

Stakeholder Assemblages of Destination Climate Adaptation

Elisa Burrai^{a*}, Vanja Krajinović^b, Jane Turner^a, Rodolfo Baggio^c,
Nevenka Čavlek^b and Chris Cooper^a

^a*School of Events, Tourism and Hospitality Management, Leeds Beckett University, Leeds, United Kingdom;*

^b*Faculty of Economics and Business, University of Zagreb, Zagreb, Croatia;*

^c*Dondena Centre for Research on Social Dynamics and Public Policy, Bocconi University, Milan, Italy*

*email e.burrai@leedsbeckett.ac.uk

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Abstract

This paper examines local perceptions of climate adaptation. We develop climate scenarios using the Tourism Climate Index (TCI) to determine the type of tourism that future climate resources will support. Using the case study of Croatia, our findings suggest the possibility of season extension, but also problematic snow cover for winter sports resorts. We design our study using assemblage theory, enabling us to examine local perceptions to climate change adaptation whilst unpacking the complex combination of (local) diverse, relational and processual approaches. Hence, through the lens of assemblage theory, we contend that participants' perceptions are heterogenous, dependent on their socio-economic roles, agendas, and purposes. Participants' narratives shape four different assemblages: tourism products, education, cooperation and transformation. Our informants highlight willingness to keep tourism as a main economic activity, in spite of negative links to climate change. Yet, assemblages on ecological education and cooperation address the importance of re-thinking how tourism can contribute to addressing climate change instead of focusing primarily and only on adaptation avenues.

Keywords: destination climate change; perceptions; assemblages; climate scenarios; adaptation.

Introduction

Climate change is the defining challenge of this century and tourism is not immune (Scott & Gössling, 2022). Climate is an important element of the destination resource base, rendering tourism sensitive to changes in climate. This vulnerability to climate change demands adaptation and mitigation (Čavlek et al., 2019). Although tourism and climate research began in the 1970s, it is only

in the new millennium that more focused studies have emerged. Kaján and Saarinen (2013) identify five foci for adaptation research - business, consumer, destination, policy studies, and frameworks for adaptation. Njoroge (2015) added an additional theme; sustainable adaptation. However, the IPCC (2022, p. 21) notes that adaptation is fragmented, small-scale, incremental, sector-specific, focused on current impacts or short-term risks, and focused on planning rather than implementation, with inconsistent implementation around the world. The IPCC is clear that adaptation is a long term, not a short term, process and that there are clear financial commitments required from governments to close adaptation gaps. Here, the Glasgow declaration 'climate action in tourism' signed at the 2021 UN climate change conference (COP 26) provides a contemporary framework for destinations to move forward with 'climate action plans' (UNEP, 2021).

Research on climate adaptability is extensive (Nalau & Verrall, 2021), yet its applicability to the tourism field is still limited, particularly when focusing on the perceptions of local tourism stakeholders towards adaptability to climate change in destinations (Rice et al., 2022). Local people are those most likely to experience the worst and most sustained negative effects of climate change. Thus, focusing on local perceptions can shed light on how to devise sustainable adaptation approaches (Hu et al., 2020) which can meaningfully respond to the socio-ecological and economic threats posed by climate change.

Given the relevance of the topic and the paucity of research available, this study aims to examine how local tourism stakeholders articulate their responses to climate change adaptation. We did this through the adoption of a multi-method research approach spanning the years 2015-2021 and focusing upon three different climate scenarios ranging from the most optimistic to the most pessimistic, modelled to 2030 and 2050. We analysed the present climatic situation of two case study destinations and their climate predictions for the future. We draw upon two Croatian tourism destinations, namely Lošinj and Gorski Kotar for three main reasons. First, Lošinj is highly dependent upon tourism, whilst Gorski Kotar is an emerging destination where tourism is less significant in the economy. Second, the destinations are characterised by very different features, Lošinj being an island in the northern Adriatic Sea and Gorski Kotar a mountainous region located in the Western part of Croatia. Third, both destinations offer different tourism products and experiences which are likely to be affected in different ways by the impacts of climate change. Focusing upon these two different settings, over the course of six years, enables us to gather local views on the distinctive adaptation strategies required, due to the varied impacts of climate change over time and the range of natural resources available.

Through the adoption of assemblage theory, our study unpacks the complex and multifaceted (local) perceptions of climate change adaptation which help to move away from singular, homogeneous and often oversimplified understandings of climate change. Assemblage theory is a theoretical framework originating from the work of Deleuze and Guattari (1987) and used to shed light on the complexities of our world and the relationships between various elements (physical, such as objects and non-physical, such as values, ideas and social structures) within specific systems. Assemblages are heterogeneous, physical entities (e.g. people, rocks, water) or conceptual entities (e.g. values, beliefs, ideas) that form in a relational manner (i.e. through human-human and human-nonhuman interactions) in a specific time and space. Assemblage theory enables us to understand how these entities meet and interact, in originating complex systems. Climate change is a complicated

system made of physical, biological and chemical processes. The phenomenon of climate change has been studied from a multitude of interdisciplinary approaches, including physics, ecology, economics and sociology and whilst climate change represents a global issue, efforts have been made to find local approaches that could mitigate its negative effects through the identification of adaptive systems.

Local stakeholders' assemblages of climate adaptation are shaped by a set of very diverse and contradictory agendas. The theoretical lens of assemblage theory allows us to rethink – in the context of climate change adaptation - commonly used analytical units such as 'market'; 'state' and 'civil society' in a more nuanced and holistic manner, unpacking the heterogeneous character of such groups.

To elaborate further on these arguments, the paper is organised as follows. First, we examine the intersection between climate and assemblage theory which enables us to understand the implications of considering local responses to climate change adaptation and to capture their heterogeneity and complexities. Second, we discuss the nexus between destination adaptation and climate change focusing on climate knowledge, destination vulnerability and adaptation enablers. We then focus upon Lošinj and Gorski Kotar as empirical examples through which local responses to adaptation are articulated in the form of assemblages around the key themes of tourism products, (ecological) education, cooperation and changes/transformation.

Climate Assemblages

An assemblage is defined as “some form of provisional socio-spatial formation [...] composed of heterogeneous elements that may be human and nonhuman, organic and inorganic, technical and natural” (Anderson & McFarlane, 2011, p. 24). Assemblages comprise relations that can reproduce themselves across time and space. The use of the term and concept of assemblage has gained popularity in recent years given its manipulability (Anderson & McFarlane, 2011). Accordingly, it has been used to understand the interconnectedness between human and non-human actors and between society and nature. It does so by providing a way of thinking about fluid and heterogeneous constructions of the social and by enabling to address origins, agency, politics and ethics (Anderson & McFarlane, 2011). These relations and meanings form, interrupt and re-form multiple times in the tourism climate context (Fox & Alldred, 2020). We argue that assemblages are of a socioecological nature as they consist of networks of individuals positioned within specific intangible (e.g., political, moral) and tangible (e.g., job-related, organisation) contexts that they are part of, or relate to. Additionally, their roles form part of a specific macro-dimension made up of local and national policies, interventions, investments, and infrastructures.

Assemblage theory provides an alternative to notions of network within the sphere of actor-network theory. This is because assemblage theory acknowledges that interconnections between entities are characterised by 'relations of exteriority' (DeLanda, 2006), meaning that there is a certain autonomy of the entities from the relations between them (for example individual's roles or degree of power). Hence, parts of assemblages can have intrinsic characteristics that influence the way assemblages form and re-form overtime. In contrast, actor network theory “has been criticised for

being blind to what remains outside associations but may shape them nevertheless” (Muller, 2015, p. 31).

Recent posthuman understandings of assemblages within the field of climate change highlight how humans are not the prime actors of ecosystems (Braidotti, 2013, 2019). Instead, from the intersection of human and non-human actors, originate assemblages of "biological, sociocultural and environmental elements whose capacity to influence and be influenced depends on the environment and its relations to other things" (Fox & Alldred, 2020, p. 272). Here, sets of relations and interactions among different entities, produce (and reproduce over time) meanings of climate change which transform in accordance with the heterogeneity of identities and roles which define the (tourism) stakeholders involved in the network: those being, stakeholders who have very diverse and contradictory agendas.

Hence, in this study we link the micro destination level with the macro, national level (i.e. Croatia), “through a non-hierarchical flat ontology that stresses the emergent nature of fluid, multifunctional socio-spatial formation” (Briassoulis, 2017, p. 169). Within this framework, the different levels of operations are autonomous and form a unit of analysis. In general, our participants' responses regarding their understanding of adaptation to climate change reflect the argument of Briassoulis (2017, p. 167), who emphasises that, depending on the prevailing conditions, people can choose to continue as they are (no action), engage in more resource-intensive activities (negative responses) or take formal and/or informal action to counter environmental degradation (positive responses).

The identification of local assemblages facilitates understanding of how individuals within tourism destinations engage with climate change. Seeing the tourism landscape through relational associations which revolve around adaptation to climate change, we acknowledge the importance of the relations of exteriority (DeLanda, 2006) in impacting on and shaping the assemblage (for example, the roles that stakeholders have in the tourism context of a specific destination). Hence, local stakeholders' (lack of) efforts shift from being part of institutional and political discourses to pave more meaningful, and often tangible, paths directed to post-carbon and self-sufficient economies (Higgins-Desbiolles et al., 2019). For the purposes of this study, this is where our attention lies: on understanding how local perceptions relate to, and are influenced by each other, and the wider environment in respect of climate adaptation. This approach enables us to rethink climate change adaptation as assemblages made of processual and relational practices situated in the specific spatio-temporal context (Croatia).

Destination Adaptation to Climate Change

Leary et al. (2001) note that adaptation of destinations to climate change involves changes in structures, processes or practises to cope with changing climate conditions. Adaptation will therefore mitigate potential damages or benefit from opportunities associated with climate change (Leary et al., 2001). In other words, the costs of climate change are reduced by adaptation and the need for mitigation is reduced (Simpson et al., 2008). Adaptation and mitigation can be seen as complementary, where mitigation avoids irreversible changes to the climate system, and adaptation is necessary due to historic and current rises in greenhouse gases (GHGs) causing irreversible climate

change (Simpson et al., 2008). The very nature of tourism as a cross-cutting sector means that adaptation is complex and best achieved at the regional or local destination level (Jopp et al., 2010).

Research into tourism climate change adaptation is a growing field and an array of methods are available to ensure that climate change is mainstreamed into destination planning and management (Čavlek et al., 2019; Simpson et al., 2008). Mainstreaming ensures that adaptation research is not done in isolation, but can be linked to approaches to poverty reduction, disaster risk reduction, and sector planning and development. In order to develop adaptive strategies, tourism destinations must have knowledge on the risks and impacts of climate change. Climate knowledge, therefore, enables us to a) unpack the vulnerability of tourism destinations, and b) to identify adaptation enablers in order to develop and embed adaptive strategies in destination planning and management systems. The following subsections develop further conceptualisation on knowledge and enablers.

Climate Knowledge

Successful climate adaptation demands growing our knowledge on risks, impacts, and their consequences (IPCC, 2022). Loehr and Becken (2021) have posited a climate knowledge system where the imperative is to deepen understanding of tourism and climate processes. This can be done through knowledge sharing and capacity building at the destination level to develop a common vision for adaptation.

Deep climate knowledge helps to boost awareness of climate hazards and influence adaptation behaviours (IPCC, 2022) and, taking into account the volume of research on climate change and tourism, new knowledge continues to constantly emerge (ICLEI Oceania, 2008). Klein et al. (2017) have classified this knowledge into four generations of adaptation research: (i) descriptive; (ii) normative; (iii) policy; and (iv) implementation. First generation descriptive work asks straightforward questions about the potential impacts of climate change; vulnerable groups; and is adaptation even possible? Currently, the fourth generation of research is more sophisticated focusing on implementation. It asks what are the costs and benefits; what technical knowledge is required; how destination adaptation works; which actions are scalable and replicable; what policies are needed; what role the private sector adopts; and whether adaptation should drive transformational change. Our study aims to increase knowledge about the latter generation of adaptation research. Namely, we focus on the process of destination adaptation, with the emphasis on the role of the private sector, which fits to the context of implementation generation. The focus is put on the knowledge, and the ability to apply the necessary strategies to particular challenges brought about by climate change.

A fifth generation of research can be added to Klein et al.'s (2017) work. This is the concept of adaptation pathways (see Werners et al., 2021). Adaptation pathways represent a decision-focused approach through a sequence of actions (Werners et al., 2021). Despite obvious utility to tourism, they have not been widely used by tourism researchers, yet the benefits are clear. The pathways embrace multiple stakeholders with knowledge sharing and learning, adaptive planning and adaptive capacity. They focus on transformational actions accounting for the complexity of tourism and the need for long-term change. Further, they are performance-oriented so meet both short and long-term adaptation needs. As part of the performance work, monitoring and evaluation of adaptation, whilst critical, is still in its infancy - particularly the monitoring of adaptation outcomes and embedding monitoring into enabling governance systems.

Adaptation Enablers

Adaptation reduces the risks of climate change and destination vulnerabilities by adjusting existing systems (IPCC, 2022). However, implementation depends upon enablers at the destination and thus the capability and efficiency of governance and the process of making decisions. In other words, the ability of destination organisations to transform their organisation, operations or structure to survive under climate change (Klein et al., 2017). This is known as adaptive capacity which is a necessary condition for designing and implementing effective adaptation at the destination level (Simpson et al., 2008). Adaptive capacity is the ability or potential of a system to respond successfully to climate variability and change, and includes adaptation in behaviour and resources and technologies (Simpson et al., 2008, p. 16). Adaptive capacity also allows destinations to take advantage of the opportunities and benefits of climate change, such as overcoming seasonality or increasing product diversity (Adger et al., 2005).

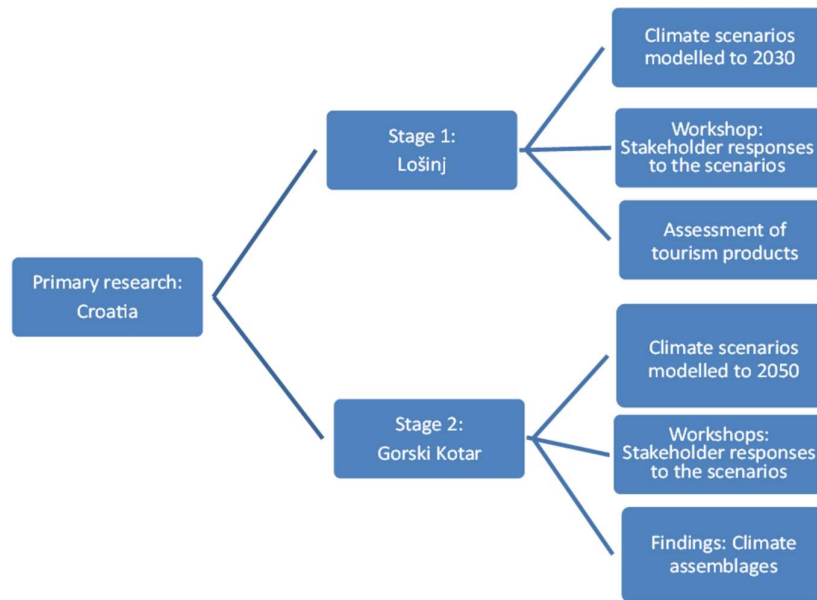
Destination adaptation requires an enabling environment to succeed (Becken & Loehr, 2022). This includes developing appropriate governance to provide trust, transparency, and accountability (Glass & Newig, 2019), as well as access to finance, innovation and research, capacity building, infrastructure development, industry tools, and development of policy frameworks. Here, inclusive governance is important to prioritise equity and deliver adaptation that addresses issues such as gender, income, disability, age, ethnicity, location disability, age, location and income (IPCC, 2022). Adaptation therefore requires political commitment from the destination across all levels of government.

Methods

The overarching aim of this research is to examine local stakeholders' perceptions of the most effective ways for the tourism sector to adapt to climate change. This multi-method research draws on the expertise of local stakeholders and climate modelling experts from the UK, Croatia and Italy. It builds upon the first stage that was conducted in Lošinj, Croatia (Čavlek et al., 2019). Figure 1 sets out the two stages and multiple phases of research.

The key set of methods driving this research are drawn from climate science and social science. They begin with the modelling of future climate scenarios for the two case study destinations, followed by the use of the tourism climate index (TCI) to assess the tourism products that can be supported (or hindered) by the climate scenarios in the future. Secondly, tourism stakeholder workshops were held in each destination to understand the most effective ways to approach destination climate adaptation. The research projects for each of the two destinations was funded separately – the Lošinj research was funded through an ESRC Social Sciences Knowledge Exchange (KE) Dialogues Scheme grant, whilst the Gorski Kotar work was funded by a research grant from Leeds Beckett University. As a result, it was not possible to revisit the earlier Lošinj workshop to do further interviews to assess actual behaviour, nor to align the dates and emission pathways used for the climate scenarios. The following section provides an overview of the two Croatian destinations used in this study, and a detailed account of the two key methods used – climate scenario building and workshops with key destination stakeholders.

Figure 1. Stages of data collection



Source: the authors

Croatian Case Study Destinations

The Island of Lošinj and the inland mountainous region of Gorski Kotar were chosen as two distinctly diverse tourism case study destinations (see figure 2). Both destinations rely heavily on natural resources, so it is crucial to understand the impacts of climate change and ways to adapt for future destination product development.

The island of Lošinj is located in Primorje-goranska county. Tourism is the leading economic activity on the island and is highly dependent on climate specifics, relying heavily on health tourism through the healing qualities of the climate (Horwath HTL, 2021, p. 16). In 2021, total tourist arrivals in Lošinj accounted for 1.8% of total Croatian arrivals (CBS, 2022, p. 60). In contrast, the second destination of Gorski Kotar, is located in the mountainous part of the Republic of Croatia, between its continental and Adriatic regions in Primorje-goranska county. The main economic activities are agriculture, forestry, and hunting. For tourism, the region is highly dependent on outdoor activities, most notably winter sports but also horse riding, cycling, adventure sports and ecotourism - with natural resources as the basis for creating tourism experiences. The most important attractions are the Risnjak national park, caves, rivers, lakes, and mountains. The region is also rich in cultural attractions, such as sacral and archaeological sites. The region's tourism potential remains unfulfilled with a small share of Croatia's total arrivals (0.31% in 2021) and a small number of bedspaces (CBS, 2022).

For both destinations, climate science was used to build climate scenarios for future decades. This used basic climate variables (temperature, humidity, precipitation, wind) to compute the TCI (see details below).

Figure 2. Location of the case study destinations



Climate Scenarios and the Tourism Climate Index

Lošinj: For Lošinj, climate scenarios were modelled from 2021 to 2030 to inform what future climates on the Island of Lošinj will look like and the implications for tourism. Working with the Croatian Meteorological and Hydrological Service, climate modelling was performed using the Regional Climate model of the third generation, RegCM3 (Čavlek et al., 2019). The climate data were then used to assess which tourism products would remain viable and how seasonality might be affected. Using climate data from 7 a.m. and 1 p.m. local time, for the climate period 1961-1990 and future scenario of 2021-2030, the data were run through the TCI that integrates the aesthetic, physical and thermal facets of the atmospheric environment important for tourism (de Freitas et al., 2008). The results reported the number of days, for each month, having unacceptable, acceptable, or ideal climatic conditions for a range of tourism activities. The scenarios were built comparing historical data for the period 1981-2000, with a modelled estimate for the period 2021-2030.

The model considered different possible emission scenarios, the Representative Concentration Pathways (RCPs) (Moss et al., 2008), which describe the possible developments of the additional radiative forcing from anthropogenic activities until the end of the 21st century. The model's emissions pathways used are RCP8.5 – the most pessimistic estimate, and RCP4.5, an intermediate estimate which takes into account a reduction in GHGs leading to average global temperatures in the year 2100 of no more than 2 to 3 °C warmer than in 2000.

Gorski Kotar: Building upon the Lošinj research, a second stage of data collection was undertaken in Gorski Kotar. The first phase of the Gorski Kotar study was the modelling of climate change vulnerabilities and the creation of future climate scenarios to 2050, taking in a longer forecasting range than had been used in Lošinj. The forecasted climate scenarios are based on data from the Copernicus Climate Data Store (CDS) (<https://cds.climate.copernicus.eu/>). The CDS provides open access to a wealth of climate datasets (Thepaut & Dee, 2016).

The data used for Gorski Kotar are the combined results of several models that form the basis for the IPCC AR5 report (IPCC, 2014). The models predict several climate variables (including

temperature, pressure, humidity and precipitation) and provide time series (with different frequencies) to the year 2100. Here, we average the monthly values for the decades ending in 2030, 2040, 2050, a period compatible with the time that would be needed to design and implement adaptation measures. For mountain areas we also employ models predicting “usable” snow cover in terms of number of days in the year with a snow cover higher than 30 cm, considered the minimum level allowing winter activities such as skiing.

For the Gorski Kotar models we use the most optimistic pathway (RCP2.6) and the most pessimistic (RCP8.5). The first considers a reduction in GHG emissions so that average global temperatures in 2100 are no more than 1.7°C warmer than in 2000. The second is a high-emissions scenario in which global temperatures by 2100 are between 2.6°C and 4.8°C warmer than in 2000. The latter corresponds to a "business-as-usual" condition, a likely outcome if society makes no effort to reduce greenhouse gas emissions.

All values in the CDS models used are provided for latitude-longitude grids at 0.11° x 0.11° resolution. We average the values over the area considered (45°.25 to 45°.67 Latitude N, 14°.48 to 15°.23 Longitude E).

Forecasted climatic data are then used as parameters for calculating a TCI. The TCI was originally proposed by Mieczkowski (1985) to quantitatively assess the suitability of the climate for general tourism taking into account people engaged in light physical activities. It has since been revised by de Freitas et al. (2008), based on the observation that climate and weather conditions impact tourist activities unevenly, as different activities differ in physical demand or are highly climate or weather sensitive, such as those performed in a typical "sun, sea and sand" holiday. The TCI is theoretically developed and empirically adjusted and is given as a function of three main parameters: thermal conditions (T), aesthetic (A) and physical (P) factors. As de Freitas specifies (2008, p. 399): A stands for the state of the sky (cloud cover), P for precipitation and wind intensity and T for the energy balance between the body and the atmosphere, which integrates the thermal variables of the environment and physiology, such as solar heat load, heat loss through convection (wind) and evaporation (sweating), the exchange of long-wave radiation and the level of physical activity. T is expressed using the standard ASHRAE scale of thermal comfort (Djongyang et al., 2010).

We further adapt the TCI by using the approach of Bafaluy et al. (2014) that better specify T for different activities instead of average values, thus obtaining a set of values tailored to the different occupations of tourists in a specific area. We consider a range of possible activities (typical of the area under study) and determine the metabolic equivalent of the task (MET), which is an objective measure of the relationship between the rate at which a person expends energy in performing a particular physical activity and the rate expended in sitting quietly (Ainsworth et al., 2011). For simplicity, we report the activities clustered into three groups:

1. Low effort: touring/traveling, boating, walking for pleasure and visiting attractions.
2. Medium effort: fishing, cycling, canoeing, kayaking, orienteering, and sledging; and
3. High effort: horse riding, hunting, hiking, walking on trim trails, swimming, visiting caves, climbing, tennis, windsurfing, adventure sports, alpine skiing, ice skating and cross-country skiing.

The METs, together with an average clothing cover for individuals, which depends on the environment temperature (Schiavon & Lee, 2013), air temperature, humidity, wind, and average human characteristics (age, gender, body mass), are used to calculate the physiological equivalent temperature (PET) according to Walther and Goestchel (2018).

Following Scott et al. (2016), we finally assemble a holiday climatic index (HCI) as:

$$HCI = 4 PET + 2 CD + 3 PR + WN$$

Where each climatic variable (PET in °C, CD = cloud cover in %, PR = precipitations in mm/day and WN = wind speed in m/s) is rated on a scale from 0 to 10, thus giving HCI on a scale from 1 to 100. These values are then reported on a 1-7 scale with the meaning: unacceptable, marginal, acceptable, good, very good, excellent, ideal. As a comparison the situation in the current decade is also calculated in the same way.

Following the calculation of the climate scenarios and identification of destination climate vulnerabilities, the findings were communicated to destination stakeholders through a series of workshops.

Lošinj workshops: For Lošinj, in October 2015 over sixty stakeholders comprising tourism and government officials, biologists and conservation agency representatives took part in an in-person workshop to explore levels of climate change awareness and potential climate vulnerabilities within the tourism sector. The workshop was facilitated by the local tourism board and the University of Zagreb and held in Croatian. During the workshop, adaptation was addressed through a semi-structured discussion. Stakeholders were encouraged to participate in the discussion and the results were limited to their current understanding about the adaptation, as no explanations were provided before the workshop.

Gorski Kotar workshops: For Gorski Kotar, the findings of the climate modelling were shared with key stakeholders through two online workshops in June 2021. Responding to the range of future climate scenarios, stakeholders were asked to consider how their organisation and the destination of Gorski Kotar might be impacted and react to potential climatic changes. In advance of the workshops, stakeholders were provided with the questions that would be used to inform the semi-structured discussion. The central theme of the questions focused upon the preparedness of Gorski Kotar to adapt to climate change with regard to tourism.

Participants were initially recruited through personal networks, supported by a snowball sampling technique. The importance of engaging a range of local stakeholders in adaptation interventions was acknowledged (Sherman & Ford, 2014), as was the need for all stakeholders to work collaboratively in planning for climate adaptation. Nevertheless, recruitment and participation of stakeholders posed challenges, including the preparedness of stakeholders to discuss climate change and tourism with academics (Conde & Lonsdale, 2005) and the wide-ranging vocations of the participants (as not all were working in roles directly associated with tourism).

To this end, the limitations of engaging fewer stakeholders from a wider remit of professions in the Gorski Kotar workshops, when compared to Lošinj, is recognised. However, the lower number of participants is also considered reflective of the very different stages of (tourism) development and the level of knowledge / information shared by respondents across both destinations. The richness of

discussions was therefore the central tenet of our workshop discussions. Further, whilst this aspect of our research collection was qualitative, our focus was on the richness of discussions with no intention to assess statistical relevance of the information gathered.

To maximise attendance, the workshops were hosted virtually on Zoom, with one held in English and one in Croatian. Stakeholders were free to choose which session they attended. Each workshop lasted approximately 2 hours. Members of the research team were present and active in hosting both workshops and notes were made during the sessions. Ten stakeholders attended the two workshops. They represented local and national tourist boards, and both the private and public sector. The first workshop hosted in English was attended by 4 stakeholders and the second workshop hosted a week later in Croatian, was attended by 6 stakeholders.

Workshop discussions were analysed using a manual thematic coding approach whereby key patterns among responses were deductively identified (Braun & Clarke, 2022). To minimise biases during the data analysis, we adopted the ‘researcher triangulation’ approach “understood as evaluating one specific research item from more than one perspective” (Vogler, 2023, p. 1214). Therefore, the codes generated were the result of an iterative process among the authors of this paper. Additionally, two of the authors were from Croatia, contributing an emic perspective to the analysis of the data. The deductive identification of codes stemmed from tourism literature on climate knowledge (of risks and impacts of climate change) and adaptation enablers (appropriate governance, capacity building, infrastructure, etc.). Finally, although assemblage theory proved to be a useful lens to understand that there are multiple and diverse ways of interpreting local adaptation to climate change, it needs to be adjusted to the characteristics and dynamics of different contexts. Therefore, the generalisability of the findings that emerge from its use in the Croatian context is limited.

Results

This section outlines the results from the stakeholder workshops on the climate scenarios.

Climate Scenarios

Lošinj: For Lošinj, the climate scenarios show that by 2030 there will generally be an increase in the number of days with acceptable and ideal climate conditions for most types of tourism activities with the best conditions for typical summer activities: beach tourism, motor boating and sailing (see Čavlek et al., 2019) (Table 1). There is also a shift of acceptable or ideal conditions from the summer periods towards ‘colder’ periods of the year, especially in spring and autumn. This offers the island the opportunity to extend its tourism season, but successful adaptation depends on the ability of the various tourism stakeholders to work together to offer products and services for an extended season and to change their current seasonal mindset.

Gorski Kotar: As with Lošinj, the climate scenarios for Gorski Kotar show that generally, ‘average’ climate changes tend to favour a ‘widening’ of the opportunities for almost all levels of activities thus offering longer seasons to the visitors (Figure 3).

Table 1. Change in the number of ideal and acceptable days by activity in the period 2011-2030 at 12 UTC, Lošinj




Activity	Year	Winter	Spring	Summer	Autumn
Beach	8.0	0.2	3.2	4.2	0.4
Sightseeing	12.6	4.2	7.2	-1.2	0.0
Cycling	15.0	2.8	8.4	1.2	-2.0
Football	10.2	5.6	4.0	0.8	-0.6
Golf	9.4	2.2	6.2	2.2	-1.0
Motor boating	7.8	0.6	9.2	2.0	-4.2
Sailing	6.4	-0.4	9.6	-0.8	-2.0

Figure 3. Climate scenarios for Gorski Kotar

	Month	Low effort				Medium effort				High effort			
		2020	2030	2040	2050	2020	2030	2040	2050	2020	2030	2040	2050
RCP2.6	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	1	1	1	1	1	1	1	1	1	1	1	1
	3	1	2	1	2	1	2	1	3	1	2	1	3
	4	1	1	1	1	1	1	1	1	1	1	1	1
	5	2	3	1	1	3	5	1	1	2	4	2	2
	6	5	6	5	6	4	6	6	7	4	6	5	6
	7	6	7	6	7	7	7	7	7	5	6	6	6
	8	6	7	6	6	7	7	7	7	5	6	6	6
	9	5	5	5	5	6	6	6	6	5	5	5	5
	10	1	1	2	3	2	1	4	1	1	1	4	1
	11	1	1	1	1	1	1	1	1	1	1	1	1
	12	1	1	1	1	1	1	1	1	1	1	1	1
RCP8.5	1	1	1	1	1	1	1	1	1	1	1	1	1
	2	1	1	1	1	1	1	1	1	1	1	1	1
	3	1	1	1	2	1	1	1	2	1	1	1	2
	4	1	1	1	1	1	1	1	1	1	1	1	1
	5	2	3	3	5	3	5	5	6	2	4	4	5
	6	5	5	5	6	4	6	6	7	4	5	5	6
	7	6	6	6	7	7	7	7	7	5	6	6	6
	8	6	6	6	7	7	7	7	7	5	6	6	6
	9	5	5	5	5	6	6	6	6	5	5	5	5
	10	1	1	1	3	2	1	1	5	1	1	1	4
	11	1	1	1	1	1	1	1	1	1	1	1	1
	12	1	1	1	1	1	1	1	1	1	1	1	1

Source: the authors

NB for ease of visualization the HCI values are colour coded as follows

HCI	
	Unfavourable conditions 1-3
	Acceptable conditions 4-5
	Good conditions 6-7

However, for winter activities, the situation is not so favourable and there is a clear vulnerability. The number of days in the year (CDS reports intervals from August 1st of one year to July 31st of the next) with snow depth of 30 cm, for the two RCPs are:

	<i>Number of days</i>			
	<i>2020</i>	<i>2030</i>	<i>2040</i>	<i>2050</i>
RCP2.6	43.1	42.1	47.0	49.3
RCP8.5	43.1	15.1	14.2	9.7

The reduction in the number of days with snow cover is quite dramatic for RCP8.5, the scenario described above (see Methods section) can be depicted as ‘nothing happens’ for what concerns the adoption of measures for reducing GHG emissions, thus strongly limiting all winter recreational activities. If instead, strong mitigation measures are adopted, such as those implied for the RCP2.6, it is noted that after a reduction (due to the inevitable ‘hysteresis’ of the climate system), the situation tends to improve, and it could come back to an acceptable level of snow cover able to sustain all winter activities.

Since effective mitigation measures are well beyond the control capacity of single institutions or even individuals, these predictions suggest that the design and implementation of a rational and realistic adaptation plan cannot be further postponed. This should take into consideration not only possible changes, but also outline new products and services if good ‘tourism levels’ are sought and satisfactory revenue streams for local activities are to be ensured.

Findings and discussion from the workshops

In thinking through assemblages, our participants’ views on adaptation to climate change generate four key thematic areas, which we have grouped as: tourism products, (ecological) education, cooperation and changes/transformation. Although these categories are context dependent, focusing on the relational patterns in other destinations at both micro (specific roles within the local tourism landscape; local financial resources; local environmental resources) and macro levels (global effects of climate change; national policies; national jurisdiction), they can help to identify what type of climate assemblages form in those specific contexts and why.

In this study, we examined stakeholders’ perceptions of tourism climate adaptation across various climate scenarios using the theoretical lens of assemblage theory. The findings showcase how our participants shape their collective and relational views on how to adapt to different climate scenarios in the future through a discussion of the actual barriers to implement meaningful adaptive strategies (see table 2). In accordance with the participants’ narratives, we have identified four different assemblages, namely: tourism products, (ecological) education, cooperation and transformation. Each of these assemblages connects the participants in different ways.

Table 2. Overview of local stakeholders’ perceptions of adaptation to climate change

Thematic codes	Informants' perceptions	Adaptation plans	Barriers for adaptation
<i>New forms of tourism; outdoor focused activities; cycling; hiking; built heritage; repositioning; refocus on tourism; not viable ski season; inland tourism; shift away from sun and sea tourism; investments; plan.</i>	Tourism products		
	Develop a wider range of tourism products.	Invest in developing hiking; biking, fishing, kayaking experiences.	No adaptation to the issues posed by climate change - it changes experiences that rely on vulnerable / finite natural resources.
	Grow diverse tourism markets.	Outdoor summer activities vs snow activities. Aim to attract tourists from Northern European Regions.	Lack of financial resources and investment. Finite natural resources vulnerable to climate change.
<i>Shift attitudes and plans; industry should educate tourists; locals to be educated too; educate tourists; sustainable behaviours; education about tourism impacts; use too much water; create rubbish; not behaving as they should.</i>	Ecological education		
	Educate tourists about the environment and local ecosystem.	Respect the local environment where tourists experience tourism.	Tourism strategies too focused on consumption and growth.
	Education for future tourism leaders.	Development of sustainable policies and planning.	Discourses of institutional, top-down approaches vs meaningful actions driven by climate knowledge.
<i>Coordination; plan; inclusive plan; strategic approach; whole destination approach; long-term strategy; not just one stakeholder's responsibility; cohesion at local, regional and national levels.</i>	Cooperation		
	Need for collaborative approaches across all stakeholders.	Find collaborative approaches and joint solutions to mitigate the hazards caused by climate change.	Local tourism approaches are too focused on overuse of finite resources.
	Collaboration of tourism bodies and institutions at different levels (local, regional and national).	Development of joint tourism policies and strategies which focus on climate mitigation & adaptation. Development of sustainable policies and approaches on different scales.	Tourism strategies too focused on consumption and growth. Discourses of institutional, top-down approaches vs meaningful actions driven by climate knowledge.
<i>Worst case scenario; climate change good for the business / productivity; transform tourism supply; more sustainable tourism; transformation; climate change; temperatures; management; domestic tourism.</i>	Transformation		
	Tangible changes in the local ecosystem.	Develop sustainable products and domestic tourism.	Different stakeholders working in silo.
	Shorter winter season. Warmer temperatures. Climate change means increased production.	Development of new / alternative forms of tourism. Development of outdoor activities such as biking or hiking. Focus on growth of tourism products / markets.	Lack of communication between tourism bodies. Discourses on sustainability vs meaningful practices. Potential of overtourism. Lack of sustainable management. Too focused on production rather than irreversible transformation of ecosystems and biodiversity.

Source: the authors

Tourism products

It is clear that participants who have direct links to tourism and operate mainly within regional tourist boards in the private sector, are prone to develop alternative tourism products to adapt to the changes that climate change brings to the destination. In Lošinj for example, the sector recognises the need to diversify the tourism product to reduce dependence on hours of sunshine. They also recognise that the climate scenarios will enhance opportunities to spread demand for products across the shoulder seasons. For Gorski Kotar, participants articulated adaptation to climate change as an opportunity to develop other tourism products. This is because climate warming impacts on the availability of snow in winter months, limiting the ski season in the region of Gorski Kotar. In articulating their assemblage on diversifying local tourism products, their responses show limited engagement with the wider context of climate change and with the broader challenges of setting joint strategies for adaptation. Instead, their views are concerned with the need to keep tourism as one of the main (regional) economic activities.

Boris, an informant from the Gorski Kotar Tourist Board, adds that it would be useful to receive more information on how climate change adaptation strategies can be used to develop alternative tourism products such as hiking, biking, kayaking, fishing and rafting as, he argues:

“it is likely that these will be the main products that the region will focus on from a tourist perspective in the coming years”.

The regional tourist board is currently looking at built heritage, including interpretation and guiding in these tourism products. This adaptation will demand financial investment in the Gorski Kotar region to enable the destination to be re-positioned within the tourism landscape away from a winter, snow destination towards summer outdoor activities. This will also involve diversifying

source markets, including Scandinavia where tourists are more tolerant of poor weather conditions. Accordingly, Boris adds that:

“it can no longer be a winter, snow destination, but needs to instead refocus on outdoor and summer activities”.

The framing of the assemblage on tourism products is shaped by the participants’ agendas contextualised within the roles they occupy in the public and private sectors. Tourism is an important source of financial income for some of our participants. Therefore, instead of discussing the need to prioritise domestic tourism and low-carbon mobilities strategies, they emphasise the need to remain focused on ‘growth’ attracting other international markets (e.g. the Scandinavian one). Furthermore, as Higgins-Desbiolles et al. (2019, p. 1929) explain, tourism authorities develop strategies to grow tourism markets, increase visitor numbers, increase visitor spending and encourage repeat visits. This happens because growth is the logic of neoliberal capitalism and because it is essential for democratic governments to get re-elected. Arguably, this approach to climate change adaptation which consists of transforming tourism products (even if they appear to be sustainable) and/or shifting tourism to other destinations within the same region, does not contribute to addressing the wider, key challenges caused by climate change. Instead, they address the lack of engagement with the critical challenges we (jointly) face.

Education

Further relational articulations that emerged shaped what we define as the second assemblage on ecological education. For Lošinj, workshop participants mentioned on numerous occasions the need to educate tourists in terms of flora and the island’s ecosystems. Similarly, for Gorski Kotar, participants noted the need to educate people and shift mindsets. Antonela, who works in the Croatian Ministry of Tourism and Sport, for example, says that:

“there is a lot of work to do in respect of educating people and shifting mindsets towards climate change, sustainable behaviour in destinations and the individual’s impact on nature”.

Participants also mentioned that younger generations are more aware of the implications of climate change and, according to Antonio, a Croatian beekeeper and honey producer, adapt more easily to the changes caused by climate change. The focus on education is an important step towards re-thinking how tourism can contribute to addressing climate change. Instead of adapting to it through the development of strategies that are still too focused on consumption and (over)use of finite and, already scarce, resources, it requires a deep, critical engagement with new ways of doing tourism which prioritise cohesive community approaches. In this vein, participants argue that education is essential for future leaders in tourism policy and planning to understand tourism as a moral endeavour and in terms of its value to human well-being (Higgins-Desbiolles et al., 2019, p. 1940). Assemblages on climate change education allow us to rethink the relationship between the human and the more-than-human worlds, as well as the gap between discourse and materiality, social and natural sciences, and the questioning of power relations and politics (Everth & Bright, 2023, p. 17).

Cooperation

The third assemblage thinking from our findings is the theme of cooperation. Both the Lošinj and Gorski Kotar workshops highlighted the lack of communication and coordination between different stakeholders, despite the importance of knowledge sharing and capacity building identified in the literature. However, for Lošinj it was recognised that there was a need for a collaborative approach across all stakeholders for successful adaptation to take place.

The Lošinj workshop identified clear climate vulnerabilities and hazards. These included air temperature and hours of sunshine; air quality and aerosols; sea water quality and temperature; and freshwater quality. There was concern about the island's resilience to extreme climate events and about the impact of carbon emissions from other economic sectors. The workshop also highlighted the danger of pollution deteriorating sea quality from other sectors. Enabling a cohesive destination approach to address climate change and to forge meaningful adaptation strategies is therefore needed.

For Gorski Kotar, participants believed that there will be more cooperation between different stakeholders in the future. The work of different stakeholders, tourism bodies and institutions, was discussed by several participants, however these remain disjointed. For example, development of policies and strategies by the Croatian Ministry of Tourism and Sport focus on 2030, with nearly all of the Croatian goals related to EU plans on sustainable tourism. These efforts to address climate change at the destination and national levels are part of institutional plans, which although potentially important to move towards more sustainable developments, risk remaining on a rhetorical level rather than resolving "the tensions of tourism that occur as we confront the limits to growth our planet faces" (Higgins-Desbiolles et al., 2019, p. 1941).

The narratives of our participants do not refer to grassroots initiatives to find other ways to link tourism with climate change. However, it is important to recognise how local and global communities are planning pathways to a low-carbon economy and transition to a self-sufficient economy. Articulations about communities and bottom-up approaches to climate change adaptation through tourism can help connect people to their environment and come to a deeper understanding to support action at personal and policy levels to address climate change (Cavaliere, 2017 cited in Higgins-Desbiolles et al., 2019, p. 1940).

Transformation

In using assemblage thinking, we stress how local and national approaches to climate change in the context of tourism are not fixed but spatially and temporally fluid. Participants' views on climate change and adaptation strategies are socially (e.g., roles of participants within the tourism landscape) and spatially constituted (e.g. Lošinj and Gorski Kotar) in a specific moment in time. This fluidity is evident in the way respondents related to changes and transformation generated by climate change. For most participants, climate change has caused tangible changes in the Croatian ecosystem and in the way that tourists experience the destination. For example, the winter season in Gorski Kotar is much shorter because of a reduction of snow and rising temperatures in winter months. Antonela notes:

"...there will be very little snow moving forward and temperatures will also rise. Plans will focus on this".

As a result, there is a willingness to transform the tourism supply and focus upon more sustainable forms of tourism such as biking and hiking which can be developed in the inner parts of

the region, decentralising tourism from the more popular coastal areas. David, employed locally within a wood company, adds:

“In previous years, winters have been very difficult to deal with from a business perspective – very low temperatures and quite large amounts of snow. In conditions like this, the business suffers as they are unable to transport goods. If the climate changes as predicted, this will be a positive thing for the company as they will be able to increase production”.

Indeed, the future climate scenarios are positive for some businesses who found the winters very difficult to deal with. In line with assemblage theory, our participants’ views of climate change adaptation are heterogeneous, dependent on their socio-economic roles, their agendas and (moral, social, and political) purposes. The dependence of our informants’ responses on such factors hinders the ability to respond – in local terms through adaptation strategies - to the negative effects of climate change.

Additionally, in assemblage thinking the processes that produce assemblages are always iterative, thus it is important to include those subjective, or as DeLanda argues (2006, p. 52), “ephemeral assemblages”, perspectives that emerge from the interactions between people. There was disagreement amongst participants in discussing changes happening in the whole ecosystem resulting in more wild animals approaching settlements. This is illustrated by Ivan, an employee of the National Park Risnjak, who is less positive than David in discussing ecosystem changes. Ivan points out that:

“There is an increasing number of wild animals approaching settlements. Sometimes there is a mother bear with three cubs in one village, they are still trying to find the reason why she has approached that village”.

These changes are mainly related to the disruption of biodiversity and ecosystems in general, which will also have repercussions on tourism and stakeholders’ lives and tourist experiences. These narratives show that the way tourism is transforming is because climate change is evident. According to Antonio there is an increase in domestic tourism. He mentions that *“there are many more domestic tourists visiting from Zagreb and Rijeka nowadays”*. Antonela echoes Antonio’s comments adding that:

“there was a notable increase in visitors to Gorski Kotar, seeking to escape the towns and cities during the pandemic”.

Transformation therefore has the potential to forge more localised and sustainable forms of tourism but, if not managed well, could lead to domestic overtourism of popular tourist areas.

Conclusion

This paper contributes important knowledge, ideas, and techniques to the field of destination climate change adaptation. We use a mixed methods approach, leading with climate science to predict future climate scenarios, and social science approaches to examine stakeholders’ responses to the scenarios. The paper makes a significant and novel contribution by attempting to capture the complexities and heterogeneity of local responses on climate change adaptation through the lens of assemblage theory. This bottom-up framework enabled the analysis of the complexities of social contexts by emphasising fluidity and exchangeability of responses. The application of assemblage

theory can assist in navigating the complexities associated with the multiple perspectives on climate change and on ways to adapt to it. In unpacking the complexities of social realities, assemblage thinking can mobilise action and cooperation among members of an assemblage. It does so by assisting individuals in understanding where power lies in social systems, the entanglements of human and non-human entities and the constraints and resources available to them in a specific system.

The results show that through the approach of modelling future climate scenarios and through the use of the TCI to assess which tourism products different climate scenarios could support, natural resources will be scarce or disappear as a result of climate change. Hence, although this opens-up opportunities to rethink meaningful, democratic, and inclusive approaches for the implementation of sustainable tourism, such as product diversification including slower and niche forms of travelling, stakeholders did demonstrate a short-term approach to adaptation plans. These include shifting the focus to other tourism destinations or diversifying markets.

These responses to adaptability highlight the willingness of some to keep tourism as one of the main economic activities, in spite of its negative links to the causes of climate change. More hopefully, assemblages on ecological education and cooperation address the importance of rethinking how tourism can contribute to addressing climate change instead of focusing primarily and only on adaptation avenues. Therefore, consumption of scarce and finite resources is critically reconsidered by prioritising cohesive community approaches to new, more beneficial ways of doing tourism. In the context of education and cooperation, the relational thinking of the participants is aligned with posthuman views of climate change whereby human and non-human entities constitute the social milieu.

In conclusion, the findings show that local experiences and responses to climate change within tourism contexts are locked within specific spatio-temporal boundaries. Hence, local responses on the same topics of adaptability to climate change will likely produce different responses in other geopolitical space and time settings. This is of significance when reflecting upon the concept of 'adaptation' which transforms over time to respond to the dynamism and changing characteristics of the issues we face.

Future research avenues point to expanding the tourism field in ways to communicate climate change to wider audiences to generate participation and meaningful responses from the tourism sector. Data gathering on how to communicate climate change to the layperson should aim to involve tourism stakeholders with different roles and agendas within the tourism landscape. Additionally, future studies should also critically reconsider the meaning of 'adaptation' to climate change for tourism destinations in line with the transformative processes that current societies have undergone and continue to transcend.

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