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Ecological Footprint and tourism: Development and sustainability monitoring of ecotourism packages in Mediterranean Protected Areas

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ABSTRACT

Ecotourism is a potential lever for sustainable development, but common standards and approaches lack to manage and monitor the impact of defined packages on natural resources and local communities. A customized version of Ecological Footprint Accounting is evaluated here to assess its usefulness as analytical tool to

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quantitatively analyse the environmental pressures associated with ecotourism packages developed in and around Protected Areas in the Mediterranean Region. Within the framework of the EU-funded DestiMED project, a bottom-up, participatory approach was developed for managing and monitoring 13 ecotourism packages by involving local tourism stakeholders and service providers. The application of Ecological Footprint Accounting relied on data sourced from local service providers to complement existing statistics and datasets, and was used in an empirical iterative process to provide local tourism stakeholders with recommendations to guide them in the management of a low-impact tourism offer. International travel to and from the 13 destinations was found to place a Footprint on the environment – mainly because of carbon emissions – higher than that of the entire stay at destination. Footprint results of the packages revealed some overlooked tourism's impacts on ecosystems due to unexpected drivers, such as the Food & Drink services offered to tourists at destination. Results indicate that managing tourism product development at destination, and investing in providing knowledge on the principles of sustainability, could lower ecotourism's impacts whilst contributing to building resilience and aiding the post-COVID recovery of destinations.

Management implications: This article tested the applicability and usefulness of Ecological Footprint Accounting (EFA) to assess ecotourism packages developed in and around Protected Areas (PAs) across the Mediterranean Region. A customized version of Ecological Footprint Accounting is suitable for managers and can be used to quantitatively assess the multiple pressures of the activities included in ecotourism packages through a bottom up approach. This innovative monitoring process typically fosters the engagement with the local service providers, which is key for a sustainability monitoring of the touristic offer. Applied to ecotourism packages, EFA allows identifying the main ecosystems under pressure as well as the main drivers causing such pressures. This information is useful to understand the actual impacts caused by the packages offered in their territory, and – when combined with tangible recommendations for improvements – to help adjust the services offered in the packages to possibly reduce environmental impacts.

1. Introduction

Abundant in ecosystems and natural resources, the Mediterranean Region provides habitats to a variety of flora and fauna (Médail & Quézel, 1999), making it one of the 25 world biodiversity hotspots, home to an exceptional number of endemic species (Valavanidis & Vlachogianni, 2011; Myers et al., 2000). This region is the cradle of some of the oldest civilizations in the world – being a crossover of culture, arts, and history (Rick et al., 2020) – as well as one of the leading tourist destinations globally; in 2016, this region welcomed 330 million international tourists, and it expects more than 500 million tourist arrivals by 2030 (UNWTO, 2017).

An increasing population and an ever-growing tourists' inflow represent a threat to both Mediterranean culture and natural resources (Tovar-Sánchez et al., 2019). In this region, "Sun & Sea" tourism is the most popular type of tourism, drawing between 46% and 69% of international arrivals in the summer season, most of which concentrate around the coastal area (Tovar-Sánchez et al., 2019). This massive amount of tourists' flow can lead to intensive land utilization and coastal urbanization, alteration of natural environments, waste and sewage pollution, loss of biodiversity, social inequity, and labour seasonality (Rodella et al., 2017). Such negative side-effects of tourism have a noticeable impact on natural and cultural assets, which are indeed essential for local communities and destinations, and their long-term success as tourism-based economies (Epler Wood et al., 2019).

As a form of outdoor recreation and nature-based tourism, ecotourism may represent a viable alternative to the mass-tourism that has historically characterized the Mediterranean Region, particularly alongside its coastal areas (Noll et al., 2019). Ecotourism is referred to as the environmentally responsible visiting of relatively unspoiled natural areas to enjoy and appreciate nature (and any accompanying cultural features), promote conservation, and bring economic benefits to the local communities, thus minimizing negative impacts on the territory (Ceballos-Lascurain, 1996). Ecotourism is often geographically defined as taking place in and around established Protected Areas (PAs), which in turn can be identified as "*a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values*" (Day et al., 2012, p. 36; Dudley, 2008). Ecotourism also ensures an active involvement of the local community in tourism processes, which might result in significant positive changes in the perception and behaviour of inhabitants and tourism operators towards the local natural and cultural resources (Ziegler et al., 2020).

The development of outdoor, nature-based tourism offers such as ecotourism requires interdisciplinary planning, management and monitoring of these alternative offers, taking into consideration their environmental impacts and the destinations' resources limits. This planning, management and monitoring process is, especially in Protected Areas (PAs), key to ensure that alternative tourism offers do not follow the same unsustainable path of mass-tourism. However, a lack of tourism expertise, resources (i.e., human and financial), and incentives, as well as inadequate training, is often observed within PA management bodies, increasing their vulnerability to tourism pressures. The significant increase in the number of visitors that natural parks have experienced in the last 2 years as a response to the COVID-19 pandemic is then likely to further exacerbate this situation (McGinlay et al., 2020), and it calls for the need to equip PAs with the right capacity to proactively develop and manage alternative forms of tourism: as called for by Epler Wood et al. (2019), a new approach is required for creating high-quality, low-impact ecotourism offers through a set of reliable monitoring and management tools that can easily be used and understood by the local stakeholders.

To address such requirements, the InterregMed project "DestiMED" launched an integrated approach to provide PAs with the set of criteria and indicators – as well as proper training – necessary to develop, manage and monitor the quality and sustainability of alternative tourism products, namely ecotourism packages. Key aspect of this project was the development of monitoring tools to quantitatively assess the quality and sustainability of packages through a participatory and iterative process with key local stakeholders such as PA management bodies, Inbound Tourism Operators (ITOs), and local service providers.

This paper focuses on the sustainability side of packages' development and specifically on the environmental impacts that ecotourism packages pose on the territory. To not give for granted that ecotourism places a lower environmental pressure, here we uses an increasingly popular environmental accounting tool – the Ecological Footprint – to quantitatively measure the pressure ecotourists' place on ecosystems because of their activities. The aim of this paper is thus to evaluate the usefulness of the Ecological Footprint methodology – as customized for application to ecotourism packages by Mancini et al. (2018) – as a monitoring tool to identify and reduce the environmental impact of ecotourism packages designed and experienced in 13 Mediterranean PAs. Results of the empirical, on-the-ground application of Ecological Footprint accounting to these ecotourism packages are shown for two

different rounds of test, and the main drivers of environmental pressure at destination analysed. As the tourism sector represents around 8% of the global greenhouse gas emissions (Lenzen et al., 2018), of which travelling *to* destinations (opposed to travelling *at* destination) contributes between 50% and 97% (Filimonau et al., 2014; Gössling et al., 2002; Hunter & Shaw, 2007), the paper also assesses the Ecological Footprint embedded in the international travel needed to reach the 13 destinations from key source markets, thus providing a comprehensive picture of the overall pressure that tourism activities place on the planet's resources and ecosystems. The paper concludes by reflecting on the role of the Ecological Footprint as a tool for integrated ecotourism planning and management at destination-level.

2. Case study: the DestiMED approach for ecotourism package's development and its 13 protected areas

A Mediterranean transnational cooperation project (financed under the 2014–2020 EU Interreg MED Territorial Cooperation programme), DestiMED piloted and tested a tailored approach for the development, management, monitoring and promotion of ecotourism products in Mediterranean Protected Areas. It brought together a network of 13 PAs in 6 Mediterranean countries – Albania, Croatia, Greece, France, Italy, and Spain (see Table 1) – and involved them in the set-up, design, development, and monitoring of high quality and low-impact ecotourism packages in their territories. These PAs were treated as the "attractors" around which to create an alternative and sustainable tourism experience, thus aligning PAs activities with the Sustainable Development Goals defined by the Agenda 2030 of the United Nations (UN, 2015), particularly SDG 12: *"Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products"* and SDG 14: *"Conserve and sustainably use the oceans, seas and marine resources for sustainable development"*.

Table 1
Key facts of the ecotourism packages developed in the 13 Protected Areas of the DestiMED project, indicating the duration of the package, the ideal number of tourists the package is designed for, and the period in which the tests were conducted. More detailed information on the type of services included under the 4 categories (Accommodation, Food&Drink, Mobility, and Activities) per each package can be found in Annex 1 of the Supplementary Material.

Protected Area	Duration of the package	Number of tourist	Testing period - Round 1	Testing period - Round 2
Albania North Shkodra Region Parks (Albania)	6 days/5 nights	7	Spring 2018	Spring 2019
Albania South Vlora Region Parks (Albania)	7 days/6 nights	7	Spring 2018	Spring 2019
Kornati Islands National park (Croatia)	6 days/5 nights	8	Fall 2017	Fall 2018
Lastovo Islands Nature Park (Croatia)	6 days/5 nights	8	Fall 2017	Spring 2018
Calanques National Park (France)	6 days/5 nights	6	Spring 2018	Fall 2018
Camargue Regional Nature Park (France)	6 days/5 nights	5	Spring 2018	Fall 2018
Samaria National Park (Greece)	6 days/5 nights	6	Fall 2017	Spring 2018
Colline Metallifere Tuscan Mining UNESCO Geopark (Italy)	4 days/3 nights	10	Fall 2017	Spring 2018
Torre del Cerrano Marine Protected Area (Italy)	4 days/3 nights	7	Fall 2017	Spring 2018
Circeo National Park (Italy)	4 days/3 nights	7	Spring 2018	Spring 2019
Riviera di Ulysses Regional Park (Italy)	5 days/4 nights	6	Spring 2018	Spring 2019
Natural Park of Ebro Delta (Spain)	4 days/3 nights	6	Fall 2017	Spring 2018
Menorca Biosphere Reserve (Spain)	6 days/5 nights	7	Fall 2017	Fall 2018

Each PA participating in the DestiMED project pertained to a geographically and culturally heterogeneous region, thus offering a unique and authentic ecotourism itinerary. Each package was adapted to the local area and context, with specific types of activities and services scheduled day by day (See Annex 1 in the Supplementary Material) and conducted by local serviced providers and guides. All ecotourism packages shared some common features as they: 1) were intended for groups of 5–10 international tourists coming from foreign countries, 2) lasted between a minimum of 4 days/3 nights to a maximum of 7 days/6 nights, 3) incorporated several conservation activities (e.g., census of flora, birdwatching) and cultural experiences (e.g., traditional dancing and singing, artisanal craftsmanship, cooking classes) related to the Protected Area as well as experiential activities (e.g., diving, stargazing), and 4) were designed to offer activities and services to tourists outside of high season and solely on-site (once at destination). Travelling to destination was not included among the packages' services and its environmental impact thus distinguished from the impact at destination.

In each PA, the creation and subsequent management of the ecotourism packages relied on a highly iterative and participative process realized through the creation of a Local Ecotourism Cluster (LEC), consisting of the PA management body, local tourism private stakeholders (i.e., local Inbound Tourism Operators – ITOs, other tourism service providers), and other tourism-related stakeholders (e.g., Destination Management Organizations - DMOs, NGOs, business associations) (Noll et al., 2019). The objectives of each LEC were to: 1) develop the ecotourism package, 2) monitor the quality and the sustainability of the package, and 3) manage and improve the package to make it market ready.

This paper focuses on the second LEC objective, as it specifically deals with the sustainability monitoring process. More precisely, although the overall monitoring process included criteria and indicators for managing and improving the economic, social, cultural, and environmental dimensions of sustainability, as well as the quality of the offer (Noll et al., 2019) – as each one of these dimensions influence the development and continuous refinement of the 13 packages – this article explores the role and utility of the Ecological Footprint for the assessment and continuous monitoring of the natural resources and ecosystem services demanded by the ecotourism packages (see section 3).

The monitoring of the Ecological Footprint of the packages followed a multistep bottom-up approach, which relied upon a continuous iterative and participatory roadmap between the LEC and the technical partners of the DestiMED project (composed of experts in tourism and conservation) (see Fig. 1). At the beginning of the process, while each LEC was tasked to design a first version of the package (i.e., Round 1), the technical partners organized trainings at each destination to provide LECs with key information on the sustainability topic and specifically on the Ecological Footprint methodology. These trainings were open to all LEC members although primarily intended for the appointed data collector in each PA. Specific goals of the training were to provide practical information on 1) how to engage with the service providers involved in the packages to collect – via ad-hoc surveys – the data needed for the Footprint assessment, and 2) how to interpret the results of Footprint assessments and use them in the iterative package development process. Ad-hoc surveys for the four categories of services included in each package were developed by the project's technical partners and validated with LEC members before being distributed in each pilot site for use in collecting data (see Mancini et al., 2018 for full survey details).

Data collection in each PA then ensured punctual and specific data for the Ecological Footprint assessment were obtained. Once data was

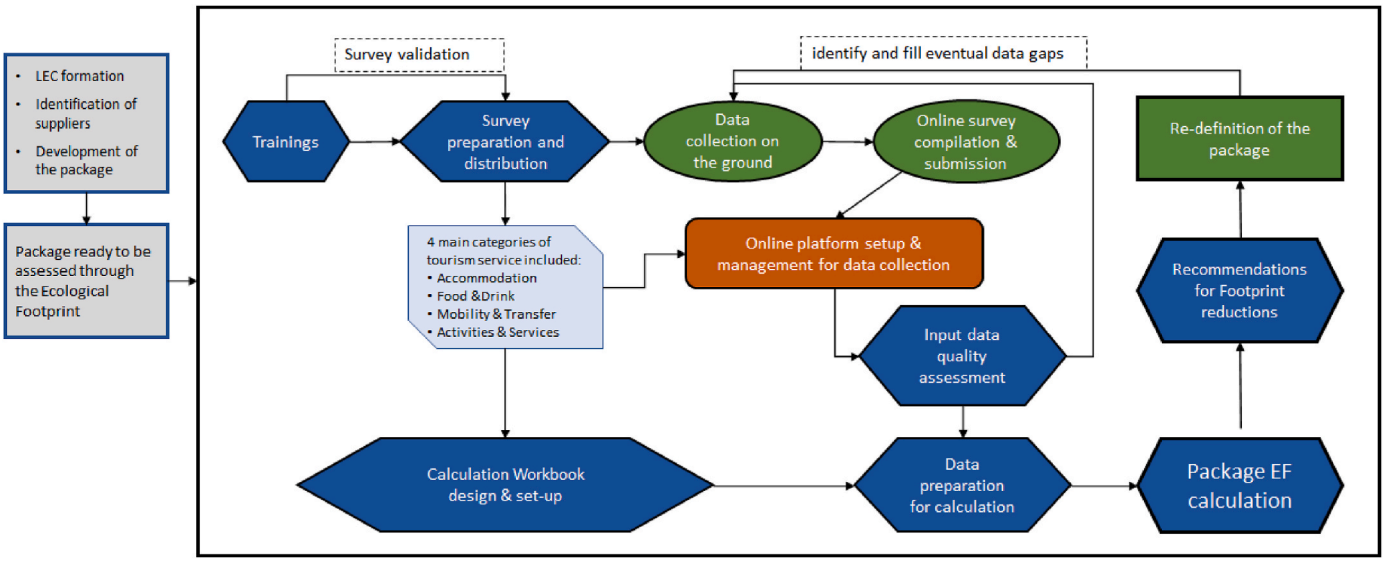

Fig. 1. Methodological steps of the Ecological Footprint assessment of DestiMED packages. Rectangle boxes represent boundaries of the overall monitoring system of DestiMED process: the biggest rectangle encloses the specific monitoring of Ecological Footprint. Hexagonal boxes represent processes conducted mainly by GFN. The round angled box represents process conducted by the technical partners of DestiMED (IUCN and GW University). Source: Adapted from Mancini et al., 2018.

collected, a validation phase was conducted by the technical partners and the data collector in collaboration with the service providers to ensure a complete and reliable dataset for each package. Once the results of Round 1 were calculated and analysed for each package as described in section 3, feedbacks and recommendations on where to intervene to potentially reduce the environmental pressures caused by each service included in the package were shared with each LEC. A revised version of each package (i.e., Round 2) was then prepared by each LEC and put through the same monitoring process, including on-site data collection, data validation, data processing, assessment of Ecological Footprint results and analysis.

This empirical, iterative process ensured alignment of each ecotourism package with the sustainability standard defined by the DestiMED project and was intended to ensure each package would be ready for the tourism market as a high-quality and low-impact ecotourism product (Noll et al., 2019).

3. Methodology and data

3.1. Ecological Footprint Accounting: an overview

The Ecological Footprint is an environmental accounting tool assessing the pressures placed on the planet by the human appropriation of the natural resources and ecological services the planet can produce and regenerate each year (Wackernagel et al., 1999). By quantifying the natural resources needed to support daily human activities, Ecological Footprint helps recognizing human-nature relationships and the biophysical limits of the ecosystems that support the human enterprise.

The methodology considers six main types of land that can be appropriated by human activities through their demand for a crucial subset of natural resources and ecosystem services: cropland to produce food and fiber; grazing land for producing meat-based food; forests for wood and timber products; fishing grounds (both marine and inland) for fish and seafood; build-up land to host residential homes and highways; and carbon uptake land to absorb excess CO_2 from fossil fuel combustion (Borucke et al., 2013).

Ecological Footprint has been mainly applied at global and national level (Lin et al., 2018) but applications of the Footprint also span from regions to cities (Baabou et al., 2017; Galli et al., 2020; Isman et al., 2018), from industrial sectors to products (Galli et al., 2017; Patrizi et al., 2018), as well as for education purposes (Collins et al., 2018). Within the tourism sector, Footprint assessments have been mainly conducted at local level for specific destinations (Bagliani et al., 2004; Patterson et al., 2008; Phumalee et al., 2018), for assessing tourist activities (Castellani & Sala, 2012), such as for instance those related to sport (Collins et al., 2009) or cultural (Collins & Cooper, 2016) events, as well as for comparing different tourism scenarios (Hunter & Shaw, 2007). Despite several Ecological Footprint studies have targeted the tourism sector (Galli et al., 2022), the application of this indicator at product level (i.e., packages) is relatively recent and a first attempt at defining a coherent and standardized approach has been made by Mancini et al., 2018, upon which this paper is based.

Applied to an ecotourism package, the Ecological Footprint is calculated by adding-up the demand for natural resources and ecosystem services needed to sustain 4 key products and services offered to tourists at destination (see section 3.2) and to bring tourists to the destination (see section 3.3) through the following equation:

$$EF = \sum_i \left(\frac{P_i}{Y_{w,i}} \times EQF_i\right) \quad (1)$$

where P_i is the amount of any product or service *i* offered to tourists (e.g., the amount of food provided or the amount of CO_2 released because of a service provided); $Y_{W,i}$ is the annual *world-average yield* for the production of *i* (or its carbon uptake capacity in cases where P is CO_2); and EQF_i is the *equivalence factor* for the type of ecosystem (e.g., crops, forests, etc) producing the product or service *i*.

EQFs convert the areas of different land use types, at their respective world average productivities, into equivalent land units or hectare-equivalents — namely global hectares (gha) (Borucke et al., 2013; Lin et al., 2018). Each gha thus represents the annual capacity of a hectare of land of world-average productivity to provide ecosystem services useful to people through photosynthesis (Galli, 2015).

3.2. Ecological Footprint of ecotourism packages at destinations

As proposed by Mancini et al. (2018), the Ecological Footprint of ecotourism packages represents the demand for natural resources and ecosystem services required to support the activities included in the ecotourism packages at destination. To facilitate the EF assessment, services and activities were grouped into four main categories: 1) *Accommodation* (i.e., facilities, where the tourists stay over nights), 2) *Food*

& Drink (i.e., all meals offered in the package), 3) *Mobility* (i.e., all transfer to move tourists from places to places at destination) and 4) *Activity & Services* (i.e., recreational or educational experiences offered to tourists).

Each physical amount constitutes the parameter P_i in equation (1) (e.g., quantities, origin and typology of food served, type and quantity of energy consumed in accommodations, fuel consumed from using vehicles, etc.), which is then converted into global hectares by specific coefficients according to the category of service; comprehensive details about all the coefficients used in the Footprint assessment of ecotourism packages are provided in Mancini et al. (2018). The total Ecological Footprint of each ecotourism package is thus the sum of the Footprint placed by each service offered to tourists at destination and the assessment of each package followed the process described in Section 2.

Compared to Mancini et al. (2018), few methodological improvements were implemented in response to feedback received from the LECs during the implementation phase of the project and are summarized here below:

- In addition to the national grid and off-grid systems, the energy system calculation was expanded to also account for the energy system supplied by local grids; specific carbon emission factor provided in Table 1 in Mancini et al. (2018) were assigned to local grids depending on the energy type (i.e., diesel- or hydro-operated generator on islands).
- The labour Footprint[7] calculation was modified to capture the different hour commitment of workers of different accommodation facilities. While Mancini et al. (2018) proposed to consider each worker to spend 8 h a day in support of tourists irrespective of the accommodation type, here we assume workers to dedicate tourists 8 h a day in the case of hotels and resorts, 24 h per day on sailing boats, and 2 h per day in all other accommodation types (e.g., B&Bs, apartment rentals, agritourism).

Finally, some assumptions were made to overcome the lack of detailed and not always accessible data on the Food & Drinks category. Specifically, food items were considered "national" and "non-organic" by default when the *origin* or *mode of production* information was missing in the data collection. An assumption was also made for capturing the Footprint of all the seafood products served in meals: a selected list of fish species was included in the survey and related Footprint intensities data from the National Footprint Accounts[8] were used for calculations. Those specific fish species not included in the list were grouped with the existing ones by matching the proximity of both species' trophic level and Footprint intensities.

3.3. Ecological Footprint of international travel

The Ecological Footprint of two ways of international travelling – by air and by land – was then calculated, considering tourists could originate from 30 European capitals and 8 non-European cities (see Table 2). Travelling by land was accounted as a combination of train and ferry transfers, while travel by private vehicles (e.g., cars) was not considered. Visiting the PA at destination was assumed to be the sole reason for travelling thus allocating the whole travel Footprint to that destination and tourism package.

Table 2
Countries of origin accounted for the international travel assessment via flight and via train.

Countries of Origin	Europe	Extra Europe
Via flight	Austria, Belgium, Bulgaria, Czech Republic, Cyprus, Croatia, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Iceland, Latvia, Lithuania, Luxembourg, Norway, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Hungary	UK, USA (New York and San Francisco), Canada (Montréal), Canada (Vancouver), Australia (Sydney), Australia (Perth), China (Beijing)
Via train and/or ferries		

In the case of air travel, the ICAO Carbon Emissions Calculator (ICAO, 2018) was used to estimate the carbon emissions attributed to each passenger. ICAO calculator allows passengers to estimate the emissions attributed to their air travel by inputting information about the flight (i.e., departure and arrival airports, including stopovers), yielding results in terms of CO_2 emission per passenger for the whole round trip. For the analysis related to tourists purchasing DestiMED ecotourism packages, the ICAO calculator was used to assess international travel from the countries of origin reported in Table 2. At destinations, the reference point was considered the nearest international airport of arrival to each of the 13 PAs. Once the CO_2 emissions values per passenger were obtained from the ICAO calculator, the average forest carbon sequestration value of 0.73 t C ha^{-1} (Mancini et al., 2016) was used to convert CO_2 emission in Ecological Footprint terms.

To calculate the Ecological Footprint of travel by land, the distance between the 30 European country of origin (see Table 2) and each pilot area was calculated using Google Maps. To allow comparability with the air travel analysis, international airports at destinations were kept as the arrival point. For each route, the distance travelled by two means of transport, trains and ferries, was calculated considering their relative percentage share within each trip. A literature review was conducted (see Annex 2 and 3 in the Supplementary Online Materials) to identify the CO_2 emission factor per passenger per kilometre for both trains (0.036 kg pkm^{-1}) and ferries (0.36 kg pkm^{-1}). The Ecological Footprint of travelling by land was finally calculated by considering these CO_2 emission factors, the distance between capitals and international airports at DestiMED destinations, and the average forest carbon sequestration value of 0.73 t C ha^{-1} (Mancini et al., 2016).

To ease visualization of international travel results, the Ecological Footprint of travel was aggregated in three macro-categories: 1) air travel Footprint per tourist coming from European countries, 2) ground travel Footprint per tourist coming from European countries (train and ferry) and 3) air travel Footprint per tourist coming from non-European countries. For each of the 13 pilot actions involved in DestiMED, the weighted average travel Footprint results in the three categories were calculated from all countries of origin considered. Finally, an overall average (using the averages of the three macro-categories) was calculated among all DestiMED pilot actions and assessed against the Ecological Footprint of the average DestiMED package.

3.4. Limitation of the study

Although the DestiMED project and its related Standard aim to consider all aspects of sustainability – including quality, economic, social, cultural, and environmental dimensions – only a specific aspect of the environmental dimension was quantitatively assessed through Ecological Footprint Accounting and is described in this study; governance, conservation and socio-economic indicators are being explored in the currently ongoing DestiMED Plus follow-up project, while the quantitative assessment of the cultural dimension remains unaddressed

[7] Labour Footprint refers to the Ecological Footprint of each worker employed in the package and needed to provide the specific service. The EF of human labour derives from the amount of resources needed for each worker to properly perform his/her job.

[8] See National Footprint Account 2017 edition. and the guidebook to it: *D. Lin, L. Hanscom, J. Martindill, M. Borucke, L. Cohen, A. Galli, E. Lazarus, G. Zokai, K. Iha, D. Eaton, M. Wackernagel. 2017. Working Guidebook to the National Footprint Accounts. Oakland: Global Footprint Network.*

and should be prioritized in future research and projects, given the importance of the cultural dimension for Mediterranean destinations. Moreover, the Ecological Footprint methodology applied to ecotourism products can also be subject to further improvements as highlighted in Mancini et al. (2018), beside those already implemented in this study (Section 3.2).

Concerning the international travel assessment, the international journey from a capital city to the capital city of destination was assessed, neglecting the transfer from the tourist's hometown to the departure capital. This is an underestimation of the actual travelled distance, but it is assumed to represent a minor share of the total travel compared to the international journey. Secondly, a more comprehensive evaluation of ground transport, including ships and ferries, would consider the relative percentage of diesel vs. electric power fuel of the locomotive to measure the required amount of CO2 emissions. However, the average value of both electric and diesel trains was calculated using the values found in the literature (Annex 2). The average value is 36 g km-1 and can be considered a conservative estimation as it is lower than the average (49 g km-1) found in other studies (AEA Technology, 2005). Third, as the focus was on international travel, public transportation modes were specifically investigated, thus omitting travel by private vehicles; future research on the Footprint embedded in land-travel by cars and/or vans would thus expand the current analysis, especially considering that more travellers could likely opt for using private vehicles in the immediate post-COVID recovery.

Future improvements could also focus on identifying the motivation behind travelling. The current analysis assumes each international travel segment to be motivated by the need to reach a single destination; however, tourists from across the ocean, for instance, could likely travel to the Mediterranean region to experience multiple packages in different destinations thus requiring allocating shared responsibilities among destinations for the international travel Footprint.

Finally, analysis of flight and train travel only accounts for the direct CO2 emissions (e.g. emissions derived from fuel combustion during all travel phases), while ignoring the indirect or embodied carbon Footprint associated with the life cycle resulting from other non-operational phases of the transports (i.e., industrial processes necessary to extract raw materials of vehicles, repair and final disposal as well as construction and maintenance of infrastructures), highlighting again a likely underestimation of the overall Ecological Footprint of travel.

4. Results

4.1. Round 1 vs. round 2: Footprint results at destination and related recommendations

Fig. 2 shows results of the Ecological Footprint application to ecotourism packages in Round 1 for the 13 PAs, expressed in global hectares and broken down by land types. Footprint results range from 0.29 to 0.82 gha per package, with an average Footprint value of 0.54 gha per package. The highest pressure from ecotourism is due to carbon emissions and is placed on the carbon-sequestering ecosystems (i.e., forests – see Mancini et al., 2016), which represents on average 46% of the total package Footprint. Other land-types impacted are croplands (21% of the total Footprint on average), fishing grounds (17%), grazing lands (13%) and built-up lands (1%).

As different packages are characterized by a different number of tourists and different lengths of stays, Footprint results are then expressed in global hectares per tourist per day (gha tourist^{-1} day^{-1}) – measuring the pressures placed on ecosystems by each individual tourist during one full day – to allow comparing different packages and rounds of test. Results range from 0.0078 to 0.0259 gha tourist^{-1} day^{-1}, with an average Footprint value of 0.0153 gha tourist^{-1} day^{-1} (see Fig. 3).

When looking at the results by categories of services, Food & Drinks represented the major Footprint driver in all 13 packages in Round 1, contributing on average to 63% of the total package Footprint (with percentage contribution ranging from 39% in Albania South to 79% in Torre del Cerrano). Accommodation represented on average the second-largest share (25%) of the total package Footprint (ranging from 10% in Colline Metallifere to 45% in Albania South).

For 2 of the 13 packages (Colline Metallifere and Delta del Ebro), Mobility & Transfers was the second-highest Footprint driver while this category ranked as the third-highest for all other packages, contributing on average to about 8% of the total Footprint (ranging from 3% in Menorca to 19% in Delta del Ebro). Activities & Services only contributed to 4% of the average Footprint of a package, with values ranging from 1% (Albania North) to 9% (Delta del Ebro).

Results from Round 1 were analysed in detail and used to draw general recommendations to help PAs develop low-Footprint ecotourism offers (see Table 3).

Alongside these general recommendations, a set of specific recommendations based on detailed Ecological Footprint results was compiled for each Protected Area, and then shared with each LEC to encourage changes in the services included in the package to possibly reduce the Footprint value in Round 2. The list of specific recommendations for each PA can be found in Annex 5, while Table 4 below describes how each LEC acted to implement the changes recommended by the Ecological Footprint assessment.

Based on both the general and specific recommendations, a second version of each package was conceived by the respective LEC, and their Footprint was calculated and compared with that of Round 1 (see Fig. 4).

In between the two rounds, 6 packages managed to decrease their Footprint value, with reductions ranging from −4% in Ulysses Riviera to −37% in Circeo; yet, 7 ecotourism packages increased their Footprint, with increases ranging from +5% in Menorca to +74% in Kornati. As a result, the average daily per capita Footprint value increased by 4% (0.0153 vs. 0.0159 gha per tourist per day in Round 1 and Round 2 respectively).

Looking at the services offered to tourists, Food & Drinks was the sole service to increase (+12% on average) its Footprint value in Round 2. All other categories of services on average decreased their Footprint value in Round 2: Mobility & Transfers and Activity & Service both decreased by an average 16%, while Accommodation decreased by 6% compared to Round 1.

It should be noted that the Ecological Footprint results provided here depend on the robustness and reliability of collected data, which were checked during the validation phase in collaboration with LEC members and service providers. Data quality check also served as further proof of the level of engagement of the service providers involved in the project. Annex 4 in the Supplementary material shows the output of the data quality check for all PAs in both rounds.

4.2. International travel assessment: Footprint results

Fig. 5 compares the Ecological Footprint of each ecotourism package with average air travel and ground travel Footprints of international travel. Origin and destination-specific results for international travel are reported in Annex 6 and 7 of the Supplementary Online Material.

Travel Footprint results ranged from 0.044 gha cap^{-1} – in the case of a tourist travelling from Europe to Colline Metallifere by ground travel – to 0.433 gha cap^{-1} considering a tourist travelling from outside of Europe to Albania by plane. On average, a tourist travelling by flight from within Europe and going to any DestiMED pilot action had a Footprint of 0.110 gha cap^{-1}; the same tourist travelling by ground had a Footprint of 0.065 gha cap^{-1}, while a tourist flying from outside Europe to any pilot action was found to have an average Footprint of 0.404 gha cap^{-1}.

Ecological Footprint results derived from air travel analysis ranged from 0.095 gha cap^{-1} to 0.130 gha cap^{-1} for a tourist coming from a European country, while Footprint results for a tourist coming from outside Europe were about three times higher, ranging from 0.347 gha cap^{-1} to 0.433 gha cap^{-1}. Ground travel Footprint results ranged from

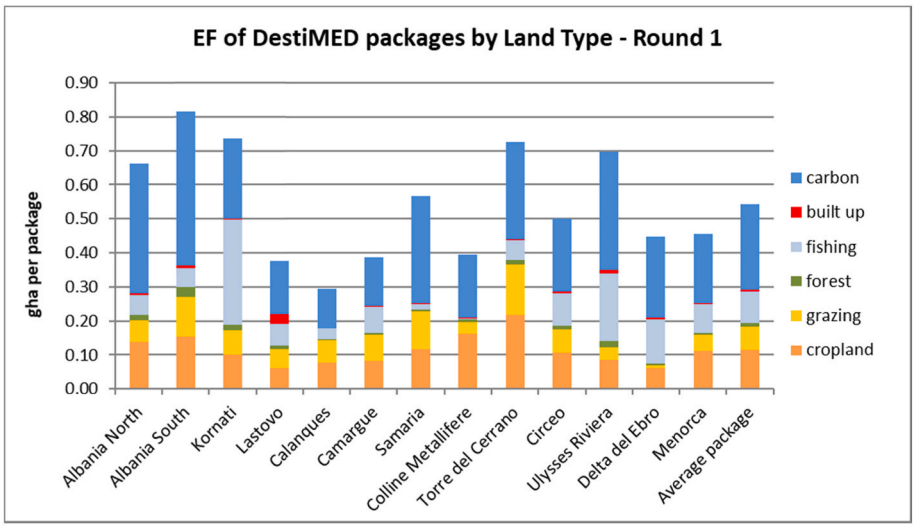

Fig. 2. Ecological Footprint results from Round 1 of DestiMED project for the 13 packages and calculated average. Results are broken down by land types.

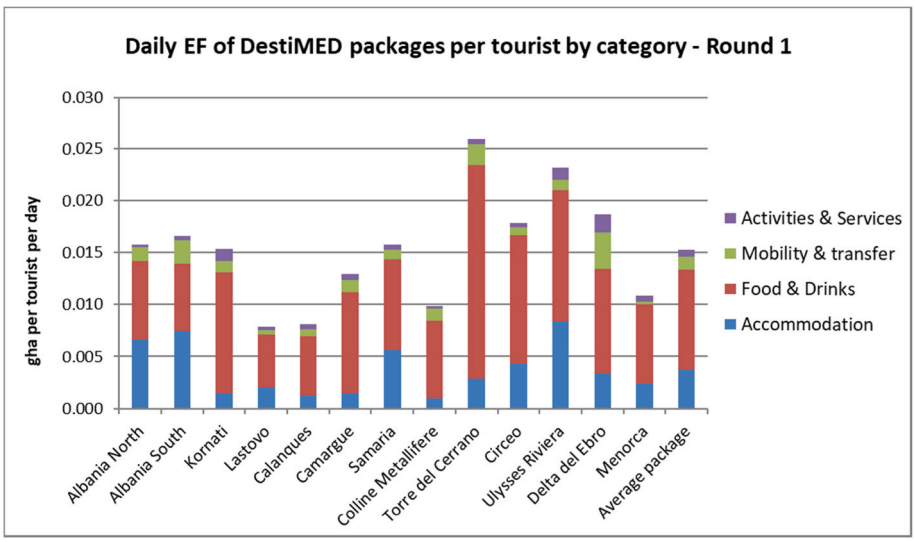

Fig. 3. Daily Ecological Footprint results per tourist of the 13 packages in Round 1 and calculated average. Results are broken down by the 4 main categories of activities and services offered in the package.

0.044 gha cap^{-1} to 0.147 gha cap^{-1}. Travelling by land/sea generated a lower Footprint than travelling by air. Yet, this trend changed when ground travel included a high percentage of distance travelled by ferry, as the CO_2 emissions per ferry passenger (0.3630 kg pkm^{-1}) are one order of magnitude higher than for a train passenger (0.0363 kg pkm^{-1}). For instance, a European tourist travelling to Samaria – a protected area in the island of Crete in Greece that requires the highest share of travel by ferry (19% of the overall ground travel) to be reached – via both train and ferries was found to have an overall travel Footprint of 0.147 gha cap^{-1}, 12% higher than travelling by plane to the same destination (0.130 gha cap^{-1}).

5. Discussions

5.1. Relevance and implications of Footprint results

Ecological Footprint Accounting was here applied to the tourism sector to 1) measure the demand for natural resources and ecosystem services of well-defined ecotourism packages to support all the included activities offered to tourists, 2) identify specific pressure drivers and derive concrete recommendations for improvement, and 3) actively engage with local stakeholders (park managers, service providers and ITOs) as part of the overall DestiMED monitoring process, thus contributing to the development of low impact ecotourism offers in Protected Areas.

While Footprint results with a breakdown by land type (Fig. 2) provides insight on the types of ecosystems being mostly "demanded" by the tourists' activities, the Footprint results breakdown by consumption categories (Figs. 3 and 4) provides a complementary information, indicating which daily tourist activity drives anthropogenic pressures on the various ecosystems. The Food & Drink category represented the largest driver across all 13 packages in both rounds and the highest values were found in those packages serving big amounts of food in general, with a high share of fish and meat products (e.g., Torre del Cerrano). Conversely, lowest Footprint values were found in packages (e.g., Samaria) opting for unpackaged on-farm and/or local food products, or for animal-protein-free light lunches (e.g., picnic) provided to tourists as part of activities (e.g., hiking). Two other factors affecting the Ecological Footprint value of the Food & Drinks category were the mode of production (e.g., non-organic vs. organic), and the origin (e.g., on-farm,

Table 3
General recommendations provided to all PAs to reduce the Footprint value in each category of service of the packages.

anAccommodation	Food & Drinks	Mobility & Transfers	Activities & Services
- Opt for small-scale traditional facilities that pay particular attention to the use of alternative energy sources (e.g., photovoltaic, etc.).	- Shift to lower protein-intensive food (e.g., vegetables, legumes and cereals) - Reduce the amount of food calories provided to tourists and increase the share of food ingredients that are produced locally (e.g., on-farm or within a 60 km radius), and that are fresh and unpackaged - Re-shape of the lunch meals (e.g., favouring picnics) to reduce the volume of food while also freeing-up time for tourists.	- Make use of local public transportation systems (e.g., trains) for the transfers of tourist to and from the airport (or harbour) - Opt for hybrid or highly efficient motor vehicles whenever possible.	- Avoid the use of motor vehicles and limit the number of employees involved in the activity

local, national, or international) of the food served to tourists.

The second largest Footprint driver for the majority of packages was Accommodation and the highest Footprint values were found in those packages (i.e., Menorca) using hotel-type facilities, which require a high number of employees and use a high amount of energy; the lowest Footprint values were found in small-scale accommodations, equipped with an installed self-production system (i.e., photovoltaic as in Colline Metallifere). These findings support the DestiMED Standard criteria for selecting small family-run facilities, which are local, "authentic", and meet both environmental and socio-economic criteria. Nonetheless, a few examples have been found of small-scale facilities (e.g., apartments) with high Footprint values, mainly due to the low energy efficiency (e.g., Kornati in Round 2).

As for the Mobility & Transfers category, the highest Footprint values for this category were found in those packages that included long transfers (more than 100 km) to and from the closest airport (or harbour) and the PA (e.g. Colline Metallifere), or in which multiple airport (or harbour) pickups were required due to the tourists' arrival schedule (e.g., Delta del Ebro). Conversely, low mobility Footprint was found in those packages that minimized the use of private vehicles, favouring instead alternative transport options, such as bikes (e.g., Ulysse Riviera) or public transport (e.g., Calanques); yet the impact of daily transfers to and from activities/hotels was found to be marginal in most cases. When use of motor vehicles was inevitable, lowest Footprint values were found in the packages using vehicles with a motor efficiency of at least 10–15 km/l (e.g., Lastovo) and covering shorter distances (e.g., Circeo). Finally, Activities & Services represented the category with the lowest contribution to the Ecological Footprint as the main factors within this category are the use of motor vehicles in the activities (as it implies the release of CO_2 emissions) and the Footprint associated with the staff involved in guiding or assisting the tourist group along the itinerary (i.e., "labor Footprint", see also section 3.2). The lowest values in this category were found in those packages minimizing (e.g., Albania North and Camargue, both in Round 2) or avoiding at all (e.g., Calanques in both Rounds and Kornati in Round 2) the use of motor vehicles in their activities.

When comparing the Footprint results in the two Rounds, the reason why only 6 out of 7 packages managed to reduce their Footprint can be attributed to the fact that when reshaping packages, LECs members had to also consider recommendations concerning the marketability and quality of the ecotourism packages,[9] which included other criteria and indicators in line with the integrated DestiMED standard (e.g., quality, marketability, coherence, timing and distribution of all the activities scheduled in each package). However, when solely looking at Footprint results, the increase in the value for the Food & Drink category – despite the recommendations given to LECs – was due to an increase in the food quantities offered to tourists, coupled in some packages with an increased offer of highly Footprint-intensive (e.g., Kim et al., 2019; Galli et al., 2020) fish and seafood servings. On the contrary, the Footprint reduction in Mobility & Transfers and Activity & Service was due to a re-arranging of the itineraries to allow for shorter distances to be covered by motor vehicles and a more extensive use of public transport modes and alternative vehicles (i.e., bicycles) in the daily transfers; the use of motor vehicles during activities was also reduced. Likewise, Accommodation Footprint decreased in Round 2 because of the effective implementation of the recommendations provided to the LECs (See Table 4).

Finally, the international travel analysis showed that the Footprint of travel ranged from slightly less than a third (for European tourists going to Kornati by boat and/or train) to slightly more than 8 times (for a non-European tourist going to Colline Metallifere by plane) the Ecological Footprint of a DestiMED ecotourism package. This indicates that the Footprint of travelling to a destination is for the most part higher than the Footprint due to experiencing the ecotourism package at destination. The Ecological Footprint of a tourist travelling by air from a non-European country was found to be on average 4.6 times higher than the average per capita Footprint of a DestiMED Ecotourism package, while the Footprint of a European tourist travelling by air or by ground was 124% and 73% higher, respectively.

6. Conclusions

This article tested the applicability and usefulness of Ecological Footprint Accounting (EFA) to assess 13 ecotourism packages developed in and around Protected Areas (PAs) across the Mediterranean Region, within the context of the DestiMED project. A customized version of Ecological Footprint Accounting was used to quantitatively assess the multiple pressures of the activities included in ecotourism packages through a bottom-up approach – relying on data collected directly from the providers of touristic services – which allowed overcoming the lack of input data that usually affects other tourism-related studies. This innovative monitoring process fostered the engagement with the local service providers, which was key for a punctual data collection and to ensure a participatory process for the development and sustainability monitoring of the touristic offer. The process also offered some initial trainings that turned out as an opportunity for the local stakeholders (mostly the PAs) to get a general understanding of the sustainability topic, and the importance of resource accounting, going beyond the sole knowledge of biodiversity conservation.

Applied to ecotourism packages, EFA allowed identifying the main

[9] Please note that details of the Quality Assessment Plans are not reported in this study as they go beyond the scope of this article. However, they likely influenced the actions implemented by the LECs in revising their packages; this explains why, for a few packages, the Ecological Footprint increased in between the two rounds.

Table 4
Responses of each PA on how they implemented changes in the four categories of services following the recommendations provided to possibly reduce Footprint results in Round 2. Further details on the specific recommendations provided to each PA are reported in Annex 5 of the Supplementary Material.

Protected Area	Accommodation	Food & Drinks	Mobility & Transfer	Activity & Service
Albania North Shkodra Region Parks (Albania)	In order to represent the authenticity and also the tradition of the area Tradita Hotel and Shpella were the appropriate choices. In the future, it is suggested to train hotel owners on basic sustainability principles and ease their integration in the hotel/guesthouse's management.	Several meetings were held with the service providers to discuss the high quantities of food served and options to reduce them The restaurants selected for the package were local restaurants During the meals the water was quite always served in jug or glass water with the exception of just one case in Velipoja	Transfers with vehicles were reduced as much as possible. The sites were reached by bike or walking	The bikes and walking were used as much as possible. In the future, it might be an idea to include a kayak activity when doing Shkodra - Shiroke
Albania South Vlora Region Parks (Albania)	Hotel Regina was replaced with Hotel Picasso which is more eco-friendly and has also a small yard for growing vegetables. We kept the second accommodation in Sofo, also due to its traditional kitchen.	Local coordinators recommended to use food coming from short distances, reducing as much as possible the food coming from long distances. The ITO committed to equip tourists with reusable water bottles. In general, food quantity was reduced as much as possible. Meat was reduced in all meals, except in the experience with the shepherd hut, because it was important to show the tradition of the area in serving the meat.	One single vehicle with higher fuel efficiency was used during the entire stay. The hotel Picasso was chosen in a way that the testers did not have to take any vehicle to go to the Visitor Centre in Radhime	Some activities were cut (e.g., Archeological site of Oriku and Monument of Blue Eye).
Kornati Islands National park (Croatia)	Sailing boat was avoided completely. Accommodations in Murter and Kornati island have solar system and a water cistern	One meal was based on only vegetables and cheese options. For fish-based meals, lower trophic-level seafood was served (sardines, prawns, oysters, mussels) Meals served during the tour were traditional meals, adhering to the local cuisine tradition Plastic bottles and dishes were avoided as much as possible and plastic bottles solely were used in Kornati due to the lack of running water	All testers were moved all at once on one single van avoiding multiple pick-ups For transfer from accommodation in Murter to accommodation in Kornati a traditional wooden boat was used.	Only one activity (Diving Tour) included a motor vehicle (motorboat) as that was the only option for transport from the diving school to the diving location. The presence of 3 workers during this activity was needed to guarantee the safety of the testers
Lastovo Islands Nature Park (Croatia)	The campsite accommodation was replaced by an apartment. New accommodations are high-class apartments that include air conditioning and swimming pool, the building is also equipped with a solar water heater and a biological septic tank.	Mostly local food was provided in the second round The quantity of the food served per meal was reduced and more options for vegetarian meals were given To reduce plastic, testers were asked to use their private reusable water bottles since the tap water on the island is drinkable. Also, reduction of other packages, e. g., jam and marmalade, was done by serving domestic products without disposable packaging.	No public transport is present on the island nor financial resources are available for hybrid vehicles. The number of car trips were reduced	Same as mobility
Calanques National Park (France)	The first accommodation (urban youth hostel) was changed for two eco-friendly lodges nearby the park. The rustic refugee was maintained.	No implementations since the package already had one of the lowest food EF value (out of the 13 PA analysed). Meals consisted in picnics mostly based on vegetal protein and local restaurants in the afternoon.	Transfers reduced because of the reduced number of activities during the day.	Only one activity per day was planned instead of two.
Camargue Regional Nature Park (France)	Same accommodation maintained More info was given about the typology of accommodation to tourists in the pre-departure document and explanation on its functioning given by the owner on the first day	Some "food activities" were removed, like the cook lesson, the lunch in the oyster farm and the snack in Marais du Vigueirat The menu and the packaging of the picnic was revised to use biodegradable packaging The quantity of food for lunch time was reduced	Distances with the van were reduced The cycle tour is maintained. However, the loop approach was not possible because of the territory.	The tiki boat activity has been removed to spend more time with local organic farmers More conservation activities in the Park were planned with park guides/managers More time was dedicated to specific activities
Samaria National Park (Greece)	An eco-friendlier facility was chosen for the first night. Other facilities remained the same since they were small scale ones. All facilities in the area were included in a nationally funded program for reducing energy by substituting appliance, changing windows and doors, initiating small renewable energy sources etc.	Most of the served food was produced on farm or locally (up to 60 km and even less). Meat and protein food were reduced to one meal per day. Only one meal of the package was based on low-trophic level seafood; Vegetables and legumes consumption was implemented as well as the	Presence of PA staff was reduced to lower the total movement of the PA's vehicles Motorboat transfer excluded from the package	PA staff did not participate as much as in Round 1 in some of the activities

(*continued on next page*)

Table 4 (*continued*)

Protected Area	Accommodation	Food & Drinks	Mobility & Transfer	Activity & Service
		suggestion to favor "on farm" and/or local organic food. Lunch breaks were slightly reduced in time and portions		
Colline Metallifere Tuscan Mining UNESCO Geopark (Italy)	Two different accommodations were used in Round 2 to avoid using the motor vehicle on the first day	Plastic bottles avoided use was avoided Option for recipes requiring a shorter cooking time More fresh fruits and vegetables introduced Request to reduce the amount of food served The use of any kind of pre-packed food was banned	Use of motor vehicle avoided on first day. A re-call training to improve the skills in eco-driving were asked to the driver Good practice: Eco-driving License (−20% CO_2 emissions)	Two guides were employed only on the first day, and thus staff was reduced compared to R1 for some of the activities
Torre del Cerrano Marine Protected Area (Italy)	Two family-run small facilities were selected in place of two hotels of Round 1. The third hotel "friend of the Protected Area", was kept from Round 1 given its considerations for water and energy consumption.	Operators were asked to reduce the contribution of proteins during the meals Quantity of food was reduced All lunches were provided in the "tasting" mode which required a reduced cooking time Two dinners were included as activities such as workshop and meetings with locals	Use of moto vehicles was reduced On the arrival day, transfer from Rome to the PA (Silvi) was made through a vehicle already based in Rome E-bikes were mainly used throughout the package Return to Rome was made by train	All activities were made on foot or by bike
Circeo National Park (Italy)	The hotel was changed as the ITO enforced a collaboration with agritourisms, which then became the main accommodation sites LEC choose to re-test three agritourisms, paying attention to the work they did to improve their services from Round 1 to Round 2	The time taken for lunch was reduced. Almost every meal was a tasting of typical local products. Most of meals were prepared in agritourism using ingredients produced on farm.	LEC decided to cover some transfer distance by e-bike or by walk. Vehicles, were used only when there was no other alternative	All activities of the package were still done without the use of a motor vehicle. To increase the quality of service provided, the guides for bike transfers were certified Mountain bike guides that followed testers during the entire bike route.
Riviera di Ulysses Regional Park (Italy)	The type of accommodations were completely changed to provide more environmental sustainability	More vegetables, carbohydrates and legumes were added to the diet to reduce fish products The change in the accommodation formula had also the purpose to enforce the use of food coming from a short distance, even 0 km with their own production, to limit transportation and reduce carbon emissions Quantity of food was reduced through picnic/take away solutions when possible	Bike was used as much as possible to cover the short distance transfers, also to foster muscular activity.	The goal was to keep the activity & services at the same level of Round 1.
Natural Park of Ebro Delta (Spain)	Same accommodation chosen for Round 2	Quantity of food was reduced in some meals The use of plastic in restaurants and activities was avoided.	Bikes or e-bikes were provided in the place of the accommodation, and used during the package Alternative modes of transportation from the airport to the PA were used in Round 2: a more efficient van and public transport such as Bus (regular line).	Some activities were changed to use sailing boat instead of motorboat The boat ride was done with a charter boat having 12 seats for a group of 10 people For each activity, advices and messages about sustainability were given
Menorca Biosphere Reserve (Spain)	Two agritourisms with sustainable policies were selected for the package	The intake of highly caloric foods was considerably reduced, shifting to more light meals The typical Mediterranean diet of the island was considered, local products were used, menus were kept as varied as possible Food quantities were reduced considering the actual needs of the participants and to avoid food waste	Public transportation was used on the day of arrival as well as on the departure day Bicycles were used on the last day	The use of motor vehicles was reduced as much as possible A few activities that needed polluting vehicles were removed from the package

ecosystems under pressure as well as the main drivers causing such pressures. This information proved to be useful to each LEC to understand the actual impacts caused by the packages offered in their territory, and – when combined with tangible recommendations for improvements – to help adjust the services offered in the packages to possibly reduce environmental impacts. When comparing results from the two rounds, it was found that results and recommendations provided by the Ecological Footprint methodology were useful to decrease the impact of some categories, although about half of the Protected Areas didn't experience a reduction in their Footprint value. This was the case in those areas in which major improvements on the quality of the services and the overall experience offered to tourists were needed (e.g.,

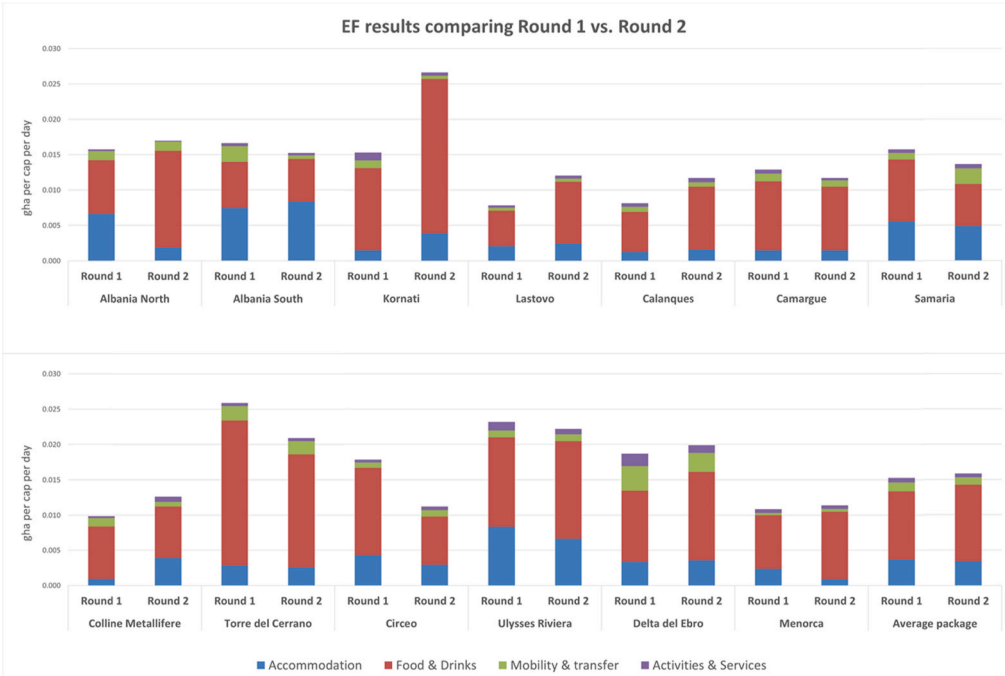

Fig. 4. Daily Ecological Footprint results per tourist of 13 ecotourism packages, comparing Round 1 and Round 2 and showing the results by category. The last two columns show the Footprint value of a calculated average package.

rescheduling the sequence of activities; replacing non-satisfactory facilities/activities) so that the overall quality of the ecotourism packages could meet the DestiMED standard.

Such dynamic reflects the intrinsic nature of sustainability – in tourism as any other sector of our economies – that necessarily needs to be addressed transversally, considering trade-offs among activities as well as all sustainability dimensions (i.e. environment, social and economic) and product quality. It should also be noted that once the desired level of quality is reached and maintained, a continuous Footprint reduction might be achieved as a result of either a general spreading of less resource-demanding practices or because service providers are stimulated to improve their own practices to adhere to the expectations of travellers and increase their market readiness. To allow a monitoring process in the long run, DestiMED project partners developed an online platform to digitalize and streamline the data collection process and automatize the overall monitoring process, including all quality and sustainability indicators as well as a specific online calculator for the Ecological Footprint assessment of ecotourism packages developed within Protected Areas.[10]

Interestingly, results from the Footprint assessment at destinations revealed *Food & Drinks* to be the major driver of the total Footprint value in all packages. This was new to LEC members in most of the PAs, as they envisioned *Mobility* and *Accommodations* to represent the main drivers of environmental pressure at the start of the process, when conceiving the first version of packages. Furthermore, despite the recommendations provided after Round 1, the majority of the LECs were not able to significantly reduce the Food Footprint of their packages, likely because of the typical Mediterranean habit of serving large portions of (mainly protein-based) food.

As experiencing food is increasingly becoming a reason for travelling and a factor influencing the selection of destinations by tourists (Andersson et al., 2017), our findings call for the need to raise the awareness of key tourism-related actors on the sustainability of food provisioning. They also contribute to the broader debate around the sustainability of food production and consumption systems in the region, providing further evidence to support the transition towards more sustainable Mediterranean food systems, in line with the objectives of the UN Agenda 2030.

In the meetings between technical partners and LECs members to present the outcomes of Round 1 and develop improvement plans for Round 2, Ecological Footprint results were found useful to shed light on such sensitive and underestimated issue and trigger new understandings to the local stakeholders. Although the Footprint application helped frame a fruitful discussion among all local actors – PA managers, ITOs and service providers – to reshape their offers in an effort to develop a low-impact ecotourism in their territory, the fact that about half of the PAs did not manage to reduce the Footprint of their offer calls for the need of more specific sustainability trainings that may practically speak to the local actors and make them overcome the difficulty to understand the issues at stake as well as lead their choices towards a more sustainable path.

Finally, along with managing and reducing the Footprint caused by the stay at destination, a sustainable tourism planning and management need to take into consideration the "travel-to-destination" aspect. The results of the international travel Footprint support the conventional view that transport to and from a destination produces the highest Ecological Footprint (primarily in its carbon component), and that the most important carbon savings can be achieved by shifting from air to ground travel, particularly train. This aligns with the study of Filimonau et al. (2014) which identifies rail as the least carbon-intense scenario.

Results of the Footprint assessment may also be viewed within a broader global context, wherein tourist destinations, tour operators, and service providers are increasingly being required to better account for – and transparently communicate – the specific and measurable environmental impacts associated with servicing the tourism economy. This is due to an increasing demand from travellers, investors, the conservation sector, and local residents, to understand and report on sustainability performance and the mitigation of tourism burdens on resources

[10] Visit https://www.iucn.org/news/mediterranean/202011/meet-network-launches-online-training-develop-ecotourism-protected-areas for further info on the e-learning platform and https://www.meetnetwork.org/calculator for the Ecological Footprint calculator applied to ecotourism packages.

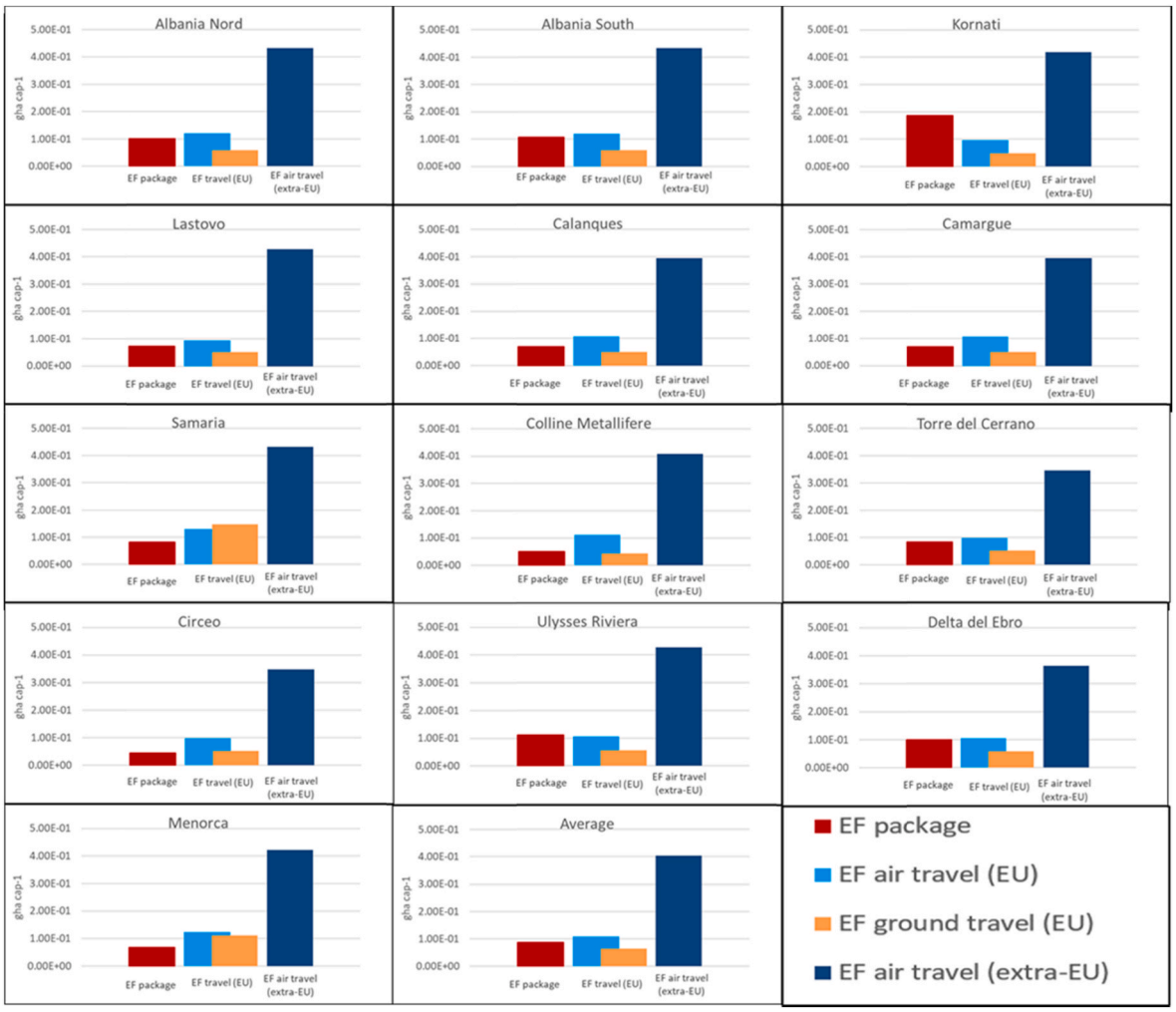

Fig. 5. Package and international travel Footprint comparison, expressed in gha per tourist. Each graph compares each pilot action's package Footprint with the per capita air and ground travel Footprint from both European and non-European (extra-EU) departures.

and communities.

Alongside the challenge tourist destinations face in better balancing tourism's economic contributions with its environmental impacts, the reality of the climate crisis and new legislation such as the European Green Deal will also require the sector to find tangible ways to decarbonise its activities and significantly reduce emissions and demand for natural resources in the coming years. Achieving these broad objectives will require significant investment in scaling-up practical solutions and building the capacity of governments and businesses to localise supply chains, account for impacts, and engage in better destination stewardship. In this context, global initiatives such as the Future of Tourism Coalition and Tourism Declares a Climate Emergency, have already recognized the Footprint assessment for its concrete approach and applicability in tackling these challenges.

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Appendix A. Supplementary data

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