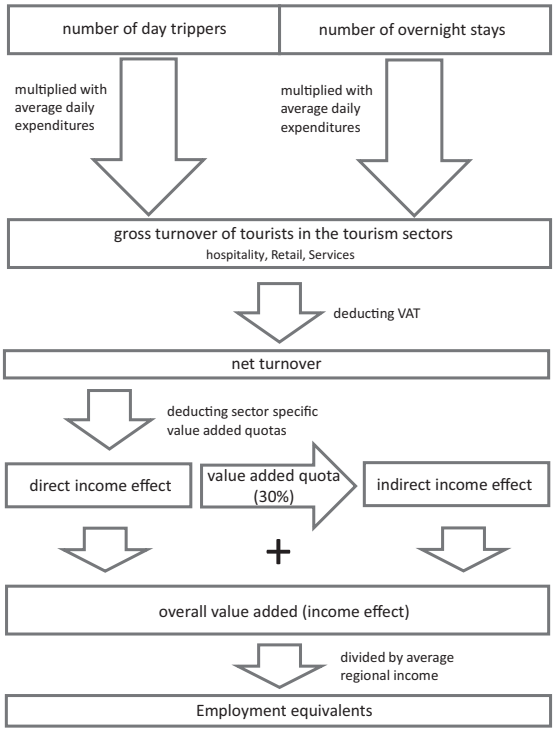

Figure 5.4. Approach of estimating regional economic impacts of PA tourism.
Source: own elaboration, based on Job et al. (2003, p. 127) and Job et al. (2005, p. 61).

Some alterations to the calculations had to be made due to methodological challenges with the mobile questionnaire application. A technical bug excluded the expenditure questions for day-trippers in the summer season I. In order to prevent data skewing, the daily expenditures of day-trippers for the summer season were imputed with the total daily expenditures of the survey days in the summer season II. The calculations showed only slight deviations of the expenditures, which were adjusted in the overall expenditures.

Additionally, VAT rates were reduced from July-December 2020 as measures for supporting the German economy during COVID-19. These reductions were taken into account within the calculations.

5.4. Economic impact of tourism in protected areas in the Pomerania region

5.4.1. Economic impact of tourism in Polish protected areas – the example of Wolin National Park

We present the number of visitor days and the visitors' yearly spendings in Table 5.4.

Table 5.4. The annual number of visitor days and the visitors' total net expenditure.

Groups of visitors	Fraction [%]	Net expenditure per person [PLN]	Annual number of visitor days	Annual total expenditure [PLN]
Day-trippers	8.6	110	59,490	6,543,900
Overnight visitors	91.4	277	632,251	175,133,527
Total	100.0		691,741	181,677,427

Source: own elaboration.

Over 91% of visitor days were generated by overnight visitors. They also contributed the largest part of the total expenditure (over 96%). All the expenditure was net of tax, because the VAT is a tax that flows to the central government and therefore does not contribute to the local economic effects.

The visitor expenditure could be differentiated into four groups of expenses, supplying four industries (Table 5.5).

Table 5.5. Visitor expenditure structure.

Groups of expenses	Day-trippers	Overnight visitors
Accommodation and food services	33.0%	56.5%
Retail trade	55.5%	39.5%
Arts, entertainment, recreation and other service activities	6.5%	2.3%
Transportation and storage	5.0%	1.7%

Source: own elaboration.

The largest share of day-trippers' expenses were the expenses on retail trade, while for overnight visitors the expenses on accommodation and food services were the most important.

We merged the I/O table to obtain the following sections:

- Section A: Agriculture, forestry and fishing,
- Section B+C+D+E: Mining and extraction of energy producing products, electricity, gas, water supply, sewerage, waste and remediation services,
- Section F: Construction,
- Section H: Transportation and storage,
- Section G: Wholesale and retail trade; repair of motor vehicles,
- Section I: Accommodation and food services,
- Section J: Telecommunications, IT and other information services,
- Section K: Financial and insurance activities,
- Section L: Real estate activities,
- Section M+N: Professional, scientific and technical activities; administrative and support service activities,
- Section O: Public administration and defence; compulsory social security,
- Section P: Education,
- Section Q: Human health and social work,
- Section P+R: Arts, entertainment, recreation and other service activities.

The estimated visitors' expenses (final demand) and the global regional production (economic impact) in 2020 are presented in Table 5.6.

Table 5.6. Estimated economic impacts of tourism in Wolin National Park in 2020 (in PLN thousand).

Sections	Day-trippers		Overnight visitors		Total
	Expenses	Production	Expenses	Production	Production
A	0.0	504.7	0.0	15,923.8	16,428.5
B+C+D+E	0.0	3,106.1	0.0	90,486.3	93,592.4
F	0.0	265.2	0.0	6,474.0	6,739.2
G	3,631.9	4,521.3	69,177.7	93,722.7	98,244.0
H	327.2	849.2	2,977.3	14,543.6	15,392.9
I	2,159.5	2,226.4	98,950.4	100,674.6	102,901.0
J	0.0	122.9	0.0	2,880.8	3,003.7
K	0.0	100.1	0.0	2,401.9	2,502.0
L	0.0	188.6	0.0	4,694.1	4,882.7
M+N	0.0	379.8	0.0	9,200.7	9,580.5
O	0.0	7.8	0.0	183.3	191.1
P	0.0	11.2	0.0	267.2	278.4
Q	0.0	166.5	0.0	3852.3	4018.8
R+S	425.4	523.5	4028.1	6369.5	6893.0
Total	6,543.9	12,973.3	175,133.5	351,674.9	364,648.3

Source: own elaboration.

As every sector influences all other sectors in the I/O model, the four groups of expenses caused production in all the other sectors. The visitors' final demand caused the highest increase in production in sectors B+C+D+E (mining and extraction of energy producing products, electricity, gas, water supply, sewerage, waste and remediation services), G (wholesale and retail trade; repair of motor vehicles) and I (accommodation and food services). The estimated number of day-trippers and their expenses brought nearly PLN 13 million (2.78 million Euro) of total value of production in the region. The effect of the overnight visitors' expenses was much higher – over PLN 351 million (over 75 million Euro), which brought the total economic impact to the level of PLN 364.65 million (almost 78 million Euro).

The equivalent number of jobs in Wolin National Park in 2020 is presented in Table 5.7.

Table 5.7. Estimated equivalent number of jobs in Wolin National Park in 2020.

Sections	Mean wages [PLN]		Jobs		
	Monthly	Yearly	Day-trippers	Overnight visitors	Total
A	5,398.38	64,780.56	8	246	254
B+C+D+E	4,877.44	58,529.28	53	1,546	1,599
F	3,729.41	44,752.92	6	145	151
G	3,954.14	47,449.68	95	1,975	2,070
H	4,269.26	51,231.12	17	284	301
I	3,243.33	38,919.96	57	2,587	2,644
J	7,605.96	91,271.52	1	32	33
K	6,090.66	73,087.92	1	33	34
L	5,111.57	61,338.84	3	77	80
M+N	4,606.94	55,283.28	7	166	173
O	6,337.05	76,044.60	0	2	2
P	5,267.10	63,205.20	0	4	4
Q	4,845.95	58,151.40	3	66	69
R+S	4,323.29	51,879.48	10	123	133
Total			261	7,286	7,547

Source: own elaboration.

The equivalent of total production in the number of jobs can be obtained by dividing the estimated total production in every sector by average yearly wages in this sector. We estimated the number income equivalents generated by the expenditures of day-trippers at 261 and for the overnight visitors at 7,286. The total equivalent of production in the region of Wolin National Park in the number of jobs was 7,547. In some sectors (O and P – public administration and defence; compulsory social security and education, respectively), the increase in the number of jobs was hardly visible (these sectors depended on tourism to a very small degree). The highest increase in the number of jobs was visible in the case of the same sectors, as presented in the previous table – B+C+D+E (mining and

extraction of energy producing products, electricity, gas, water supply, sewerage, waste and remediation services), G (wholesale and retail trade; repair of motor vehicles) and I (accommodation and food services).

5.4.2. Economic impact of tourism in Schorfheide-Chorin Biosphere Reserve, Germany

In total, 28,593 persons could be reached by the counts (21,493) and short surveys (7,100) during the 16 survey days in Biosphere Reserve Schorfheide-Chorin. In addition, 1,171 long interviews were conducted, reaching a total sample of 29,764 visitors to the Biosphere Reserve during the survey time.

5.4.2.1. Visitor structure

The empirical results together with the data from official tourism statistics resulted in a total number of 2,540,000 visitor days within the boundaries of Schorfheide-Chorin Biosphere Reserve from July 2020 to June 2021. This marked a decline of 21% in comparison to 2017/18, with overnight visitors reaching 840,000 (–12%), and 1,650,000 day trips (–26%) and 51,000 residents[22].

This decline is explained by the COVID-19 lockdown of almost seven months during the surveyed period of 2020–2021 (197 lockdown days). An estimation of the average number of visitor days per day during the surveyed seasons (187 days) shows that visitor frequentation during that time was higher with 13,600 visitors per day than in the previous survey time of 2017/18 with an average of 8,800 visitors per day. Therefore, the decline in the total visitor number was not necessarily an indicator of a reduced visitor demand in the region; it must be assumed that it resulted in an even higher tourist pressure during times of the officially open days.

Visitor days of people staying overnight accounted for a share of 33%. The Biosphere Reserve received a larger influx of day-trippers, who accounted for a share of 67%. This structure is similar to most other examined biosphere reserves in Germany (Merlin, 2017) and it can be assumed that this biosphere reserve is particularly suitable for local, short-distance recreation.

Not all visitors came to the region because of the Biosphere Reserve. To find out the importance of the Biosphere Reserve for the motivation to visit the region, the affinity of the visitors and the awareness of the protection status were examined. Furthermore, other characteristics and preferences were determined.

For the region, a share of 20.4% of visitors with a high biosphere reserve affinity could be revealed, which was a decrease of 1.1%, compared to the previous study from 2017/18. Still, this percentage was significantly higher than the average of 10.5% of the six biosphere reserves studied in Germany in 2013 (Job et al., 2013, p. 76). A protected area status such as that of a national park can create a significant incentive to visit, especially in new destinations or those

[22] Residents that were in the region because of leisure purposes, were counted as day-trippers, whereas all other residents (just crossing the counting locations) were excluded in further calculations.

that are not very developed in terms of tourism. This is particularly interesting against the background of the COVID-19 pandemic, which was accompanied by a change in the tourism demand structure in many rural tourism regions in Germany (see details in Chapter 6 of this publication).

For Schorfheide-Chorin Biosphere Reserve, the visitor structure in the survey period 2020/21 was as follows: of the approximately 2,540,000 visitor days, approx. 519,100 were due to specific Biosphere Reserve visitors. Of these, approx. 294,600 were day-trippers and approx. 224,500 were visitor days of people staying overnight. The distribution of visitor types was almost identical with the structure in 2017/18, with a slight shift towards overnight visitors for both PA affinity types.

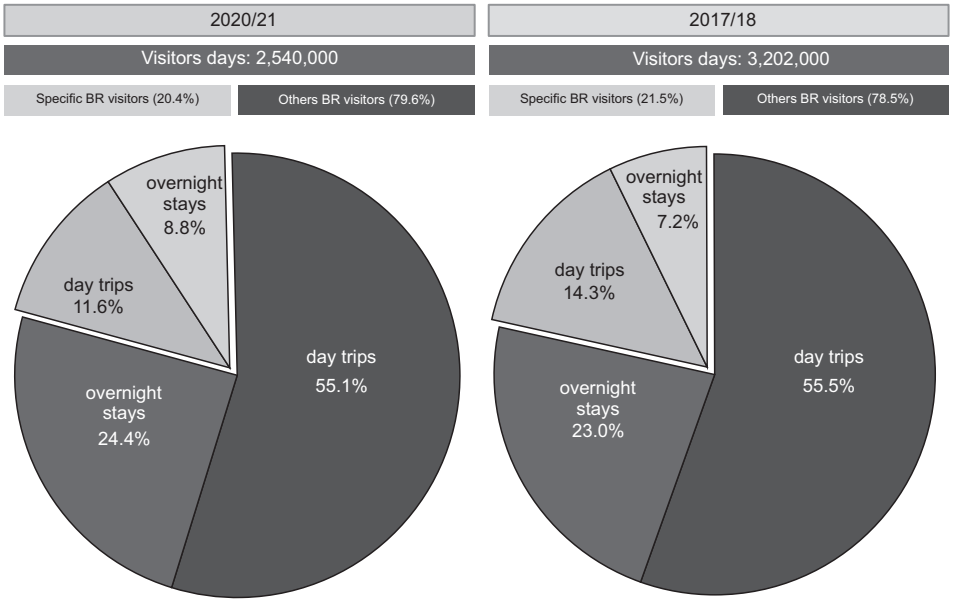

Figure 5.5. Visitor structure in Schorfheide-Chorin Biosphere Reserve 2020/21 in comparison with the previous study from 2017/18.
Source: own elaboration based on Job et al., 2023 (right part of the figure).

Overnight visits were clearly dominated by stays in holiday apartments (38%) followed by camping (19%) and hotel (14%). Compared to 2017/18, there was a shift from hotel stays to holiday apartments, whereas all other shares of accommodation categories were very similar. Only about one fifth of the overnight guests (19%) opted for catering services, especially breakfast - mainly in hotels. Only 3% of the guests who did not stay in hotels took advantage of catering services provided by the accommodation. 35% of overnight guests spent up to EUR 30 per person per night. Approx. another third of overnight guests (31%) spent up to EUR 50 per person for an overnight stay and another quarter (23%) spent between EUR 51 and EUR 75 per overnight stay. These values also reflected an increase in the total daily visitor expenditures compared to 2017/18.

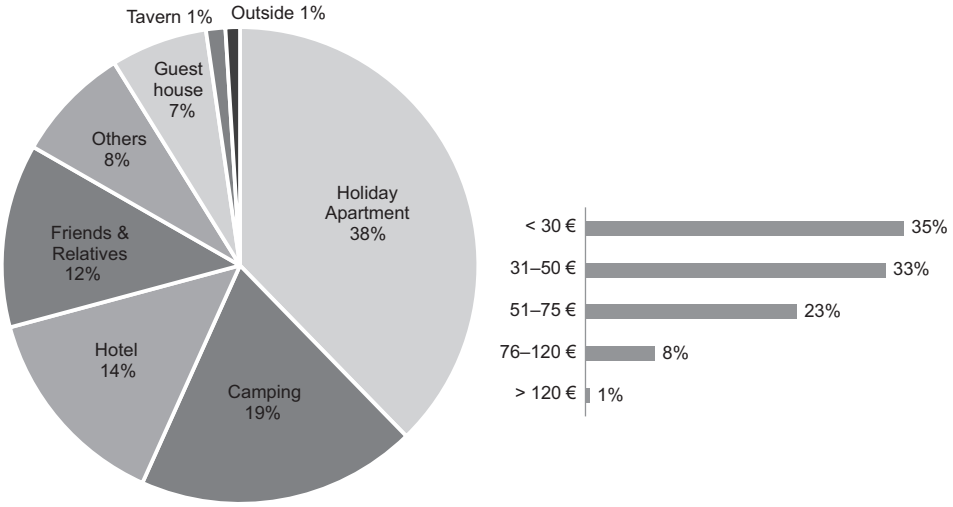

Figure 5.6. Choice of accommodation types and average spending per night in the Schorfheide-Chorin Biosphere Reserve.
Source: own elaboration.

The majority of guests (90%) came to the region for holidays and leisure. The main reasons for visiting were hiking (47%), cycling (29%), and visiting cultural sites (29%), as well as farm shops (24%). For as many as 27% of the visitors, activities such as sunbathing or water sports were decisive for their visit. Overall, the activities were quite balanced in popularity, which indicates a diverse tourism portfolio; hence, the region is attractive for pursuing various activities.

The majority of tourists arrived by their own or rented car (67.2%) or motorbike (12.2%). The region is especially well known for motorbike trips by Berliners. However, public transport also had quite a relevant significance as a mode of transport to the region, with a share of 12.9%. This is reasonable, as many starting points for hiking and cycling in the Biosphere Reserve are connected to the public transport network – especially for visitors from Berlin. Interestingly, the share of arrivals by train doubled over the last three years (2017/18: 5.7%). Another considerable proportion of visitors arrived on foot as hikers (5.5%). Arrival by bicycle, on the other hand, was extremely low at only 0.4%, although the Biosphere Reserve is crossed by some significant cycle routes. However, visitors also often took their bicycles on the train or car for cycling within the area. The importance of buses can be estimated somewhat higher than reported, especially at the site of the Niederfinow, as participants of group tours were underrepresented in the long interviews.

By asking for the zip-code during the short interviews, the origins of the visitors to the Biosphere Reserve could be mapped very precisely, as presented in Figure 5.8. Overall, visitors from Germany predominated (98%), with a very small proportion of visitors from abroad and no dominant foreign source markets. About two thirds of the visitors came from the Berlin-Brandenburg region (65.4%). Of course, this included a large proportion of day-trippers who came

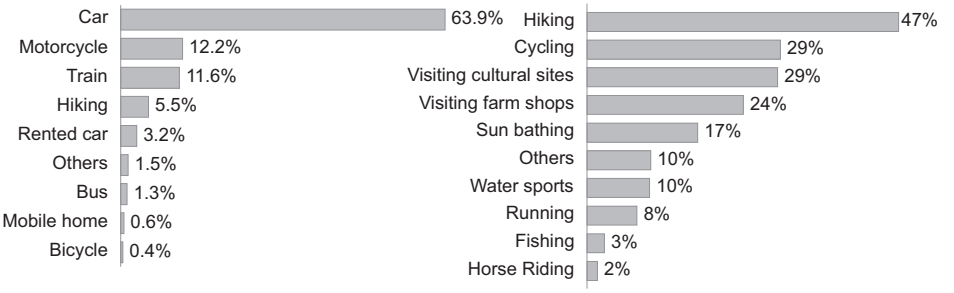

Figure 5.7. Activities (right) and mode of transport (left) for arrivals at Schorfheide-Chorin Biosphere Reserve.
Source: own elaboration.

mainly from Berlin and the immediate surrounding of the Biosphere Reserve (Barnim county). Besides the surrounding federal states, all other source markets were more regularly distributed among the other federal states, with a surprisingly low proportion of visitors from Mecklenburg-Vorpommern (2.3%).

Visitors between the ages of 31 and 45 were the biggest group with 30%. The 46–65 year old were the second largest age group with 29%. More than half of the visitors were below the age of 50 (56%). About a quarter of visitors (26%) were under 30 years of age, of which 17% were children and young people under 18 years of age. The age category of older adults over 65 years was represented by 15% of the visitors. Compared to the age group structure in Germany, the

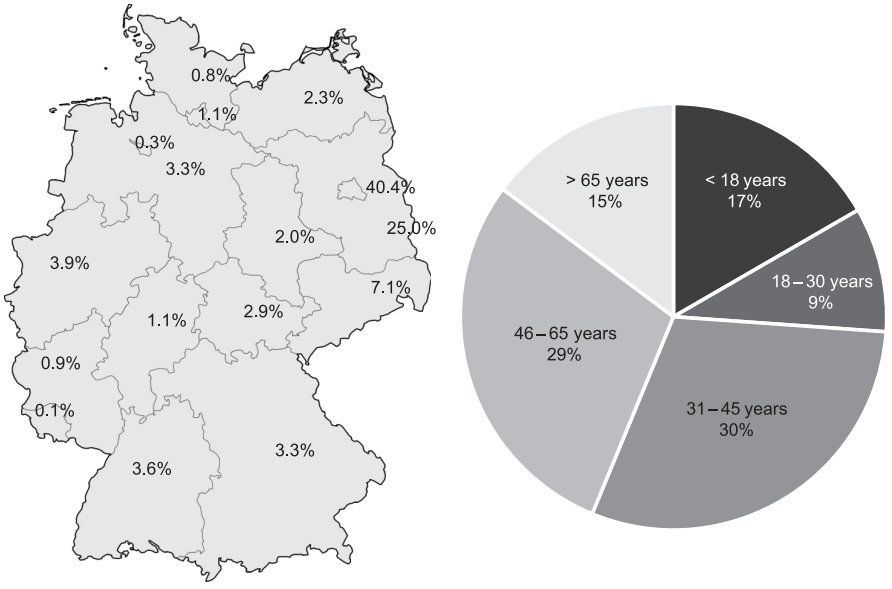

Figure 5.8. Source markets and age-groups of visitors in Schorfheide-Chorin Biosphere Reserve.
Source: own elaboration.

disproportionate share of visitors aged 31 to 45 was noticeable. The proportion of children and adolescents was also slightly higher than the proportion of this age group at the national level.

Regarding their educational status, the visitors to the Biosphere Reserve had a disproportionately higher educational background than the German average population, with 48% having a University degree and another 20% with A-levels / High-School diploma.

5.4.3.2. Economic impacts

According to a national study (BMWi, 2013), a day-tripper in Germany spends an average of EUR 28.30 per day, whereas the expenditure for day trips in urban areas is considerably higher at up to EUR 34.70 than in rural areas, with day-tripper spendings at an average of EUR 19.0.

The expenditure of day-trippers in Schorfheide-Chorin Biosphere Reserve was significantly above that average with EUR 27.80. This also marks a remarkable increase compared to 2017/18, where day-visitor expenditures were about EUR 18.0. Reasons for this increase might partly be connected to increased prices of the tourism offer and inflation, and a change of the target groups due to COVID-19 (see Chapter 6). When grouping the expenses into the three expenditure types of hospitality, retail and services, it becomes obvious that about one third of the daily expenses were earmarked for the service sector with transport in the region being the highest cost type. About half of the expenses were used for hospitality, in the case of day trips this means gastronomy services. The results also show that visitors with a high biosphere reserve affinity spent less money overall during a day trip. A national study of expenditure structures in German biosphere reserves (Job et al. 2013, p. 77) concluded that biosphere reserve affinity does not influence the level of expenditure. Instead, it states that the average expenditure values in biosphere reserves have a wide range between EUR 23.00 and EUR 71.40 and are very strongly influenced by regional conditions and tourism structures.

On a national average, overnight guests in Germany spend an average of EUR 131.60 per person and day in commercial accommodation establishments (Harrer & Scherr, 2010), with a very wide range of expenditure depending on the type of accommodation (youth hostel, inns, guesthouses, hotels, spas etc.).

The average expenditure of overnight guests visiting Schorfheide-Chorin Biosphere Reserve was EUR 65.50 per day, hence, it was considerably lower than the national average. This essentially depended on the choice of the respective types of accommodation by the visitors and thus also on the accommodation structure in the region. The Biosphere Reserve is located in a rural region, where – compared to cities – rather low-price forms of accommodation prevail, with only a few high-priced hotels. Moreover, the visitors did not only stay in commercial accommodation establishments. Approx. 38% of all guests chose a holiday apartment as the type of accommodation for their visit. In this mostly non-commercial type of establishment, the daily expenditure was also significantly lower than in commercial accommodation establishments nationwide (Harrer & Scherr, 2010,

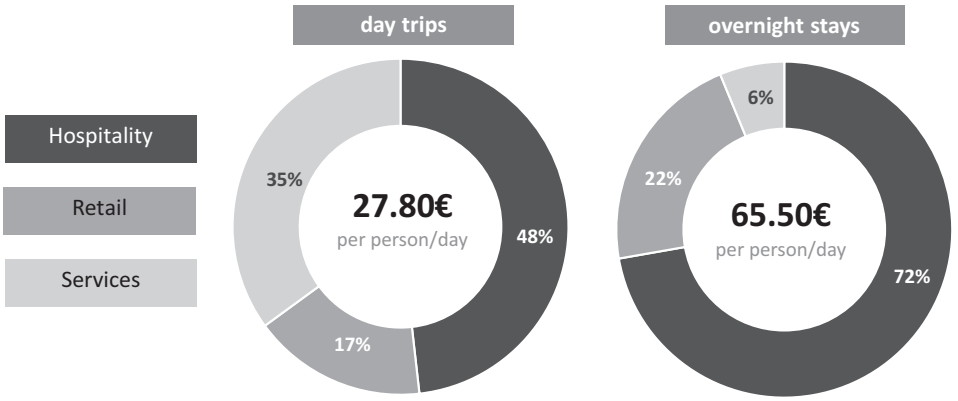

Figure 5.9. Daily expenditures of visitors in the Schorfheide-Chorin Biosphere Reserve.
Source: own elaboration.

p. 77). In addition, approx. 12% of the guests also visited friends and relatives and thus principally did not have any accommodation costs.

A differentiation of the overnight guests among the Biosphere Reserve visitors showed that visitors with a high biosphere reserve affinity spent less (EUR 53.00 per person and day) than other Biosphere Reserve visitors (EUR 70.00); with almost identical shares amongst the profiting economic sectors (71–72% hospitality, 21–22% retail, 6–7% services).

The gross tourism turnover can be calculated by multiplying the average expenditure per day by the length of stay of the day-trippers and overnight visitors. In 2020/21, a total gross turnover of EUR 101,146,900 was generated by visitors to the Biosphere Reserve. Of this, EUR 19,084,800, or approx. 19%, was generated by visitors with a high biosphere reserve affinity, and EUR 82,062,100, or about 81%, was generated by other biosphere reserve visitors.

As visitors of all types spent significantly more during their visit, the gross turnover compared to 2017/18 increased by 12%. Hence, fortunately the decrease of visitors since 2017/18 (–21%) did not have an impact on the overall gross turnover of tourism in the biosphere region.

The net turnover was calculated by deducting VAT from the gross turnover. The calculations were carried out separately for all relevant target groups (day trips, overnight stays, as well as visitors with a high biosphere reserve affinity and other biosphere reserve visitors). All types of expenditures were considered individually to estimate the VAT rate as precisely as possible. Based on the expenditure structure of the guests, the total average VAT rate was 14.2% with a day-tripper rate of 17.1% and an overnight visitor rate of 11.7%. In total, a tourism-related VAT amount of EUR 14,316,000 was incurred in the Biosphere Reserve. A subtraction of this amount from the gross turnover resulted in a net turnover of EUR 86,822,000.

	Segment	Visitor days		Daily expenses		Turnover (rounded)
Specific Biosphere Reserve visitors	Overnight stays	224,554	x	52.98 €	=	11,896,900€
	Day trips	294,587	x	24.40 €	=	7,187,900 €
		=				=
	TOTAL	519,141				**19,084,800 €**
Other Biosphere Reserve visitors	Overnight stays	621,661	x	70.03 €	=	43,534,900 €
	Day trippers	1,351,359	x	28.51 €	=	38,527,200 €
		=				=
	TOTAL	1,973,020				**82,062,100 €**

Total **101,146,900 €** in 2020/21

Figure 5.10. Tourism turnover in the Schorfheide-Chorin Biosphere Reserve[23].
Source: own elaboration.

In terms of the value added, all income effects resulting from the direct expenditure of tourists were recorded (see section 5.3.2). In this context, income or value added refers to salaries and profits. The value-added ratio in the Biosphere Reserve for day trips was approx. 38.9% and overnight visits approx. 39.6%. These average values were based on the expenditure structures of the visitors and thus corresponded to the individual economic conditions in the Biosphere Reserve.

Linking the value-added ratio with net turnover resulted in a direct income of EUR 34,207,000.

After deducting the direct income effects from the net turnover, an amount of EUR 52,615,000 remained. This sum was spent by the direct suppliers of the tourism services for the purchase of inputs or for the use of these services. Exact value-added ratios of companies profiting from indirect impacts could only be estimated on a regional-specific basis with the help of detailed analyses, which were not yet available at the time of this study. However, such a business study has been undertaken and the results are expected in mid-2022. For this study, an average value of 30% was used. As explained in section 5.3.2, this resulted in an income of EUR 15,784,000 in indirect impacts. This means that input suppliers generated indirect effects of around 15.8 million euros in wages, salaries and profits.

To sum it up, the gross turnover from all visitors (EUR 101,146,900) generated an income of EUR 49,992,000 (first and second levels of turnover). Around

[23] Local inhabitants of the Biosphere Reserve were not included in the economic impact estimations. Therefore, the sum of visitor days varies between Fig. 5.5 and Fig. 5.10.

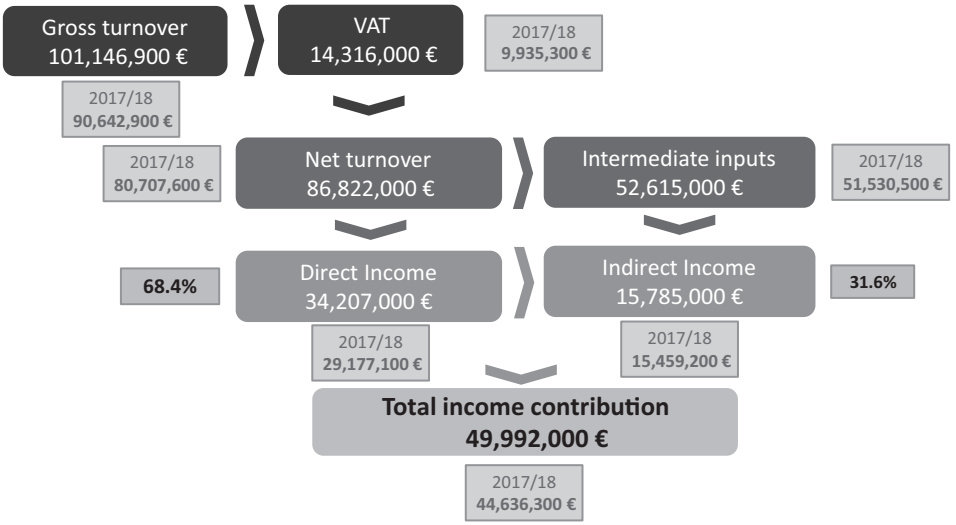

Figure 5.11. Value added of tourism activities in the Schorfheide-Chorin Biosphere Reserve.
Source: own elaboration.

68% of this was accounted for by the direct income and 32% by the indirect income.

In comparison to 2017/18, the overall income contribution increased by 12%, which was an impressive result, as there was a deep drop in the overall visitor numbers of 21% because of the COVID-19 pandemic. This positive result was derived from the overall higher visitor expenses and a higher value-added quota (39% compared to 36% in 2017/18). In total, the tourism income also increased by 12 per cent, reaching almost 50 million Euros. However, the spending categories were different to the previous study, with higher expenditures for services during the period 2020/21, which resulted in higher VAT rates (14% in comparison to 11% in 2017/18) and therefore a lower increase in the net turnover rate compared to 2017/18 (+8%), despite the VAT cut in mid-2020.

In order to determine income equivalents, the tourism income contribution (EUR 49,992,000) was divided by the average primary income per capita in the Biosphere Reserve (EUR 21,633). Accordingly, this resulted in an income equivalent of 2,311 persons whose income could be financed by tourism and day trips in the Biosphere Reserve. This meant a slight decrease of 0.2% that was due to the increase of the average primary income per capita (from EUR 19,276 in 2016 to EUR 21,633 in 2019). Differentiated according to the visitor types, 432 income equivalents were generated due to visitors with a high biosphere reserve affinity and 1,879 income equivalents due to other biosphere reserve visitors.

The recent economic impact assessment of visitors to Schorfheide-Chorin Biosphere Reserve showed a development clearly characterised by the COVID-19 pandemic with surprising results, compared to the previous study of three years ago:

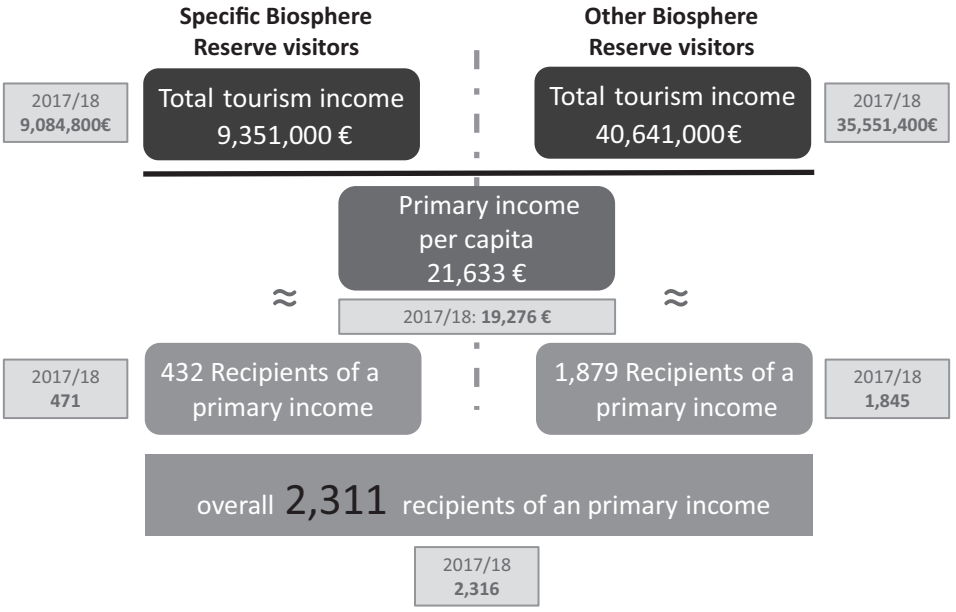

Figure 5.12. Income equivalents by tourism activities in the Schorfheide-Chorin Biosphere Reserve.
Source: own elaboration.

- The total number of visitors decreased tremendously by 21% since the last survey from 2017/18. This was mainly due to the COVID-19 lockdowns, where no tourism activities were officially allowed. However, the visits per day outside the lockdown increased significantly in comparison to 2017/18. Hence, the visitor pressure in the Biosphere Reserve rather increased in the years of the COVID-19 pandemic. The decrease in visitor numbers also reflected recent studies that showed very similar results for overnight stays (minus 25% and less) for the region (Dwif-Consulting GmbH, 2022).
- The daily expenditure of visitors increased very strongly overall, both for overnight visits and day trips.
- This resulted in an increase in gross turnover (+11.6%), which was due to the significantly increased daily expenditures.
- Therefore, the income effects also increased by 12%, with VAT rates increasing compared to 2017/18. Another positive development was that the value-added ratios increased compared to the previous study. 68% of the tourism income was distributed to direct tourism businesses and 32% to indirect suppliers.
- Out of the total of 2,311 employment equivalents, 432 equivalents could be attributed to the demand of visitors with a high biosphere reserve affinity. This number slightly decreased (by 8%), mainly because of the different expenditure structure of visitors that resulted in different VAT structures.

Table 5.8. Summary of economic impacts effects of visitors to Schorfheide-Chorin Biosphere Reserve in 2020/21 in comparison to 2017/18.

	Total			Specific Biosphere Reserve visitors			Other Biosphere Reserve visits		
	2017/18	2020/21	21/18	2017/18	2020/21	21/18	2017/18	2020/21	21/18
	[euro]	[euro]	[%]	[euro]	[euro]	[%]	[euro]	[euro]	[%]
Daily expenses	28.31	40.58	145	n.a.	36.76	–	n.a.	41.59	–
Daily expenses day-trips	18.63	27.77	149	17.20	24.40	142	19.00	28.51	150
Daily expenses overnight stays	50.68	65.50	129	47.70	52.98	111	51.60	71.03	136
Gross turnover	90,642,900	101,146,900	112	18,818,100	19,084,800	101	71,824,800	82,062,100	114
Gross turnover day trips	41,638,800	45,715,100	110	7,894,800	7,187,900	91	33,744,000	38,527,200	114
Gross turnover overnight stays	49,004,100	55,431,800	113	10,923,300	11,896,900	109	38,080,800	43,534,900	114
Tourism income	44,636,300	49,991,776	1112	n.a.	9,351,125	–	n.a.	27,916,483	–
Direct tourism income	29,177,100	34,207,346	117	n.a.	6,290,864	–	n.a.	12,724,169	–
Indirect tourism income	15,459,200	15,784,430	102	n.a.	3,060,261	–	n.a.	8,354,900	–
Income equivalent	2,316	2,311	100	471	432	92	1,845	1,879	102

Source: own elaboration. based on Job et al., 2023.

Table 5.8 summarises the most important economic impacts in comparison to 2017/18.

5.5. Discussion: Towards a cross-border methodology to assess economic impacts of protected area tourism?

The economic impact of PAs lies at the heart of the global discussion on nature conservation (Phillips, 1998; Emerton et al., 2006; Mayer, 2013). Therefore, one of the aims of the Polish-German REGE project research team was to adapt a methodological approach for estimating the regional economic impact of tourism in protected areas, while keeping in mind that the method should above all be applicable internationally, especially in the Pomerania Euroregion, that it should be simple, affordable, and that the results of studies carried out in different countries based on this method should be comparable. To ensure international comparability of the results, it is necessary to consider global methodological standards, above all those regarding PA visitor counting and economic impact estimation. Global guidelines for this purpose have been published recently by the UNESCO together with the German Federal Agency for Nature Conservation (Spenceley et al., 2021).

A method commonly used in German protected areas was taken as the starting point for our attempt to adapt existing methodological approaches for estimating the regional economic impact of PA tourism. Since 2006, numerous studies on economic impact data collection, estimation and assessment for German large-scale PAs have been carried out during several long-term research projects with strong financial support from ministries and authorities at the national and federal states level but also from the PA administrations. The economic impacts of German national parks (Job et al., 2005, 2009, 2016), biosphere reserves (Job et al., 2013), and some nature parks (Job et al., 2005), have been estimated. This is very comprehensive and utilises an extensive database (as presented in more detail in section 5.3). Overall, the economic impact of tourism can only be estimated using this approach if the number of visitor days and the visitor expenditure structure are known, and as long as for the identified expenditure groups the regional multipliers (in the form of value-added ratios) for businesses handling the visitor flows are available. Such data should be obtained through statistically based visitor counting and surveying throughout the year (due to the seasonal variability of tourism). As such studies are costly (due to the required man power and the necessary acquisition of the regional multipliers), the application of this approach may be beyond the financial capabilities of protected area administrations since PAs typically face the need to finance numerous tasks with severely limited funding (Emerton et al., 2006). At the same time in Poland, in contrast to Germany, no standard method for estimating the economic impact of PA tourism has been established, and any effort undertaken so far should rather be regarded as pilot research (for details see section 5.2.1.).

The methodological approach established in the German PAs was used as the starting point and a reference for the intended adapted regional impact estimation method, also because it was already in widespread use in numerous German PAs and enabled PA stakeholders to easily understand and interpret the results.

One of the key elements affecting the costs of conducting surveys based on the German approach is the need to count visitors. According to the project team, an opportunity to reduce the cost of visitor counting lines in the use of automatic counting devices. In this way, complete visitor-day data could be obtained instead of only acquiring information for selected days on which visitors are counted, as is the case with the German approach. At the same time, the data from automatic counters could be used not only for estimating the economic impacts, but also for an ongoing monitoring of tourist flows. Of course, all automatic counters must be calibrated empirically through observations and manual counts, because correction factors provided by the device manufacturer deliver a first orientation only. Especially where the natural conditions do not allow for leading all visitors past an automatic counter, visitors can often walk right past the devices without being detected. For such locations, the number of people counted by automatic counters must be increased by a correction factor to be determined empirically (see also the deviations Staab et al., 2021 revealed between automatic and manual counting approaches).

However, since not all PAs operate visitor counting devices the project team suggests that – in methodological terms – the counting procedure should have the following characteristics:

- a year-round study period,
- if no data from automatic counters can be obtained, visitor days should be estimated empirically by a combination of sampling and existing secondary data (e.g. overnight statistics from the PA municipalities). For this purpose, sampling days distributed over the whole year and covering all relevant seasons are required.

Another key issue with the German approach is the visitor surveys: the surveys make use of a) an extended questionnaire (the so-called long interviews) and b) the so-called short interviews. In previous research based on this method, the long questionnaire included questions about the structure of the visitor expenditure and educational background or enquired on their environmental awareness, the frequency with which they visited the PA, their reasons for coming, the type of transport means they used, the type of their activity in the PA, and more. Based on our overview of the literature, the experience gained, and an exchange of views and opinions, the project team proposes that the research should be conducted using only one survey template with a modular structure. As the primary objective of this method is to estimate the regional economic impacts of PA tourism, questions about the structure of expenditures are of pivotal significance. The remaining questions may be clustered into modules to be used on an as-needed basis. This structure allows for adding or removing individual modules. Apart from enabling a better adaptation of the questions to the needs of the stakeholders, this allows for reducing the costs of the study as the potentially

smaller number of questions asked makes it possible to reach the aspired sample size in a shorter time.

The third element required by the German approach are the regional multipliers. This project developed a questionnaire to measure these value-added ratios, and a pilot study was conducted in 2021 using the CATI method in the Wolin National Park region using the mentioned questionnaire. The survey included a group of 20 randomly selected enterprises among micro-, small- and medium-sized enterprises which were classified as belonging to one of the characteristic tourism activity types. According to the report of the survey carried out by a professional company specialising in such studies, the respondents indicated, among other things, that the data sought from them were too confidential to share or too intrusive into the situation of their enterprise, and thus the vast majority refused to answer such questions. As a result, the pilot study failed to provide any basis for estimating the value-added ratios in any recognised way and for continuing the study in this regard on a larger scale.

Therefore, the project team proposes that the regionalised input-output method should be applied (for details see section 5.3.1), which makes use of widely available national input-output tables to estimate the multiplier effects of PA tourism instead of using value-added ratios which are obviously very difficult to obtain for Polish PA regions[24]. As a next step, the regionalised input-output approach could also be applied in the future for some parks in the German part of the Euroregion or in Poland's Drawa National Park where the German methodological approach has already been employed. This would allow for comparing both approaches in more detail and assessing the comparability of their results. Majewski (2022) has already showed that input-output approaches are a valuable alternative for German PAs, although not a necessarily more affordable one as regards the costs for obtaining the secondary data.

During our project, the approach presented above could not be tested to its full extent, primarily with regard to the modular construction of the questionnaire, because of the numerous restrictions imposed during the COVID-19 pandemic in 2020 and 2021. It is therefore fully justified that research about the development of a more affordable approach for estimating the regional economic impacts of PA tourism in Poland that will provide internationally comparable results should continue.

5.6. Interim summary

The regional economic impact of protected area tourism is an important indicator of the recreational function of protected areas as well as their contribution to regional development and job creation in the often structurally weak, peripheral,

[24] These negative experiences notwithstanding the results of our business survey in the Biosphere Reserve Schorfheide-Chorin (see Chapter 6) are more promising, reaching a response rate of at least 14%. Similarly, the postal enterprise survey of Mayer and Woltering (2008) in the environs of the Bavarian Forest National Park also turned out satisfactory. However, both surveys required the cooperation of many local stakeholders and lots of organisational and logistical efforts.

rural protected area regions. These economic impacts provide substantial arguments in favour of protected areas and also positively influence the local populations' attitudes towards protected areas. For these reasons, these values are of great relevance for political decision makers and protected area administrations alike. However, due to the complexity of their estimations and the required datasets which mostly need to be generated separately for each protected area the assessment of the regional economic impact of PA tourism is far from straightforward. The state of research concerning these values varies between Poland and Germany: while especially Polish national parks (among other things – due to required entrance fees to some parks) have a relatively good database concerning their visitation, these numbers are usually non-existent for German protected areas. In contrast, these existing visitation data have not yet been used for the estimation of the economic impact of park tourism in Poland, except for a pilot study, while in Germany a standard methodology has been established in the last two decades (mostly by Job et al.), which has been applied to basically all national parks and biosphere reserves and even some nature parks by 2022. Thus, this research adapted the German estimation approach to the conditions in Polish PAs and estimated the regional economic impact of tourism to Wolin National Park for the first time using a regionalised input-output-table for the estimation of the multiplier effects in contrast to the German approach of value-added quotas. In Wolin National Park, we recorded 691,741 visitor days/year, strongly dominated (91.4%) by overnight visitors. Overnight visitors spent 2.5 times more per person and day compared to day-trippers (PLN 270 vs. 110 or EUR 59.2 vs. EUR 23.5). This led to a gross turnover of PLN 181.68 million (EUR 38.85 million), which generated a regional income derived by the input-output estimations of PLN 364.65 million per year (EUR 77.98 million) and which equaled an income equivalent of about 7,500 persons. These results highlight the regional economic importance of visitation in Wolin National Park for its surrounding region.

In the German part of the Euroregion, we estimated the economic impact of visitation to Schorfheide-Chorin Biosphere Reserve. This provided the opportunity to compare these results with a relatively recent assessment from 2017/18 which was done using the same methodological approach. This also allowed for estimating the effects of the COVID-19 pandemic on the visitation structure of the Biosphere Reserve and the economic impact of its visitation (see Chapter 6). Our estimations revealed 2.54 million visitor days for Schorfheide-Chorin Biosphere Reserve. Regarding the visitor types, 33.1% of the visitor days were generated by overnight visitors, 64.0% by day-trippers and 2.0% by local residents living inside the Reserve. Day-trippers spent, on average, EUR 27.80 per person and day in the Biosphere Reserve, while overnight visitors spent EUR 65.50 per person and day. The average daily expenditures of specific biosphere visitors were lower compared to other visitors. The combination of visitor days and visitor-type-specific expenditure patterns led to a total gross turnover of EUR 101.14 million generated by visitors to the Biosphere Reserve and a regional income of EUR 49.99 million per year, which corresponded to an income equivalent of 2,311 persons. These numbers underlined the considerable regional economic relevance

of tourism and recreation in Schorfheide-Chorin Biosphere Reserve, especially as around one fifth of these economic impacts could be attributed to visitors with a high biosphere reserve affinity, i.e. those that would not occur if the protected area did not exist.

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Appendix I

Balas, M., Strasdas, W., Neumann, F., Mattes, A., Becker, L., Giese, J, Renner, A., Weber, A., Kohl, K., Pinnow, D., Zeiner, M., Rein, H. & Heck, S. (2021). Messung der Nachhaltigkeit im Tourismus - Entwicklung eines Tourismus-Nachhaltigkeits-Satellitenkontos. (Measuring sustainability in tourism - development of a tourism sustainability satellite account). German Environment Agency.
https://www.umweltbundesamt.de/sites/default/files/medien/5750/publikationen/2021-04-19_texte_61-2021_weiterentwicklung_nachhaltiger_tourismus_zw_0.pdf (Accessed: 13th September 2023)

Summary

The aim of the project was to develop a practicable system for measuring sustainability of national tourism in Germany. Initially, 18 sustainability criteria for tourism were identified. In a second step, these criteria were analyzed with regard to their measurability using indicators in a coherent accounting system in compliance with international recommendations. The outcome is a Tourism Sustainability Satellite Account (TSSA), a system of indicators which is mainly based on statistical frameworks of national accounts and environmental-economic accounts. In addition, social indicators have been added that mainly measure decent job creation in tourism. Thus, the TSSA allows a systematic allocation of the economic, ecological and social impacts of tourism to the tourism-relevant economic sectors at a national level. However, there is still a need for development of some sustainability indicators, especially from the management and, to some extent, the ecological sector. As a test, the TSSA indicators have been filled with currently available data. The results show that tourism in Germany contributes significantly to creating added value and jobs, although labor productivity is low. In terms of ecological impacts, climate impacts with a slightly above average greenhouse gas intensity compared to the economy as a whole are at the top of the list, although this intensity varies significantly within the tourism sub-sectors. Working conditions are generally considered to be less sustainable than in other industries. Only the pay gap between men and women is significantly smaller than in other sectors of the economy.

Appendix II

Balas, M. & Strasdas, W. (2020): Erfassung von Auswirkungen des deutschen Outbound-Tourismus auf die Nachhaltigkeit in bereisten Ländern. (Estimating the effects of German outbound tourism on sustainability in visited countries.). German Environment Agency. https://www.umweltbundesamt.de/sites/default/files/medien/5750/publikationen/2020_12_09_texte_232-2020_themenpapier_outbound-tourismus.pdf (Accessed: 13th September 2023)

Summary

Sustainability assessments in tourism mainly focus on incoming tourism, be it from a destination-specific perspective or a production-based perspective. The "polluter pays" approach, which is widespread in the sustainability debate, is often not considered, neither in the concepts of the UN World Tourism Organization nor in national indicator systems for sustainable tourism. Thus, the ecological, socio-economic and socio-cultural impacts generated by tourism-related consumption by German residents abroad are not recorded by now. This paper introduces several studies and frameworks for sustainability impacts of outbound tourism. None of the studies considered in this paper allow an overall assessment of the sustainability impacts. There is either a focus on specific groups of countries, or individual sustainability aspects such as ecological factors are being analysed. It is obvious that the social dimension of sustainability is insufficiently, if at all, included in the analysed studies. Furthermore, it is apparent that various methodological approaches are used that do not allow for a comparison of data from different studies or even the combination of different sustainability aspects from the respective studies. As there is no standardised methodology for the assessment of data-based sustainability impacts of tourism, it is recommended to consider outbound tourism in future studies and analyses. There is an urgent need for further research on data generation methods.

Appendix III

Balas, M., Strasdas, W. (2019). Sustainability in tourism: developments, approaches and clarification of terms. German Environment Agency. https://www.umweltbundesamt.de/publikationen/sustainability-in-tourism-developments-approaches (Accessed: 13th September 2023)

Summary

Sustainability is understood as an ethically motivated guiding principle for future-oriented social development, which is constantly subject to trade-offs between different interests. In this process, tourism is seen both as an ally of sustainable development and as a cause of undesired ecological and socio-cultural effects. First applied to tourism in connection with a number of alternative niche markets, an integrated view of sustainability relating to the entire tourism industry has since emerged. Nevertheless, the multi-faceted interactions with a range of social and economic processes has precluded the formulation of a tourism-specific definition of sustainability. For this reason, the authors advocate the term "sustainability in tourism", which describes tourism as a component of a wider sustainable development. This interpretation permits a systemic approach within which different, mutually influencing economic sectors and levels of action interact and under which all principles of sustainability can be classified.

Appendix IV

Balas, M., Mayer, M., & Kintscher, C. (2023). Auf dem Weg zur Klimaneutralität in Tourismusdestinationen. Leitfaden zu Klimabilanzierungen im Tourismus. (On the way to climate neutrality in tourism destinations. Guide to climate accounting in tourism.). Eberswalde/München: reCET/Hochschule München. https://kompetenzzentrum-tourismus.de/media/lift_klima_klimabilanzierungen_im_tourismus_leitfaden_final.pdf (Accessed: 13th September 2023)

Summary

Decarbonising tourism is a critical element of future-proofing the sector. The first step in achieving this is to systematically measure the carbon footprint and to Understand the greenhouse gas emissions profile of a tourism destination. This report introduces two main methodological approaches to measure GHG emissions for subnational tourism destinations. The bottom-up approach uses tourist activity data in a destination and links these with emission factors. Thus, data on visitor behaviour are combined with average emissions per type of activity. From this, detailed data per tourism segment or visitor groups can be presented. The top-down method is a macro-economic approach and records emissions by economic sector using extended environmental-economic accounts. This allows emission linkages of the sector and all emission types to be mapped. This calculation also allows a differentiated view of emission sources and the identification of emission-intensive or low-emission subsectors. The report exemplifies the calculation of emissions in the destinations Mecklenburg-Western Pomerania, Berlin and Northern Black Forest according to the two approaches "bottom-up" and "top-down". As a result, the report provides orientation for other destinations that seek to measure their GHG emissions.

Appendix V

Balas, M., Lund-Durlacher, D., Strasdas., W. (2020): Steigt Nachhaltiger Tourismus als Phönix aus der Krise? (Is sustainable tourism rising as a phoenix from the crisis?) In Tourismus Wissen – quarterly, 21(6), 195-200.

Summary

The Corona crisis was an unprecedented challenge for tourism professionals in the years 2020 until 2022. Long-established and successful practices of the tourism industry came to a standstill. A rapid recovery to the old business logic was less and less foreseeable and the longstanding goal of further volume growth in the industry was thwarted by containment measures of the virus, at least in the medium term. This article provided a reflection of the first months after the Covid outbreak, summarizing results of various expert interviews with tourism professionals. It highlights that strong cooperation models and sustainability-based orientations at all levels are more in demand than ever before, because they offer opportunities for innovation, give rise to new jointly developed products and are a sign of the industry's own responsibility, securing its current existence. The article concludes that tourism services will have to meet new requirements in terms of hygiene, health and safety that arise from the corona situation and are perceived by guests as a new basic quality. However, these new qualities are not only of a hygienic, health and safety nature, but are also linked to criteria of environmental friendliness, regionality and social responsibility.

Appendix VI

Balas, M., Majewska, A. (2022). Effects of COVID-19 on visitation and tourism in the protected areas of the Pomerania region. In: Zbaraszewski, W., Balas, M., Dmytrów, K., Majewska, A., Mayer, M., Steingrube, W. (2022). Socio-economic research in protected areas of the Euroregion Pomerania: Visitor satisfaction, economic impacts and park–people relationships. Poznań: Bogucki Wydawnictwo Naukowe.
https://doi.org/10.12657/9788379864201

Summary

This article provided an in-depth analysis of the effects of COVID-19 on tourism in the protected areas (PA) of the Pomerania Euroregion. It is based on three major surveys covering the perspective of inhabitants of 14 PA (5,600 responses), tourists in five PA (2,770 responses) and 120 tourism businesses in one PA. The visitor surveys showed that many visitors chose one of the PAs as an alternative destination to their originally planned journey, which created new economic potentials for the tourism businesses, as the visitors who were affected by the coronavirus spent more money in the region and stayed there longer. This resulted in even higher tourism incomes for the analysed Schorfheide-Chorin Biosphere Reserve, compared to 2017/18 when a similar economic impact study was conducted. Even though the overall economic situation of tourism in Schorfheide-Chorin Biosphere Reserve did not decrease due to the pandemic, our business-survey showed that this did not account for all tourism businesses in the region, as COVID-19 created both winners and losers in terms of economic performance in the years of the pandemic. Hence, business outlooks are rather pessimistic, as the pandemic is still ongoing. Surveys conducted in the Polish PAs in September and October 2020 showed that the respondents, despite declaring a high level of knowledge about coronavirus, in many cases took a neutral stance. It can be assumed that a future regulated and evidence-based approach to pandemics will also stabilise tourism in PAs again and that the current potentials for developing sustainable tourism approaches can be used to further pursue conservation interests and to increase the quality of life of the host population by way of tourism activities.