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Tesis Doctoral
Ecosystem Services Evaluation: the case of the brown bear

Evaluación de los servicios del ecosistema: el caso del oso pardo

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A thesis presented in fulfilment of the requirements for the degree of Doctor of Philosophy

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English summary

This doctoral thesis contributes to the interdisciplinary field of conservation social science and environmental economics by examining the alpine environment and the presence of brown bears in Italy. By integrating methods from conservation biology, environmental modelling, and economics, this work provides information on ecosystem service valuation (ESV) and its role in shaping EU policy and community engagement.

A key outcome of this research is the holistic framework developed to link conservation evidence with economic valuation techniques. The study highlights the role of the brown bear as a flagship species that can promote public awareness and contribute to conservation efforts. The results presented across the chapters demonstrate the strong interconnection between ecosystem functions, social acceptance, and the economic value of biodiversity.

One of the main contributions of this thesis is the comprehensive evaluation of bear-related ecosystem services (ESS). While similar studies exist for Europe and the US, significant knowledge gaps remain in other regions. Cultural ecosystem services, in particular, are still under explored and this work helps address this gap. The findings from this research informed the selection of realistic attributes and levels for the discrete choice experiment (DCE) through a thorough pre-survey process involving global literature reviews, expert discussions, and focus groups.

The framework developed in this research proved to be effective. Ecosystem services and ecosystem functions are often difficult concepts for people to grasp, but by designing the DCE around tangible benefits, respondents were able to make meaningful choices. This confirms the utility of a well-structured valuation approach in capturing public preferences.

The DCE was designed with methodological rigour, resulting in a higher willingness to pay (WTP) compared to other studies and produced statistically significant coefficients. The importance of forest diversity and berry availability was found to outweigh concerns about safety, even in light of recent fatal accidents, indicating that fear is not a dominant factor in public perception.

However, while DCE is a powerful tool that delivers valuable socio-demographic insights, it also has limitations. It is among the most resource-intensive approaches in terms of both time and cost. Additionally, certain links between choices and individual decision-making processes were not fully disentangled. Future research may benefit from integrating deliberative participation methods or other qualitative approaches to complement the findings and provide a more nuanced understanding of public preferences. Such methods could further refine policy recommendations and management strategies to balance conservation efforts with social acceptance.

In general, this research improves the understanding of human-wildlife interactions in the context of ecosystem service valuation and offers valuable contributions to both academia and policy making. The insights gained here can inform more effective and socially acceptable conservation strategies for large carnivores, particularly in regions undergoing rapid ecological and socio-economic changes.

Resumen en Español

Esta tesis doctoral contribuye al campo interdisciplinar de las ciencias sociales de la conservación y la economía medioambiental, examinando el medio ambiente alpino con un enfoque específico en la presencia del oso pardo en Italia. Mediante la integración de métodos de biología de la conservación, modelización ambiental y economía, se analiza la valoración de los servicios ecosistémicos (VSE) y su papel en la elaboración de políticas de la UE, así como en el compromiso de las comunidades. Uno de los principales aportes de esta investigación es el desarrollo de un marco holístico que vincula la evidencia en conservación con técnicas de valoración económica. El estudio destaca el papel del oso pardo como una especie emblemática capaz de sensibilizar al público y contribuir a los esfuerzos de conservación. Los resultados presentados a lo largo de los capítulos demuestran la fuerte interconexión entre las funciones de los ecosistemas, la aceptación social y el valor económico de la biodiversidad. Una de las contribuciones más relevantes de esta tesis es la evaluación exhaustiva de los servicios ecosistémicos (ESS) relacionados con los osos. Si bien existen estudios similares en EE.UU., aún persisten importantes lagunas de conocimiento en otras regiones. En particular, los servicios ecosistémicos culturales siguen estando poco explorados, y este trabajo contribuye a reducir dicha brecha. Los resultados de esta investigación sirvieron para la selección de atributos y niveles realistas en el diseño del experimento de elección discreta (EDC). Este proceso se llevó a cabo mediante una rigurosa encuesta previa, que incluyó revisiones bibliográficas globales, debates con expertos y grupos de discusión. El marco desarrollado en esta investigación demostró ser eficaz. Los ecosistemas y sus funciones suelen ser conceptos difíciles de comprender, pero al estructurar el EDC en torno a beneficios tangibles, los encuestados pudieron tomar decisiones significativas. Esto confirma la utilidad de un enfoque de valoración bien diseñado para captar las preferencias del público. El EDC se diseñó con rigor metodológico, lo que resultó en una mayor disposición a pagar (DAP) en comparación con otros estudios y en coeficientes estadísticamente significativos. Se observó que la diversidad forestal y la disponibilidad de bayas fueron aspectos más valorados que la preocupación por la seguridad, incluso tras recientes accidentes mortales, lo que indica que el miedo no es un factor dominante en la percepción pública. Sin embargo, aunque el EDC es una herramienta poderosa que ofrece valiosas perspectivas sociodemográficas, también presenta limitaciones. Es uno de los enfoques que requiere mayores recursos en términos de tiempo y costes. Además, persisten desafíos en la comprensión de ciertos vínculos entre los servicios ecosistémicos y los procesos individuales de toma de decisiones. En general, esta investigación contribuye a una mejor comprensión de las interacciones entre los seres humanos y la fauna salvaje en el contexto de la valoración de los servicios ecosistémicos. Sus hallazgos aportan información valiosa tanto para el ámbito académico como para la formulación de políticas, ofreciendo estrategias de conservación de grandes carnívoros más eficaces y socialmente aceptables, especialmente en regiones que experimentan rápidos cambios ecológicos y socioeconómicos.

Acknowledgements

Chapter 1

Valuing Nature through ecosystem services

1.1 Valuing Nature

The current historical period is called the Anthropocene, an era dominated by human impact. According to geologists, this definition is given to the period during which human activity has been the dominant influence on climate and the environment. According to some scientists, this geological era started with the Industrial Revolution. Although the International Union of Geological Sciences (https://www.iugs.org/) debates whether it is a proper geological era or not, the planetary effects that human activities have on the environment are evident: pollution, climate change, and biodiversity loss are widely recognised by the scientific community as human-induced impacts.

Since the 1970s, scientists have produced a lot of studies and research about the causes and dynamics of biodiversity loss and how to restore it. The word "conservation biology" was devised during the "The First International Conference on Research in Conservation Biology", in 1978, by American biologists Bruce A. Wilcox and Michael E. Soulé (Soulé, 1985).

For some people, Nature conservation is a philosophy, a moral duty with many and various nuances, from the underlying idea that Nature has an intangible value and also an utilitarian one.

Shortly after the introduction of "Conservation biology", in the 1980s the term "Ecological economics" was also created and shortly after the Ecological Economics journal, whose first director was Robert Costanza (Røpke, 2004). Costanza is one of the first and most important ecological economists, known for his work on the seminal paper on Nature entitled "The value of the world's ecosystem services and natural capital" Costanza et al., 1997. An **ecosystem service** (ES) is a benefit that humans get from nature. These services come from natural ecosystems and support human well-being in different ways (Costanza et al., 1997; Westman, 1977). For example, forests provide timber , clean the air , offer hiking opportunities, and support biodiversity. The concept of ecosystem services (ESS) (Gómez-Baggethun et al., 2010) will be discussed in detail in Chapter 2.

This seminal paper by Costanza et al., 1997 emphasises the necessity of introducing economic evaluations to nature and to the services it provides to human well-being, such as clean air, water, food, and others. The main reason for valuing nature, according to the review by Martin-López et al., 2008 is to correct market failures, that is, the fact that markets fail to capture the value of nature, so economic

valuation can provide trade-offs between different development alternatives.

Concerning species conservation, giving them value opens more possibilities for the implementation of conservation policies, providing useful information to policy makers on biodiversity conservation (Martino & Kenter, 2023). Additionally, when nature or species have a monetary value (Ehrlich & Ehrlich, 1981), it is possible to develop incentives toward environmentally friendly attitudes or build, compensation schemes or credits, such as Carbon off setting.

When speaking of the economic value of nature, it is not as straightforward as in the case of a traded goods or services. Nature services are not exchanged on markets, thus no observed market price. Therefore, economists have developed non-market valuation methods to address this gap, but there is not a single price to obtain; in fact, there are different values for an ecosystem which can be distinguished as follows (Bonner, 2022; Plottu & Plottu, 2007):

- **Total economic value** is a concept derived from the theory of cost-benefit analysis. It is defined in environmental economics as an aggregation of the (primary function-based) values offered by a specific ecosystem.

- **Use value** it is a concept coming from the classical economy that refers to tangible features of a product. In the framework of ecosystem valuation, it refers to the value of a good that can be obtained **directly** from nature such as crops, timber, and water. By contrast the **indirect use-value**, is obtained without physical removal: for instance the view of a beautiful landscape.

- **Option value** exists when as an option for future use, even if it is not currently used and future use is uncertain.

- **Non-use value** Individuals may never use this resource, but they simply gain satisfaction from its existence (Existence value). For example, maintaining whales or the Amazon forest . The bequest value extends to the future since it is the value placed on preserving a resource for the benefit of future generations

In this work, this classification is taken as a reference to estimate some single values and the total values related to the presence of bears in the wild.

While this thesis focuses on values framed within the Total Economic Value (TEV) , it is important to acknowledge the broader spectrum of value frameworks discussed in the literature. In particular, the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has advanced the understanding of plural values of nature, including intrinsic, relational, and instrumental values (Pascual et al., 2023; Vilá et al., 2022), highlighting the importance of integrating diverse world-views and knowledge systems in environmental valuation.

In recent decades, economic valuation of nature has become increasingly interdisciplinary, integrating diverse scientific and humanistic disciplines to address complex environmental problems. The economic value of nature has evolved, with a growing recognition of the integration of cultural and social values into economic analyses, and led to another new approach proposed by Bennett et al., 2017 as Conservation Social Sciences. Conservation social science is an interdisciplinary field that applies social sciences to understand and improve conservation policy, practice, and outcomes (Manfredo et al., 2021; Mascia et al., 2003). It integrates human dimensions into conservation and environmental management to produce effective policies, actions, and results (Bennett et al., 2017; Dietsch et al., 2016).
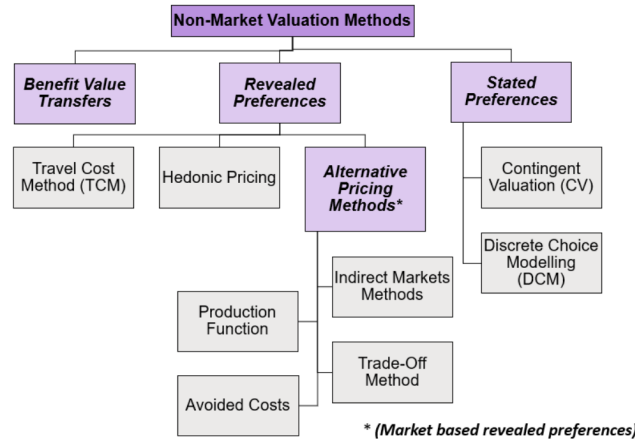
Figure 1.1: Non-Market Valuation Methods, from Bonner, 2022

Economists have started to recognise the importance of biodiversity and ecosystems in global economic discussions. This emphasis is evident in various international forums, including the G8 and recent United Nations Biodiversity Conferences (COP). For example, in 2007, during the G8+5 summit in Potsdam, the importance of valuing biodiversity was underscored, leading to the launch of The Economics of Ecosystems and Biodiversity (TEEB) initiative. During the 2024 World Economic Days in Davos, economists and global leaders stated that addressing biodiversity loss is crucial for sustainable economic development. Again in 2024, the United Nations Biodiversity Conference (COP16) in Colombia further emphasised the economic aspects of biodiversity conservation, even among difficulties and different consequences.

The progress observed in international conferences such as the G8, WED, and COP16 underscores a significant movement toward incorporating economic aspects within biodiversity and ecosystem conservation, reflecting a recognition of their vital importance in sustainable development. Therefore, the subject matter of this dissertation aligns with these global objectives.

1.1.1 Methodologies to value Nature

Although they are not bought and sold, nature's non-market goods and services significantly contribute to human welfare and are essential for conducting cost-benefit analyses. Therefore, despite the absence of a market price, considering the economic value of these non-market goods and services remains crucial. Figure!1.1 provides an overview of the methods used to evaluate non-market goods.

One of the key concepts in the evaluation of non-market goods is Willingness to Pay (WTP), which is the maximum price an individual is willing to pay for a good or service. It represents the perceived value of that good or service to the consumer and is widely used in economics, marketing, and choice modelling.

The concept of WTP originates from early economic theories of utility and demand. An early seed was discussed by Adam Smith (1776) in The Wealth of Nations, where he discussed value in use versus value in exchange. Only in the 19th century, the Marginal Utility Theory was formally stating that consumers derive different levels of satisfaction (utility) from goods, influencing how much they are willing to pay. Later, McFadden 1974 refined the Random Utility Theory. In the

random utility framework, an individual is assumed to maximise utility by choosing the alternative with the highest utility from a given choice situation that is used in the state preference model (International Encyclopaedia of the Social & Behavioural Sciences https://www.sciencedirect.com/referencework/9780080430768/international-encyclopaedia-of-the-social-and-behavioural-sciences).

There are three primary methodologies employed for estimating the overall value of goods that do not have a market price:

- **Benefit Value Transfer** A similar good or service must exist in the private market. For example, waste water depuration. The information is then used to estimate the value of that good or service provided by Nature for free or the avoided cost not sustained.

- **Revealed preference** A person gives preference to alternatives based on her relative utility. Revealed preferences are preferences revealed by studying real decisions people make (measured by their actions) .

- **Stated preferences** people are asked about their willingness-to-pay or willingness-to-accept under a series of hypothetical decisions.

Revealed preference

Common methods used to derive the preferences, also in conservation studies, are : Hedonic Pricing Method, Travel Cost, Hedonic pricing based on the assumption that the value of non-market goods and services is partly reflected in the price paid for an underlying asset, good, or service Then a function is fit between the price as the dependent variable and the attributes of the good serve as independent variables. The coefficient on the non-market attribute indicates the willingness to pay (WTP) for a unit change. The main disadvantages of this method is defining the function and all inputs in the regression model must be measured without errors to ensure the analysis is sound and there are no multicollinearity issues. This method is rarely used in conservation studies (2%) (Garrod & Willis, 1992; Martino & Kenter, 2023), except in some cases for hunting licences Bostedt and Grahn, 2008.

Travel Cost Method is a revealed method based on the expenses incurred to travel to natural destination such as parks and wilderness areas as a proxy for the value of the good. The number of visits is a function of the travel cost and socioeconomic variables. This method has been used in conservation studies, especially for charismatic species, as the vulture Becker et al., 2005 is used in about (19% of wildlife studies). The travel cost method has some limitations, because it often includes only the use value, not the total value, by overlooking the use value of people living near the site of interest and the non-use value.

Stated preference

Concerning the estimation of WTP for nature conservation, the beginning can be set in the 1980s and 1990s: The studies focused on identifying which factors were influenced (WTP) for wildlife conservation. After the year 2000s, Contingent Valuation (CV) became the most used method for measuring the economic value of species, according to the review by Martin-López et al., 2008 50% of examined studies used it.

Contingent valuation is used to estimate the economic value individuals assign to non-market goods or services by directly asking them their willingness to pay

(WTP) or willingness to accept (WTA) compensation under hypothetical scenarios. Typically implemented through surveys, CV allows for the valuation of environmental goods, public services, or changes in policy that lack observable market prices. Surveys are influenced by the context in which they are conducted; in other words, estimated values can be affected by various components of the questionnaire's design. Certain elements of a survey are typically assumed to have no impact on the responses, such as inquiries related to family size, as these should not change an individual's answer to the willingness-to-pay (WTP) question. However, other elements influence how respondents assess value (P. W. Bateman & Fleming, 2017). Among these factors are the way benefits are measured, the method or vehicle of payment, the manner in which information is collected (referred to as the elicitation method), and the timing when payment is made (Martin-López et al., 2008). Another limitation of this method in conservation studies is that apparently the estimates of values are sensitive to the population size of endangered species (see 1996 Loomis & White's meta-analysis by Martin-López et al., 2008. CVM has some limitations: firstly, subjectivity as questions often involve hypothetical scenarios, results may not be realistic. Second, there may be differences between willingness to pay and willingness to accept, which depend on how the questions are designed. Finally, it has high operational costs because, in order to be significant, it requires many surveys.

Discrete Choice Experiments (DCE) are methods of evaluation of stated preferences. DCEs originated from conjoint analysis, were initially used in the fields of marketing, transportation, and psychology, DCEs have since become a key methodology in economics and decision sciences (Louviere et al., 2000). The main feature of DCE is that people are requested to choose between alternative groups of attributes of a certain good. This choice-based approach aligns with random utility theory (RUT), which models decision making under uncertainty (McFadden, 1974).

The attribute value theory is the basis of DCE. Lancaster, 1966 set the basis for it, hypothesising that consumers derive utility from individual attributes of a good rather than the good itself. In DCEs, goods are decomposed into attributes, with price often included as one of them to estimate willingness to pay (WTP). Hanemann has made significant contributions to the theoretical development and application of this method Hanemann, 1989.

The direct utility is derived from the consumption of goods. The following utility function measures the preferences consumers apply to their consumption of goods and services.

Utility function :

$$U_{ij} = \alpha + \sum_{z=2}^{z} \beta_z X_{jz} + \epsilon_{ij} \qquad (1.1)$$

.

Where U_{ij} is the utility for the individual i considering the alternative choice j with the X attributes of the Z levels. The decision maker is assumed to know its utility U, while the observer is assumed to be ignorant. ϵ reflects analysts' ignorance of the choice situation that is dependent on the context, non-observable characteristics, measurement errors or misspecification.

Hanemann's work is a cornerstone of discrete choice modelling, where individuals are assumed to maximise their utility by choosing the alternative with the highest utility from a given set of options. Hanemann developed the value characteristics theory, where goods are broken into attributes, and is applied to choice experi-

ments (Hanemann, 1989; Welsh & Bishop, 1993). Later Haneman, but also Hess and Train, 2017 contributed in the development of mixed MNL models for discrete response data. At the beginning, DCEs have been widely applied across various sectors, including cultural economics, such as assessing public preferences for cultural heritage conservation, considering both economic and cultural values (Throsby, Zednik and Araa 2021)), Health economics, for evaluating patient preferences for medical treatments (Ryan et al., 2001) and transportation.

In early 2000 discrete choice experiments gained more popularity outside the economic field and started to appear in the conservation science literature. However, only about 27% of the conservation studies used DCEs approach to value ecosystem services, biodiversity, and conservation policies , as reported in the review by Martin-López et al., 2008. As shown in chapter 2, the number of studies using this approach to single species of carnivores is very few. Thus, there is room to improve the methodology for the application of DCE in the specific case of single-species evaluations.

Although DCEs are widely used for preference elicitation and policy analysis, as with all methods, they have some limitations and pose challenges. As all methods based on interviews, time and expense are a limit to obtain statistically significant sample. There are also some intrinsic limits in the theory; some can be addressed mathematically and others by careful design. Firstly , DCEs rely on stated preferences rather than actual market behaviour, thus respondents may not behave in the same way in real-world situations.

The DCE survey involves evaluating several choice cards and multiple attributes and levels, leading to fatigue. Respondents must evaluate multiple choice sets with different attributes and levels, which can be cognitively demanding. This may lead to ignoring certain attributes or loosing focus in the latest cards.

The issue of preference heterogeneity arises when the choices vary across the respondents and over time. DCEs assume that individuals have constant preferences. Mixed Logit (MIXL) and Latent Class (LC) models address this issue, even if capturing preference heterogeneity remains a challenge.

In 2007, Spash coined the term **Deliberate Monetary Valuation (DMV)**, a valuation approach that combines economic valuation with public reasoning. This method is still a stated method, but it differs from the above-mentioned stated preference approaches (i.e. CV and DCE). As the name says,it incorporates deliberation, participants are supposed to discuss values in groups before stating their WTP/WTA. DMV aims to capture a broader range of values, including moral stances, through reasoned discourse in small groups. It can lead to different value indicators such as deliberate individual WTP and social WTP. Despite the articulated and consensus-based evaluations that this method can provide, there are some limits to this approach. First, the amount of time and different professionals needed to run and organise the meetings. Second, the difficulty in ensuring that all relevant viewpoints and interests are included in the deliberative process and finally the limited number of studies that used this approach in conservation Martino and Kenter, 2023 Therefore, in this work I preferred to use more consolidated approaches.

1.2 The bio economic model

The economic valuation of nature has become increasingly interdisciplinary, integrating diverse scientific and humanistic disciplines to address complex environmental problems. One way to address this multidisciplinary approach is the so-called bioe-

conomic model. This is a mathematical framework that integrates biological and economic processes to analyse the management and sustainability of renewable and non-renewable resources. It is commonly used in fisheries, forestry, agriculture, and wildlife conservation to assess how human activities affect natural resources and how economic incentives influence resource use.

As the name says, it integrates a component that describes the biological aspects of the study, for example growth model or population ecology, and an economic component that can include revenues and market dynamics affecting resource use. Dynamic bioeconomic models include time-dependent factors such as population growth and harvesting.

The classical example is about the fish stock. The biologic component models how fish stocks grow and respond to harvesting, while the economic component models how fishers respond to costs, prices, and regulations. These models help determine sustainable harvesting strategies and assess the impact of policies such as quotas, taxes, and restrictions on fishing effort.

Bioeconomic theory and case studies can demonstrate how catch shares can reverse the global trend toward widespread collapse (Costello et al., 2008).

The underling idea is that without regulation, overexploitation of the resources will occur, until profits approach zero (Tragedy of the Commons) as in Gordon, 1954

Including management and limitation into the model the equations can be fit to produce the Maximum Economic Yield, i e harvest level that maximizes long-term profits (Clark, 1990) or . Maximum Sustainable Yield the largest catch that can be sustained over time without depleting the stock. This theoretical approach has been applied also but not limited to forestry, in order to balance timber production with ecological conservation, and to wildlife conservation: Managing endangered species and ecosystems.

1.3   Ecosystem services

An ecosystem service is a benefit that humans get from nature. These services come from natural ecosystems and support human well-being in different ways (Costanza et al., 1997; Westman, 1977). For example, forests provide timber , clean the air , offer hiking opportunities, and support biodiversity.

In this chapter and in all the thesis, the Common International Classification of Ecosystem Services (CICES, Haines-Young and Potschin, 2018) that suggest a sn organisation of the ESS as follows:

Provision: All the outputs from ecosystems that can be exchanged, traded, or directly consumed by people. This category includes, for example, nutrition (food and potable water), water supply and materials for manufacturing. For example, timber, game meat, wild fruits.

Regulating and maintenance services refer to the ways ecosystems control or modify the biotic or abiotic parameters of the environment. This includes, for example: regulation of the biophysical environment, such as nutrient cycle, and regulation of the biotic environment, such as pollination, seed dispersal, population control including pests and diseases.

Cultural services All the non-material, and normally non-rival and non-consumptive, outputs of ecosystems. This includes Existence, bequest value, non-market value, culture or heritage, religious value of bear, symbolic, use
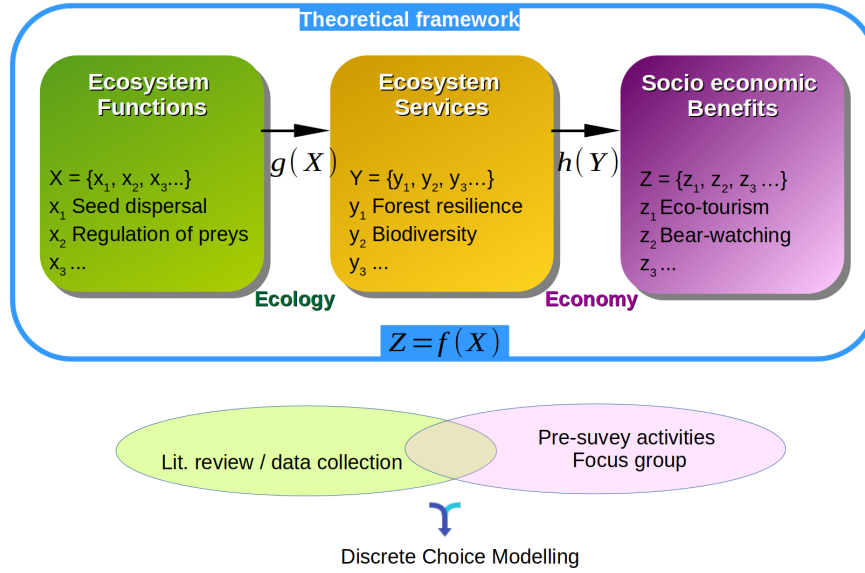
Figure 1.2: The inter-disciplinary framework designed for this thesis making explicit the links between the ecosystem services provided by bears and their perception by the society. Nature's processes create valuable services, which ultimately benefit people and society.

in logos or brands Educational and Scientific. They also include recreational activities such as watching wildlife, traditional ecological knowledge. The increase of scientific knowledge is also considered a cultural service; for example, the pollen record allows the knowledge to increase about past climates and habitats.

Each main category is further subdivided into specific groups and classes, allowing for a more detailed understanding of the various ecosystem services but is not reported here.

1.3.1 The ESS function benefit approach

The inclusion of social and economic aspects in biodiversity conservation has been widely advocated by both conservation biologists and economists to provide policy makers with the tools necessary to evaluate different decisions (Laurila-Pant et al., 2015).

This work developed an interdisciplinary framework to assess the benefits derived from the presence of the brown bear, Figure 1.2. The conservation of large carnivores is a priority at European levels (92/43/CEE Habitat Directive), and the Commission encourages the adoption of best practices and tools that promote co-existence.

The ecosystem services cascade model was originally proposed by Haines-Young and Potschin, 2010 to conceptualise the links between ecological structures and functions, ecosystem services, and human well-being. A more recent elaboration integrates this cascade within a broader natural capital framework to inform policy and decision-making (I. J. Bateman & Mace, 2020). Although the model has been widely applied at the landscape and ecosystem levels, its application to the value of a single species, as proposed in this thesis, appears to be novel.

Figure 1.2 represents a theoretical framework that connects ecosystem functions, ecosystem services, and socioeconomic benefits as a series of functions. Natural processes (X) lead to services (Y), which then translate into human benefits (Z). This is shown mathematically as: Z=f(X) Z=f(X) Meaning that socioeconomic benefits (Z) are functions of ecosystem functions (X).

Ecosystem Functions (Green Box) The natural processes and interactions that occur within ecosystems, for example, seed dispersal, predators keeping prey numbers in balance, or nutrient cycle. These ecological processes occur regardless of human benefit. These functions are not straightforward to explain to the general public, and therefore people are not able to evaluate something that they cannot fully grasp.

These functions are linked, g (X), to Ecosystem Services (Yellow Box), showing examples of the benefits that humans get from ecosystem functions. Ecosystem services are processes viewed from a human-centric perspective. For example, forest renovation through seed dispersal is crucial to create a forest resilient from disturbances and because it is composed of different tree species (biodiversity). These concepts are also difficult for people to value, even if they cannot be easily understood.

For these reasons, we introduced the Socioeconomic Benefits (Purple Box) illustrating the real-world advantages that people and societies gain from ecosystem services, linked by the function h(Y). For example, wildlife-watching is an experience that people pay to do, they are able to evaluate prices and trade-offs but is only possible because there are functions and services supporting it.

In a healthy and balanced ecosystem, functions (X) occur naturally. Thus, the ecosystem provides a variety of services (Y) for the benefit of people (Z). When biodiversity is reduced, for example, by reducing the number of large carnivores or other apex predators, the ecosystem functions still occur but in an unbalanced way, and therefore some ESS can be reduced. For example, when control of preys no longer happens, there is an increase in diseases and wildlife vehicle collisions (Sèbe et al., 2022) and reduced forest restoration (Perea et al., 2014), reducing the benefits for people.

This thesis aims to fully develop this framework to estimate the benefits (Z) provided by ES related to the presence of bears using different research approaches.

The framework is designed to provide a comprehensive and interdisciplinary approach to understanding and valuing the presence of brown bears, ultimately aiming to improve conservation outcomes by considering both ecological and socioeconomic factors and improving public acceptance.

1.4 Case study: the brown bear

Due to their ecology, low densities, large home ranges across different countries and human-wildlife conflict potential, the conservation of large carnivores (LC) is a challenge that has been addressed by the European Commission with specific guidelines. The EU has funded more than 10 LIFE projects on brown bears in southern Europe http://ec.europa.eu/environment/life/project/Projects, to preserve their declining and fragmented populations. As a consequence of one of such projects – The *Life Ursus*- the province of Trento (Italy) is home to about 100 bears (Groff et al., 2015). The project was successful from a conservation perspective, since it recovered the original population that in the 1990s was on the brink of extinction. Nevertheless, the presence of a large carnivore also created some conflicts because the inhabitants

were no longer used to bears. Most of the conflicts are of an economical nature, because the bears damage livestock, crops and honey farms, some people fear possible attacks to humans even though they are very rare. The owners of damaged goods and activities are completely refunded by the public administration but these costs are often used as an argument by those who cannot accept the presence of this carnivore in the area. The *Life Ursus* project is a clear example that the integration of human dimensions in conservation is crucial to develop effective, robust, and legitimate policies to protect species, especially when dealing with carnivores in highly anthropic landscapes such as Europe. The effect of LC on the structures and functions of the ecosystem is well known by the scientific community (Ripple, Beschta, et al., 2014), and a decline in the carnivore population is linked to a lower quality of these functions. However, ecological evidence cannot solve the social challenge of co-existence with predators by itself, this goal can only be achieved when both scientific and socio-economic evaluations are taken into account (Dickman, 2010; Mascia et al., 2003),

In particular, in the case of N Italy, the acceptance of the bear from the locals dropped from 76% to 30% according to two surveys conducted in 2001 and 2011 respectively (Groff et al., 2015), with a marked difference between city and mountain dwellers, the latter being more negative. This attitude reflects the uneven spatial distribution of costs and benefits issued by the presence of LC and can rise conflicts among people. Public acceptance is thus a major issue for conservation and management, also because bears are likely to spread in neighbouring regions, where legal and illegal killings can jeopardise the establishment of an alpine population (Preatoni et al., 2005). Although the bears do make damages to be reimbursed, they can also provide local economical benefits, as it happens in North America, Japan and other European countries, where the species attract eco-tourists who are willing to pay to attend bear-watching tours or simply to share the forests where these animals live. The communication of the benefits has proven crucial in increasing the acceptance of the bears by residents (Slagle et al., 2013), thus an economic evaluation of the local benefits can make the difference in the complex discussion with managers and stakeholders. Therefore, there is an urgent need of a conservation social science approach in European countries, because of the recovery of large carnivore populations.

Integrating social and natural sciences is essential for effective decision making in conservation during planning, implementation and management (Bennett et al., 2017; Bishop et al., 2017). Ignoring the insights and contributions of the social sciences can compromise the acceptability and effectiveness of conservation.

1.5   Aims of the work

This doctoral thesis aims to provide a contribution to the field of economics with a lean toward conservation social science by analysing the alpine environment and the presence of brown bears in Italy by using a variety of research methods, coming from both conservation biology , environmental modelling and economics, including qualitative (interviews, focus groups, participant observation), quantitative (surveys, statistical modelling), literature reviews, and historical analyses. This work provides a contribution to fill this gap by developing a holistic framework which combines evidence from conservation biology and environmental economics through the use of Ecosystem Service Valuation (ESV) techniques to design EU policy guides and to increase the engagement and acceptability of such policies by local communities.

The brown bear is considered a flagship species, a species that has an impact on people's emotions. Therefore, it may increase public awareness on conservation issues and effectively support the protection of species habitat. The results and guidelines developed here can have an effect on management by making explicit the links between ecosystem services provided by bears and their perception by society.

The case of the brown bear is particularly suitable for this exercise.

There exists a pressing demand for a conservation social science framework that integrates robust economic models with realistic biological characteristics and scales. This research aims to bridge the knowledge gap through an interdisciplinary approach. It will examine the case of the brown bear in Italy, employing an ecosystem services perspective to better understand and address ecological and socioeconomic interactions within its habitat.

Understanding the linkages between brown bears, the ecosystem services they provide, and human perceptions is essential for designing effective conservation strategies. The following research questions and hypotheses aim to explore these relationships:

1. **Which ecosystem services do bears provide to society?** Hypothesis: People tend to ignore or underestimate the positive ecosystem benefits (especially cultural ones) provided by bears. By identifying and communicating these benefits, especially to locals living alongside bears, tolerance towards the species may increase.

2. **What economic benefits are derived from these services?** Hypothesis: The monetary quantification of benefits can help people better assess and support bear conservation programmes.

3. **Does the variation in ecological functions affect the social acceptance of the species?** Hypothesis: Increased ecosystem functionality is positively correlated with the social acceptance of bears, mediated by perceptions of the benefits they provide.

In order to answer the above questions, the research project is articulated in the following objectives:

- Identify the ecosystem functions and services (X, Y and g() in Figure 1.2) provided by the brown bear in southern Europe

- Estimate the benefits (Z) provided by the ES linked to the presence bears.

- Evaluate how a change in the functions (X) can affect the benefits (Z), and thus the social acceptance of the species.

1.5.1 Thesis organisation

- **Chapter 1: Methodology** This chapter provides an overview of the economic evaluation of nature, and of the state of the art about its estimation. It frames the research in the methodology and highlights the contribution of the work to the economic field of research. Finally, it explains the case study of large carnivores and it states the aims of the work.

- **Chapter 2** It is a review of the global literature on ESS provided by bears. The scientific literature examination provided an array of ESS from which to select the attributes and levels for the Discrete Stated preference experiment described in chapter 5. This chapter focuses on the identification of the ecosystem functions and services and their links, g() and h() of Figure 1.2, *sensu* Fisher et al., 2009,

- **Chapter 3: Application of Hedonic Price via AVE.** This chapter presents a case study where the value of the bear as destination image is estimated through the the Advertisement Value Equivalency indicator. The bear is one of the most popular cover animals in conservation and nature magazines (Clucas et al., 2008). Since tourism is one of the most explored benefits among those provided by bears, but no bear-watching industry is established in the study area, we used the AVE approach to estimate it. However, AVE is a controversial indicator and in the chapter its limits and advantages are discussed.

- **Chapter 4: Evaluation of Aesthetic value via revealed preference** This chapter explores the relationship between people's preference for various aesthetics of an alpine landscape and the ESS. The estimation of ESS provided by the forest landscape over time in terms of biodiversity, CO_2 sequestration of the wood is related to the appearance of the forest, an aspect that people can appreciate and value. People's preferences are for a landscape of the past maximising ESS but different from the present situation. The results show how people can appreciate the diversity and structure of forests by looking at landscape pictures. The forest is the habitat of brown bear and here how people value the ESS of the landscape in general.

- **Chapter 5: Stated preference evaluation** Here I describe the estimation of the total value of the bear with SPM. The aim was to develop a questionnaire in which the respondent could choose between realistic and science-based attributes written in plain language. The results yielded a total value of bears and it is hoped that it can help policy makers develop bear management plans that take into account people's preference and the environmental consequences.

- **Chapter 6: Conclusions** wraps up the main conclusions and the contribution of this work to research in the fields of economics and conservation sciences, as well as policy making.

- **Appendix A List of abbreviations used in the thesis**;
  Appendix B information about **Scientific output** ;
  Appendix C SPM Experiment details of Chapter 5 including: pre-survey activities, forms, choice cards design and the transcript of the focus group.

Chapter 2

Bears and Ecosystem Services

2.1 Introduction

In this chapter is provided the sate of the art of the research about large carnivores and ESS with a focus on the bear of the world. Our appreciation of the value of biodiversity has changed rapidly in recent decades prompted by the excessive loss rates around the world with recent estimates of rates more than 1000 times higher than historical background rates of loss (Pimm et al. 2014). Such estimation has emphasized the importance of knowledge of the number of species as well as understanding the roles of species (Schneiders et al 2012, Richter et al. 2021). The concept of ecosystem services derives in part from this need for knowledge and as an effort to quantify the 'value' of species beyond the economic value of a harvested individual (Sandifer et al. 2015). Ecosystem services (ESs) are defined as the multiple ways that humans benefit from ecosystems (Millenial Assessment 2005). Concepts of natural capital have become increasingly important to environmental decision making from carbon credits to biodiversity values to ecosystem services (Gómez-Baggethun et al. 2016, Haines-Young and Potschin 2018, Costanza 2020). Current ecological knowledge indicates that large carnivores are necessary for the maintenance of biodiversity and ecosystem functions (Ripple et al., 2014a). Benefits provided by large carnivores are a key to increase acceptance (Slagle et al. 2013) more than simple biological information (Glikman et al. (2012). Small carnivores can have widespread impacts on ecosystems including the provision of ESs (Marneweck et al. 2021). Terrestrial carnivores in general likely perform subtle and cryptic ecosystem services (Prugh and Sivy 2020). A common challenge to determining values is the paucity of evidence that exists on the services provided by large carnivores (LaBarge et al. 2022). The benefits of bears to include the ESs provided must be tempered by the costs of bears. Bears can cause conflicts with humans and our activities, such as agriculture and farming, in fact in many countries the acceptance is low and people would like to have them removed (Can et al. 2014). However, the negative impacts of bears are generally considered to be less than the positive impacts that result from their presence (Johnson 2020). Understanding the value of bears enables the general public and policy makers to make data-informed decisions when investing funds or support for land management, species conservation, and predator control. The need for such approaches have long been understood (Daily et al. 2009, Hancock 2010) The state of our knowledge of the ESs provided by bears is best described as fragmentary. The important role of large carnivores in ecosystems (Ripple et al., 2014a; Fortin et al., 2016; Lozano et al., 2019) is well documented, and the relevance of bears are mentioned among other species. Similarly, assessments of economic val-

uation of wildlife conservation, that include bears, are also increasingly common (Martino and Kenter, 2023). Less common are detailed assessments of the value of bears although the importance of bear viewing to tourism (Fortin et al., 2016; Penteriani et al., 2017) or about single ESs such as seed dispersal (García-Rodríguez et al., 2021) are available. In this chapter is presented the first broad-scale review and assessment of bears as providers of ecosystem services in an effort to detail the breadth of ecological roles of the bears (Mammalia: Ursidae). Due to their unique ecology, we do not include polar bears (*U. maritimus*) or giant pandas (*Ailuropoda melanoleuca*) in our review or analyses. The aim of this chapter are: 1) to provide a comprehensive review of the scientific knowledge about bears and their role in terrestrial ecosystems. 2) Assess the distribution of knowledge across bear species. 3) identify gaps in knowledge to drive future research. 4) summarize and quantify ecosystem services when possible. 5) contribute information to improve bear conservation around the globe.

2.1.1   Bears of the world

Although taxonomically carnivores, bears show diverse foraging strategies and considerable behavioural plasticity, from highly carnivorous individual grizzly bears (*Ursus arctos horribilis*) to nearly vegetarian Marsican bear (*U. a. marsicanus*), ursids do not always behave as predators (Ciucci and Boitani 2008; Edwards et al. 2011). The ESs derived by carnivory vary according to the environment and resource available to bears but also influence to ESs provided by other behaviors such as seed dispersal, the behavioral plasticity of bears (Edwards et al. 2011) can be critical to such assessments. Preserving a suitable area for the bears allows more biodiversity of species and landscape diversity of habitats than preserving a viable population of different species (Linnell et al., 2000) because bears are considered an "umbrella" species. Bears are also very charismatic 'flagship' species that often appear on the cover pages of nature magazines (Clucas et al., 2008). As umbrella and flagship species, bears can be used to capture attention, promote conservation measures, and focus management actions (Thomsen et al. 2021).

The bears are considered an "umbrella" species,that is a species with a very large home range size. In addition bears tend to be solitary, thus home ranges of individuals only partially overlap, especially those of adult males. In order to preserve a viable population of bears, a very large area of land should be available. The area in which a viable population of bears can survive hosts a variety of other plant and animal species with a more limited space requirement. Preserving a suitable area for the bears allows more biodiversity in terms of species and habitats (landscape) than preserving a viable population of a different species(Linnell et al., 2000).

GEOGRAPHIC RANGE OF THE EIGHT BEAR SPECIES

American black bear — Asiatic black bear — Brown bear — Giant panda — Polar bear — Sloth bear — Spectacled bear — Sun bear
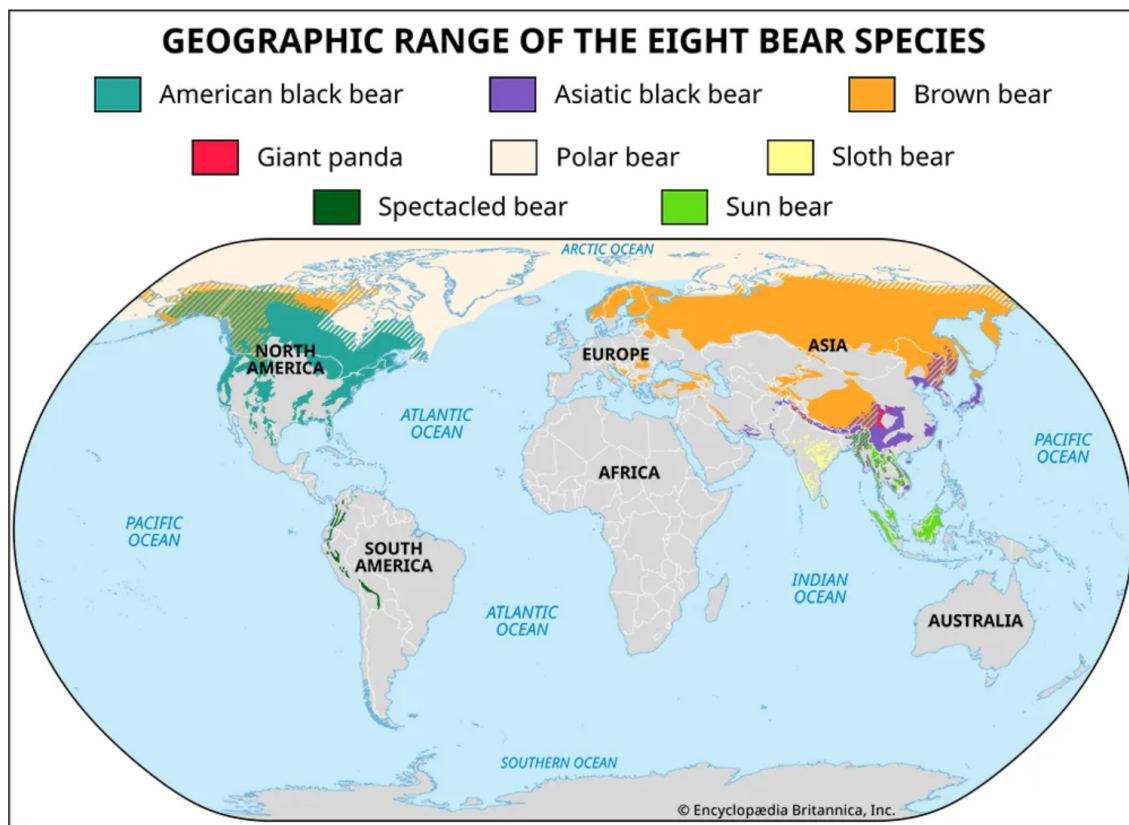
© Encyclopædia Britannica, Inc.

Figure 2.1: Distribution of the 8 species of bears in the world. Source: Enciclopedia Britannica

Several species and subspecies of bears are found in Europe, Asia, North and South America (Figure 2.1. In this work, we include all the following:

Brown bear *Ursus arctos* is widespread in the northern hemisphere with many variations in colour and size. Brown bears are omnivores and adapt their diet according to available resources, from nearly carnivorous to nearly vegetarian. The species is a species of least concern due to its widespread distribution with some exception. Brown bear has many subspecies, for example, the Grizzly bear *U. a. horribilis* and the gigantic Kodiak bear *U. a. middendorffi* that can reach 600 kg, both found in the USA and Canada. The Eurasiatic brown bear, as the name says, is present in Asia and Europe with many subspecies, including the endemic bears of Spain *U. a. pyrenaicus* and Italy *U. a. marsicanus* that are relatively smaller in size (200 kg) and are endangered.

Black bear are generally darker, smaller and more vegetarian than brown bears, there are two main species and some local subspecies, living one in America and the other Asia: the American black bear (*U. americanus*) and the Asian black bear (*Ursus thibetanus*). The majority of the diet consists of insects and berries. IUCN lists the American black bear as a least-concern species because of its widespread distribution and a large population, and it is a game specie. Asian balck instead is declared an endangered species because it is threatened by logging and commercial hunting .

15

Sun Bear (*Helarctos malayanus* lives in the tropical forests of Southeast Asia and it is an excellent tree climber. It feeds mainly on fruits, plant material, and insects. Only occasionally eats small animals. It is the smallest species of bears (25–65 kg). UCIN classifies them as vulnerable and is threatened by deforestation, illegal hunting, and trade.

Sloth bear (*Melursus ursinus* is a small bear (males up to 140 kg) found in the Indian subcontinent. Its diet consists of plants, fruits, ants, and termites. It is classified as vulnerable due to habitat loss and degradation.

Andean bear or spectacled bear (*Tremarctos ornatus*) is the only bear native to South America. This species is medium-sized (males up to 200 kg, females much smaller), it is mostly herbivorous. The species is classified as Vulnerable by the IUCN because of poaching and habitat loss.

2.2 Materials and methods

2.2.1 ESS provided by bears

An ecosystem service is a benefit that humans get from nature. These services come from natural ecosystems and support human well-being in different ways (Costanza et al., 1997; Westman, 1977). For example, forests provide timber , clean the air , offer hiking opportunities, and support biodiversity.

In this chapter and in all the thesis, the Common International Classification of Ecosystem Services (CICES) (Haines Young, 2018) is adopted, see chapter1, with some small adjustments to classify the ESS provided by bears.

Provision In case of bear provision services include legal hunting for meat, trophy or fur.

Regulating and maintenance services in the case of bears include various aspects related to their ecology, such as, but not limited to, seed dispersal, population control of prey including pest and disease control.

Cultural services Recreational activities such as bear-watching, historic values with a direct interaction with the bear or its environment are also cultural ESS.

Some ESS, such as hunting, are not as straightforward to put into the categories identified by CICES. For example, hunting for wildlife is both a provisioning service (providing meat and trophy), but also a cultural service (providing both recreational and spiritual value Green and Elmberg, 2014. Research about sport hunting was labelled as "provision ecosystem service" because there is a direct consumption of bear biomass. Papers on culling for control or hunt problem bears were not included because they are management actions. Finally, when traditional hunters, hunting techniques, or bear-centred ceremonies were the subject of research (Fagarazzi et al., 2021), bear hunting was considered a cultural service rather than a provisioning one. Even if in some cases the meat of the bear was consumed, we considered that cultural value prevailed over food provisioning. When the same publication investigates two (or more) ESS or (sub) species, we counted it more than one when possible. That is, if different values of ESS were reported for each bear, we kept track of it; otherwise, it was reported in the category of "*Ursus spp*". When more ESSs were studied, we counted each one.

2.2.2 Literature search and screening

The literature was searched through Scopus and the Web of Science research tools in November and December 2021 and updated in June 2023. We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology, using the updated guidelines for systematic reviews (Page et al., 2018). The advantages of PRISMA included transparency throughout the process, reduction of potential biases, and complete reporting of systematic reviews in the scientific literature (Page et al., 2018). Following the guidelines and providing information about the main steps gives the possibility to reproduce or update the study.

The list of keywords, identical for both databases, included the scientific and common name of the bear and words related to ecosystem services.

We included all the extant species belonging to the Ursidae family, Ursinae subfamily except polar bear. Polar bears in fact are considered to be marine mammals due to their dependence on marine ecosystems (from: Society of marine mammology.) We limited our study to the Ursinae family, thus excluding also the Panda bear, who does not belong to this sub-taxon. These two species have a very specific trophic niche, compared to the all other bears. Panda were excluded because they feed quite exclusively of bamboo and live in a very specific and limited range. These black and white bears surely play an important role in their habitat but it is not easy to generalize their role in a global review. The aim of this study was to understand the role of bears in terrestrial ecosystems and provide a general perspective. Therefore, the species included in the query were: all the species belonging to genus *Ursus* (Brown bear *Ursus arctos*, American black bear *Ursus americanus*, Asian black bear (emphUrsus thibetanus) and their subspecies; Sun Bear(*Helarctos malayanus*), Andean bear (*Tremarctos ornatus*) and Sloth bear (*Melursus ursinus*.

Since the use of the expression "ecosystem services" is quite recent, we used existing reviews on the topic to define more plainly the ecosystem services linked to bears. So we made a list of ESSs reported, for example, by (Chapron & López-Bao, 2016; Penteriani et al., 2017; Ripple & Beschta, 2012; Ripple, Beschta, et al., 2014) and added others based on our expertise and discussions, in order to be sure that we did not overlook interesting studies. The final list is reported in the caption of Figure 2.2.

The scientific articles included in this review were published in English. The first screening, involving only title and abstract evaluation, the following criteria had to be met: 1) deal with any species of bear (excluding panda and polar bear) 2) mention at least one ESS provided by bears.

The first screening was performed by all coauthors that were randomly assigned an equal number of titles and abstracts issued from the query. We used the Metagear r package Metagear (Lajeunesse, 2016), a tool for systematic review that allowed to keep track of the abstracts discarded and retained so it was possible to re-assess if necessary. In this phase, we had many meetings when in doubt to keep or discard a paper. When a decision could not be reached based only on title and abstract, the paper was retained for full text reading. The results of this first assessment were again randomly split, this time between 7 people. Each "screener" had to upload the full text of the papers to a shared Mendeley library so that everyone had access to the whole collection. In this phase, we collaborated to upload papers when one particular reference was not available by one institution, and if not available online, we requested it directly to the corresponding authors via email or Research gate.

The so formed collection was assessed for eligibility by reading the full text.

Exclusion criteria:

1. article about ESS, but not provided by bear;

2. articles about bears but not really studying ESS (for example a paper about bear physiology);

3. ESS affecting bear and not bear providing ESS. For example the effect of recreation activity in nature on bear movement.;

4. Illegal trading of bears or bear parts, as well as the economics of bile farms were not within the scope of this review. The focus was on wild bears and legal activities;

5. Research carried out only in zoos or captivated bears. The focus of this study is the role of bears in the wild and the ESS derived from having wild bears. Studies that involved captivated bears as control or only for one step of the research were retained.

6. Review papers and meta-analysis were not included, in order to avoid repetitions. However, the bibliography was carefully taken into account in order to check if we missed some important paper.

7. Any combination of the above criteria

Articles dealing only with the polar bear or the Panda, which were not species of interest and have too different ecological characteristics Articles speaking too generally about ESS (for example Hemati et al., 2020 does not specify any specific ESS that falls within the bear habitat or Lozano et al., 2019 advocates the increase of research between ESS and bears) ESS not provided by bear but affecting bear (for example, Hemati et al., 2020 does not specify any specific ESS falling inside bear habitat or Lozano et al., 2019 advocating the increase of research between ESS and bears) ESS not provided by bear but ESS not provided Di Nicola et al., 2015 that explained how disease control in wild boars affects the brown bear).

If after the full text reading, the person was in doubt to include the paper, she labelled it with a tag, and the paper was reassessed by at least one or two assessors and/or discussed until a consensus was reached. All steps and the full text of the queries are reported in the PRISMA flow chart (Page et al., 2018), following the adaptation for wildlife studies by Tedeschi et al., 2021.

PRISMA 2020 flow diagram of literature search and keywords used.
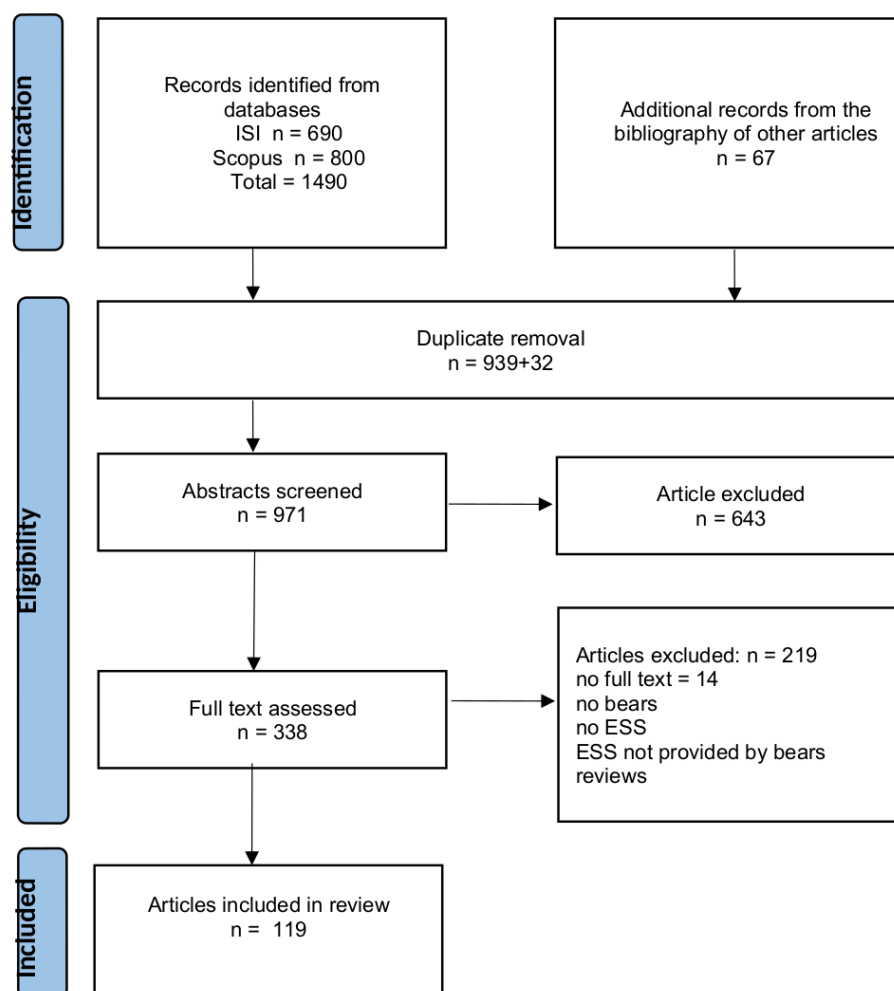
Figure 2.2: The flowchart illustrating the process of literature search and review, based on PRISMA guidelines (adapted from Moher et al. 2009). Scopus and Web of Science search terms used to review the literature (TS= ("black bear*" OR "brown bear*" OR "grizzl*" OR "Kodiak bear*" OR "sloth bear" OR "spectacled bear*" OR " sun bear*" OR "Ursus" OR "melursus ursinus" OR "Tremarctos ornatus" OR "Melarctos malayanus" OR "Ursus thibetanus")) AND TS=("alien species control" OR "bear viewing" OR "bear watching" OR "control preys" OR "cultural value" OR "Disease control" OR "Ecosystem service*" OR "Educational" OR "Existence value" OR "Heritage" OR "Hunting" OR "invasive species control" OR "landscape engineer" OR "landscape modification" OR "Maintaining biodiversity" OR "Maintaining habitats" OR "Maintaining populations" OR "nutrient cycle" OR "Pest control" OR "Recreation" OR "Seed dispersal" OR "Soil quality" OR "Symbolic" OR "Traditional knowledge")

2.2.3 Economic value actualization

The monetary estimates reported in the papers were all converted into USD/year and in cases where direct yearly estimations were not available, averages of different values provided by the papers were utilized to derive an yearly values. After obtaining the standardised values in US dollars, they were adjusted to the current (2023) dollar purchasing power, accounting for inflation. The Consumer Price
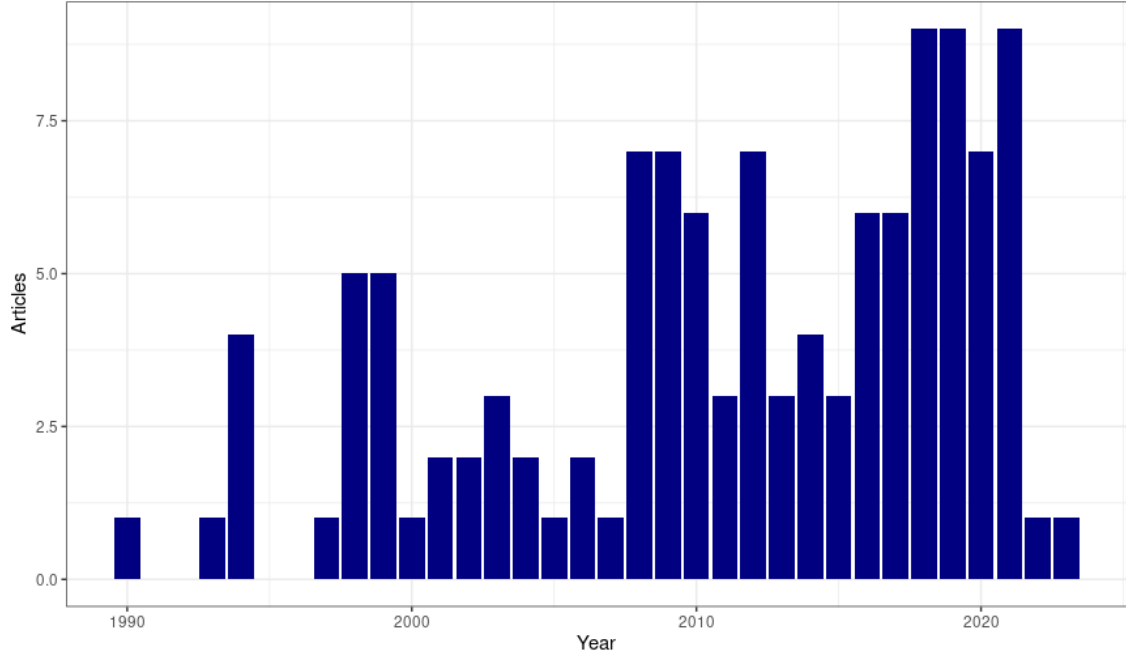
Figure 2.3: Temporal distribution of the article selected for this review.

Index (CPI), one of the most popular measures of inflation and deflation, was used to calculate an updated value for bear ESs, according to the formula :

$$Dollar2023 = DollarinYYYY * CPI_2023/CPI_YYYY$$

Where YYYY is the year of reference and CPI_YYYY are the average yearly CPIs obtained from the United States Department of Labor database published on the web (https://www.bls.gov/cpi/data.htm).

2.3 Results and discussion

2.3.1 Literature search

The query returned nearly 1500 papers. After duplicate removal, the first screening regarded more than 900 abstracts and then the assessors evaluated 330 full texts. Eventually, we obtained 120 studies that met the criteria, and in this section, we present the general results across time and space. The first article included in our review dates back to 1972, and there is a gap until 1990. From 1990 to 2023, a mean of 3 articles were published per year, with a peak of 9 papers in 2018, 2019, and 2021, and no works in other years. The general increasing number of publications about bears and ESS can be seen in Figure 2.3.

The most studied species were the Brown bear (*Ursus arctos*) and its sub species with 78 papers, the American black bear (*Ursus americanus*) with 21 and the Asian black bear (*Ursus thibetanus*) with 13 studies. We found 9 publications dealing with the American black and Brown bears together. The other species were reported in fewer cases: 4 publications were about the Sun Bear(*Helarctos malayanus*), 3 dealt with the South American Andean bear *Tremarctos ornatus*) and only two involved the sloth bear (*Melursus ursinus*), see Figure2.5.

Even if the taxonomy of the brown bear subspecies is far from agreed, most publications reported the sub species, providing important information about the study area: the European brown bear *U. arctos arctos* featured in 19 cases, the grizzly bear *U. arctos horribilis* and the Alaska peninsula grizzly *U. arctos gyas*, respectively, were mentioned 25 and 12 times, sometimes they are considered a single population of grizzlies. The Kodiak bear (*U. arctos middendorffi*, which also lives in North America, was the subject of 3 studies and a single article dealt with the Italian endemic Marsican bear (*U. arctos marsicanus*. In whatever way the grizzly subspecies could be considered, the North American bears remained more studied than the Asian and European ones (Figure2.5.

The geographical distribution of the articles reinforces the previously observed bias toward grizzlies and American black bears (Figure 2.4), with the majority of studies (70) occurring in the United States and Canada. We found 28 studies in Asia, where four species of bears live, 19 in Europe, and three in South America.
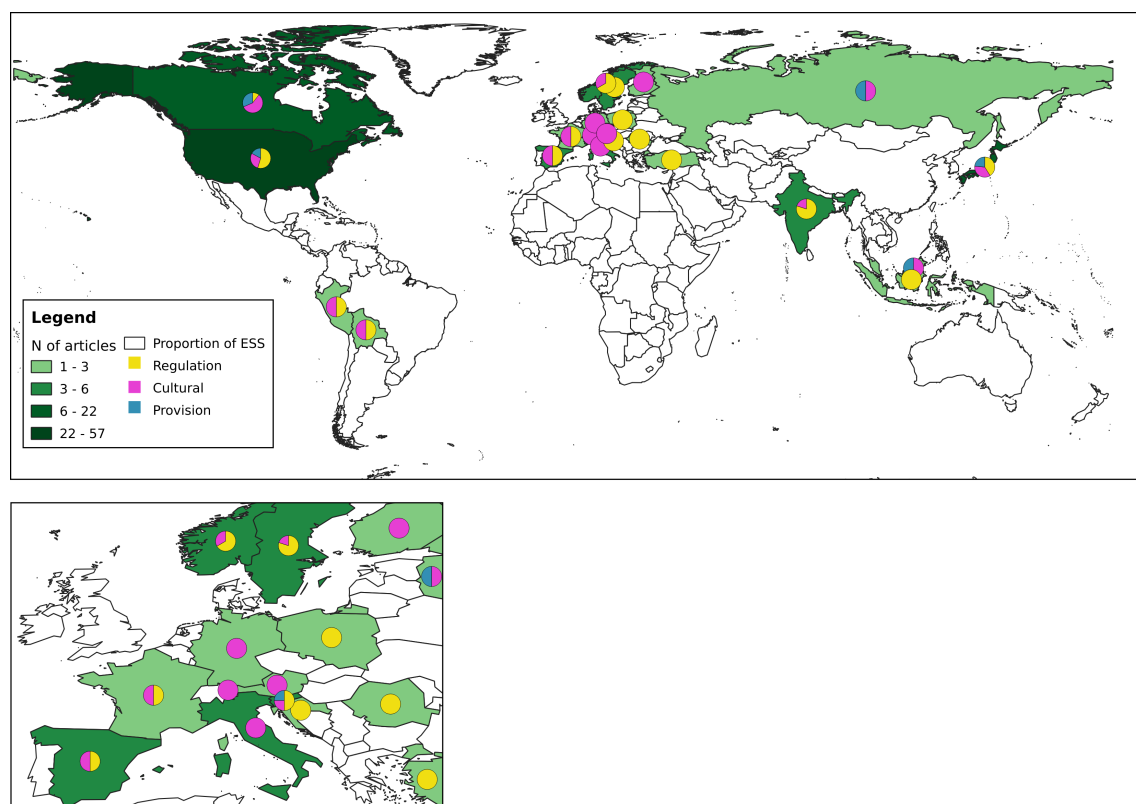
Figure 2.4: Global distribution of the scientific articles dealing with Ecosystem Services (ESS) provided by the species of bears included in the study, published from 1970 to 2023 N=120. Pie charts show the proportion of articles dealing with different ESS. Inlet shows a zoom on Europe.

Most of the studies (103/120) provided a quantitative estimate of the effects of bears on the ESS investigated, with a similar distribution of quantitative and qualitative studies between species and geographic area (Figure 2.3.1). The number of articles that provided quantitative evaluations was: 87% in North America (60 out of 70) and 89% in Asia and Europe (25 of 28 papers and 16 of 19 respectively).

The economic evaluation of the ESS provided by bears was reported in only 16 publications.
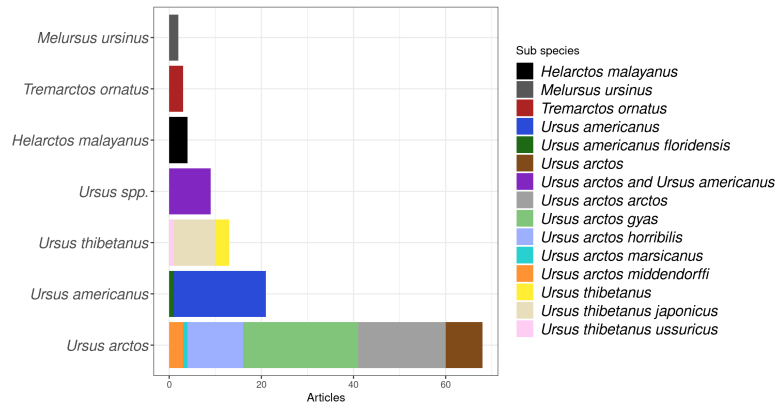
Figure 2.5: Distribution of the scientific research about bears and ecosystem services arranged by species (panda and polar bears where not included in this review. Different colour show the proportion of each subspecies when reported. Usrus spp include research carried out on multiple species (grizzly and American black bear))

2.3.2   ESS provided by bears

The ESSs provided by bears to terrestrial ecosystems and to human society are many and diverse. Some ESS received more attention than others according to the study area (Figure 2.3.2) and the bear species. Details at species level will be discussed in the single sections. In cases where multiple species or ESS were reported in the same publication, we separated each component to properly account for each species and ESS combination in the analysis. After this process we ended up with 132 "studies". So in this section "study" has this specific meaning and it is not a synonym of article.

The most investigated category of ESS was "regulation of populations and habitats" with 63 cases (47% of all the studies). Across the world, bears contribute to the N nutrient cycle and soil quality by scavenging, digging, and moving nutrients around the forest. Bears also help to keep the populations of numerous of their prey and plants in check, and they help to increase plant diversity by distributing seeds and promoting their germination. The seed dispersal role of bears received the greatest attention among the regulation services (40%), and it is evident on all continents especially in Asia where there are more articles than in North America (12 against 8), a rare exception in the general trend, Figure 2.3.2.

The next most researched ESS are cultural (36%): specifically bear-watching (32% of cultural ESS), the importance of bears in history and traditions (27%), recreation and symbolic (both 14%), and finally flagship (8%) and existence value (2%). Figure 2.3.2 shows that interest in each cultural ESS fluctuates according to local conditions. bear-watching is more researched in the United States and Canada, where there is a long-established tourist industry.

Approximately 17% of the studies related with bear hunting. Not surprisingly, there are many scholars in North America and Asia who investigated bear hunting, which is a legal practice in many countries: we came across 15 and 7 papers, respectively. In Europe, where the brown bear is strictly protected by the Habitat Directive, we identified only one study that matched our criteria in Slovenia (Krofel et al., 2012), one of the few European areas where bear shooting is permitted, along with Scandinavia and Romania.
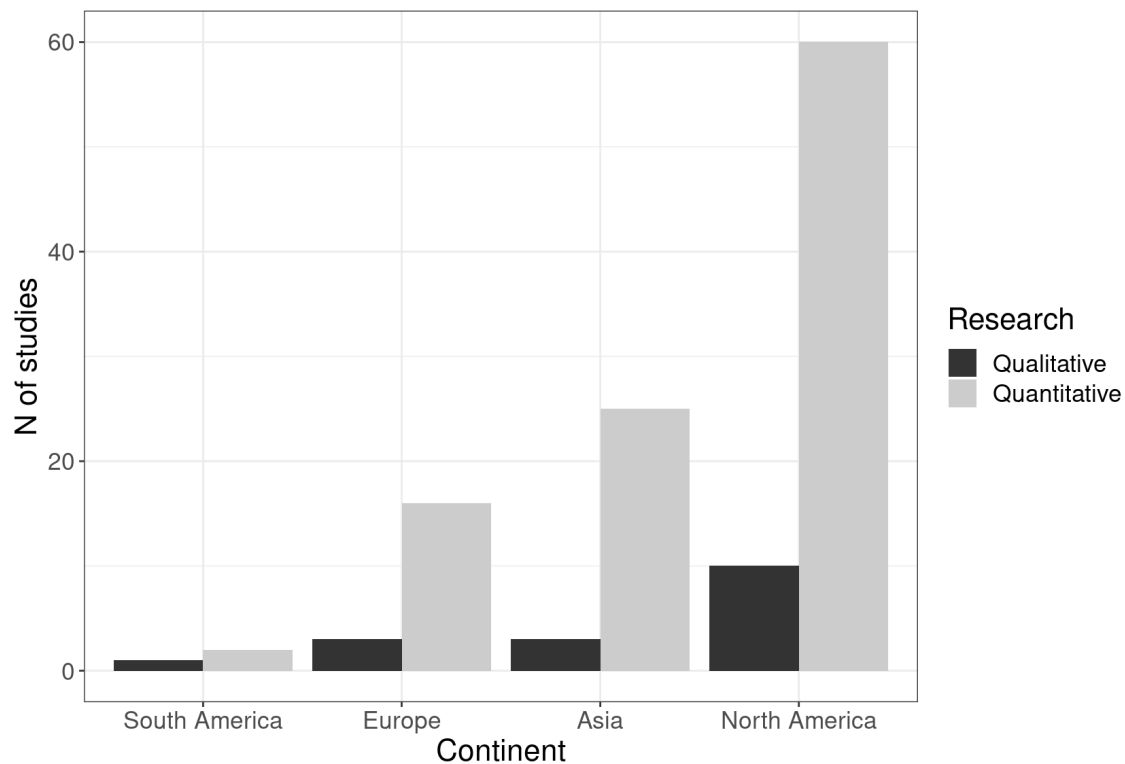
Figure 2.6: Number of qualitative and quantitative studies about the Ecosystem Services (ESS) provided by bears in the world arranged by continent. (N=119, period 1972–2023)

2.3.3 Provision

The research produced 20 publications on hunting and one on the medical use of bears. Again, most of the research was conducted in North America, with eight articles focussing on grizzly hunting and seven on the American black bear. The hunt for the Eurasian brown bear was the subject of three publications in three distinct study areas: Russia, Slovenia, and Japan. In Japan they also hunt the Asian Black bear, and 2 papers reported data about recreational and traditional hunting. A single paper was found about the hunting of the sun bear in Malaysia by the indigenous community.

Depending on its purpose, hunting can be categorised as a provisioning or cultural service. Originally evolving from a necessary activity for human survival, hunting has become a recreational sport, with historical instances of being considered a leisure activity since the time of the Roman Empire. In the 21st century, some regions, especially in Asia, still rely on hunting as a significant source of food (meat), although limited information is available on this aspect.

Within the 20 papers we collected, Takeda (1972) analysed the black bear hunting practices of traditional Matagi hunters in northern Japan. The value of this type of hunting, particularly winter hunting trips, is associated with the hunters' knowledge of the mountainous area during harsh conditions. Takeda suggests that these traditional activities are disrupted by urbanisation processes that invade remote areas, making the continuation of the hunt for Matagi bears contingent on the conservation of nature. Loke and collaborators (2020) conducted interviews to understand hunting practices among the Jahai indigenous community in north-
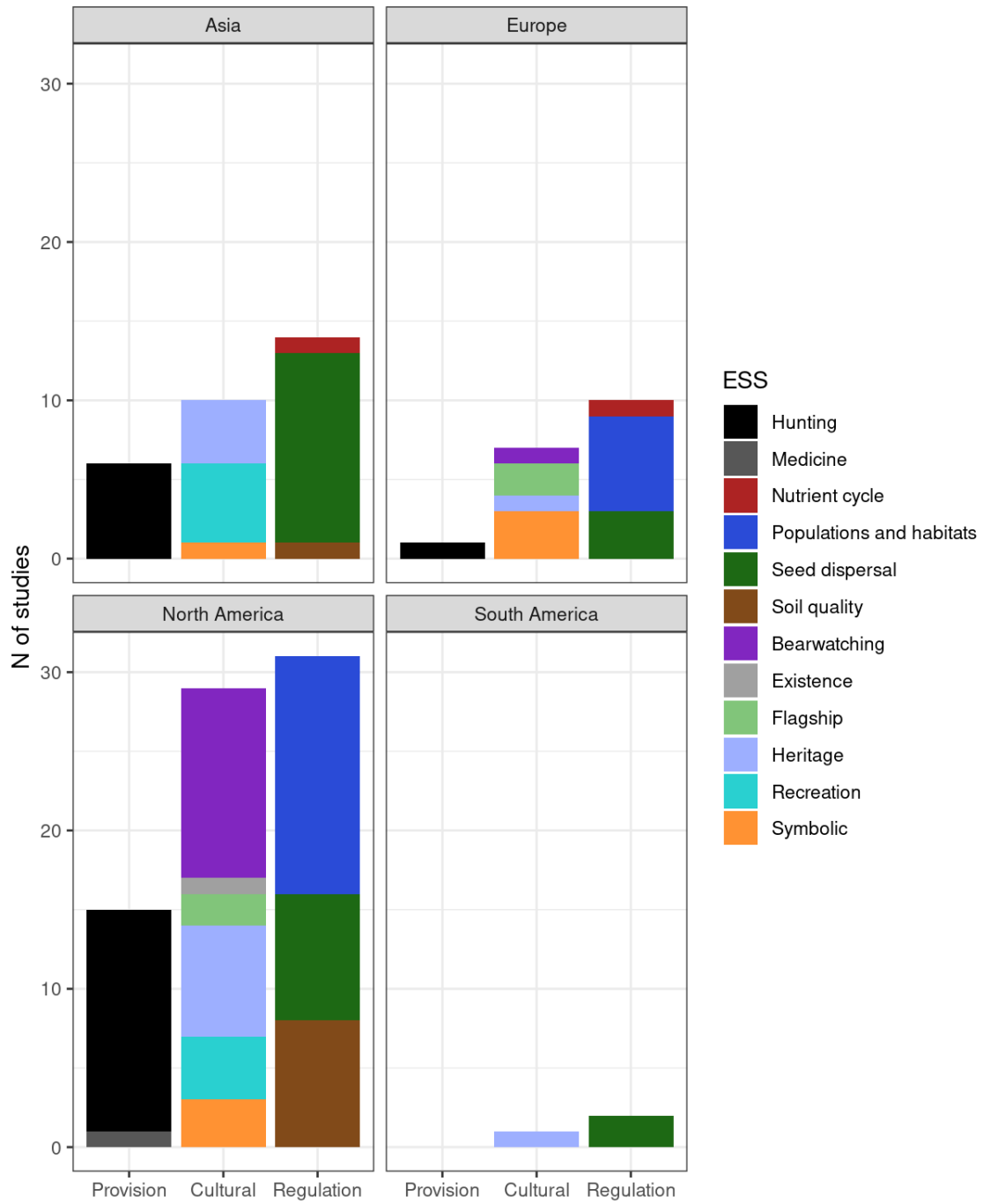
Figure 2.7: Type of ESS provided by bears in published literature (1972–2023) arranged by geographic area. Some articles were counted multiple times if they provided information about more than one ESS and/or species of bear. So the total sum of the studies exceeds 120, the number of papers selected for this review.

ern peninsular Malaysia. This community hunts for meat rather than for financial gain, consuming their prey at home and within the community, including sun bears (*Helarctos malayanus*). Senchik and collaborators (2020) studied hunting bags and the game meat market (including bears) in Hokkaido Island (Japan) and the Amur region (Russia), concluding that "wild meat is an environmentally friendly product appealing to people in Russia and Japan, capable of attracting tourists to recreational areas and gastronomic tours in Japan and Russia."

In other parts of the world, mainly in North America, bears are hunted for sport, and their value is associated with hunting licenses and the costs of hunting trips. While few studies include economic evaluations, the cost of hunting a bear can be significant, reaching up to $40,000 for non-residents in British Columbia, Canada (Norden and Tansay, 2011). In Alaska, the gross value for a bear hunting trip can exceed $1,000 for black bears and over $1,500 for brown bears (Millet et al., 1998). Millet estimated a total benefit of $17.05 million for non-resident bear hunting trips and $4.15 million for resident hunting trips in 1990. Brookshire and collaborators (1983) explored the willingness of hunters in Wyoming to pay a fee for the possibility of hunting grizzly bears in the future without having the certainty to do it. The willingness to pay (WTP, fully explained in the recreation paragraph) was linked to the probability of supply; higher probabilities resulted in greater willingness to pay. Hunters were also willing to pay more based on waiting time for hunting (5 or 15 years). In Oregon (Kohlman et al., 1999), between 1983 and 1994, hunters purchased bear tags that generated more than $220,000 in annual revenue for wildlife management for the Oregon Department of Fish and Wildlife.

In Europe, bears are protected by laws, and legal hunting information is primarily available for the Slovenian brown bear population. Between 1998 and 2008, 550 brown bears were removed, constituting an estimated 20% of the population (Krofel et al., 2012), and in 2024 a bear hunting trip costs more than USD $3,500(https://www.bookyourhunt.com/).

Across the various studies taken into account here, questionnaires emerge as a predominant tool for gathering information, providing insights into stakeholders' perspectives, attitudes, and behaviours related to bear hunting practices and conservation efforts.

Questionnaires are valuable tools for understanding stakeholders' perspectives on bear hunting and conservation efforts, and they have been used in many studies, especially in the USA. Some surveys aimed to assess the willingness to pay for bear conservation, highlighting the economic value of wildlife. However, in most cases (N = 9), the surveys were addressed only to hunters, not including all stakeholders, especially indigenous communities, whose opinion was asked only in a couple of cases (Loke2020, Takeda1972).

Hunting practices vary across different regions and countries, often influenced by factors such as conservation efforts, indigenous traditions, and economic considerations. This research showed how different bears were targeted for hunting, both for recreation and cultural aspects.

Even if 11 papers out of 20 reported the hunting quota or the number of harvested bears, it is difficult to generalise on a continental scale. In conclusion, hunting practices and species quota vary widely between regions, reflecting the complex interaction between cultural traditions, conservation goals, and economic interests. Efforts to sustainably manage bear populations require a nuanced understanding of local contexts and the implementation of evidence-based conservation strategies.

Hunting bears provide a diverse commercial sector that has the potential to

grow. However, changes in harvest methods and rules must be considered in order to account for the whole ecosystem services provided by bears (Mano1998).

2.3.4 Regulation and Maintenance

Maintaining populations and habitats

The role of bears as an "umbrella" species, recognised by the scientific community (Linnell et al., 2000), is mainly due to the great influence that these species have on the dynamics of overpopulation and the structure of the habitat. We found 23 studies explaining the bear's contribution in regulating populations and habitats, plus 2 in which bears are reported to feed on invasive species such as the Burmese python (*Python bivittatus*) in Florida (McCollister et al., 2021) and a lake non-native trout (*Salvelinus namaycush*) in North America (Haroldson et al., 2005). No studies reported that bears could control diseases in wildlife. Among these studies, the totality was concentrated in Europe (N=6) and North America (N=19) with a consistent gap in other parts of the world where bears are present. The most represented species (N=15) was the brown bear (*Ursus arctos*) with 6 studies on the Euro-Asiatic subspecies (*U. arctos arctos*), 6 on the grizzly bear (U. arctos horribilis), 2 on the Alaskan subspecies (*U. arctos gyas*) and 1 comparing Europe and North America subspecies. The remaining studies were focused on the American black bear (*Ursus americanus*) (N=6) and 4 targeting both species together. Excluding the two articles on invasive species, representing a very small sample to support the idea that bears play a role in the control of alien species, we can divide the 'maintaining' role of bears into two different topics: 1. Regulating prey populations (N=17); 2. Ecosystem functioning and habitat maintenance (N=6). See Figure 2.3.4.

Bears have a very plastic feeding behaviour that varies according to environmental conditions. They can range from a high carnivore diet, as for the grizzly bear, to more opportunistic habits and diets, as it happens for almost all the other species where they do not behave only as large predators but feed on a vast scale of resources, many times also plant-based.

However, in some areas in North America and Northern Europe, bears serve as top carnivores in forested ecosystems, exerting significant control over prey populations through predation. Most studies on predator-prey dynamics focused on large herbivores, especially of the Cervidae family, such as moose (*Alces alces*), reindeer (*Rangifer tarandus*) and elk deer (*Cervus canadensis*). Arthur and Del Vecchio (2019), stated that, with a decrease in ungulates populations, bears could shift their diets on the Bovidae Muskox populations (*Ovibos moschatus*).

From these studies, conducted on different bear species and in different parts of the world, it is clear that these carnivores play a significant role in regulating herbivore populations, accounting for most predation-related deaths. For example, 6 studies (Arthur and Del Vecchio, 2019; Guiliazov, 1998; Barber-Meyer et al., 2008; Larsen et al., 1989; Mumma et al., 2019 and Tallian et al., 2017) targeted brown bear (both in Europe or North America) and American black bear, that prey mortality due to bear's predation was always higher than 50% (average of 66% with different herbivores species). In Europe, in a long-term study (¿40 years, Giuliazov, 1998), brown bear was responsible for 68% and 30% of moose and reindeer mortality, respectively and Gervasi et al. (2012), using the Leslie-Usher matrices and a simulation approach, reported bear kill rates on moose with a per capita of 6-8 individuals per 100 days. In addition, using structural equation modeling, European

Population and habitat control

Data overview

Continent	North America	Europe
Species	Ursus arctos	Ursus americanus / Ursus spp.
Target.group	Ungulates / Birds / Mammals / Plants / Fish / Insects	
Action	Predation / Habitat / Competition	
Control.study	no	yes

Figure 2.8: Regulation and maintenance ecosystem services provided by bears globally. Overview of the scientific literature up to 2023, N= 24. Bears affect primarily the mortality of ungulates so they are grouped separately in the Target.group line. Mammals include other mammals except ungulates. "Action" stands for the means through which the bear create an effect on the rest of th community. "Control" refers to the number of studies that had an experimental design with a control.

apex predators were significantly responsible for controlling lower trophic levels, especially herbivores, but not strongly as a human direct-indirect effect (Dorresteijn et al., 2015). The density of moose remains low in much of Alaska and Canada, despite high reproductive rates, due to predation by grizzly and black bears, and it was demonstrated how a predator control programme can influence the high density of prey (Boertje et al., 2009). More generally, Crete (1999) tested the deer biomass distribution seeing that predators (including bears), regulate herbivores at a relatively constant density.

Several bear attacks targeted calves because they are easier prey, and when that happens, bears have a high impact on cub mortality. Tallian et al. (2017) reported that both bear species in Yellowstone accounted for 69% of deaths out of 94% predator's mortality for elk deer calves. Again, Rauset et al. (2012) calculated an annual kill rate of 6.1 to 9.4 moose calves per bear in Scandinavia and North America, both bear species accounted for 58-60% of elk calves mortality, having a direct influence on the decline in elk recruitment (Larsen et al., 1989; Berber-Meyer et al., 2008).

The dramatic decline of a species (e.g. the native cutthroat trout, Middleton et al., 2015) can amplify the effect of a generalist consumer, such as the grizzly bear, on other populations, such as the migratory elk, reducing their calf recruitment (4–16%) and population growth (2–11%). Furthermore, bears, focussing on calves, could kill mainly individuals in substandard physical condition as found by Mumma et al. (2019) for American black bear predation on reindeer calves.

Finally, many studies did not focus only on bears, but considered other sympatric predator species at the apex, such as wolves (*Canis lupus*) and compared the predation rate between carnivores (Giuliazov, 1998; Barber-Meyer et al., 2008; Larsen et al., 1989). Interestingly, the influence of predation on lower trophic levels may depend on the composition of predator communities, with bears also affecting the wolf kill rate (Tallian et al., 2017).

Overall, only 6 papers reported the percentage of bear-caused mortality in ungulate populations, allowing to compare the results across studies with a random-effects model. The effect of bears on ungulate mortality was on average 48.6 % with a wide range of variability (38.5–68.7 %, Figure 2.3.4).

Despite bears can effectively kill a high proportion of ungulates, there is also evidence that their predation is not effective everywhere in regulating ungulate populations: local factors, such as human presence, may limit their capacity to prey (Ordiz et al. 2013).

Other 2 studies focused on the salmon populations, a major resource especially in North America in the diet of the brown bear. Both were directly related in the control population of sockeye salmon in Alaska (*Oncorhynchus nerka*). Deacy et al. (2016) showed that GPS collared individual brown bears tracked spatial variations in salmon spawning phenology at different sites within a watershed, suggesting that bears adapt their foraging behaviour to take advantage of variations in salmon availability. Quinn and Kinnison (1999) revealed that bears selectively target male salmon and that predation rates vary across years and habitats, suggesting that bear predation may drive natural selection within salmon populations, affecting reproductive success.

In addition, a large percentage of the bear diet includes, indeed, invertebrates too, and bears can feed on the ants population, they can be up to 50% of their diet (Grosse et al., 1996), bees and other wood-feeding insects. These invertebrates account for an important amount of forest biomass.
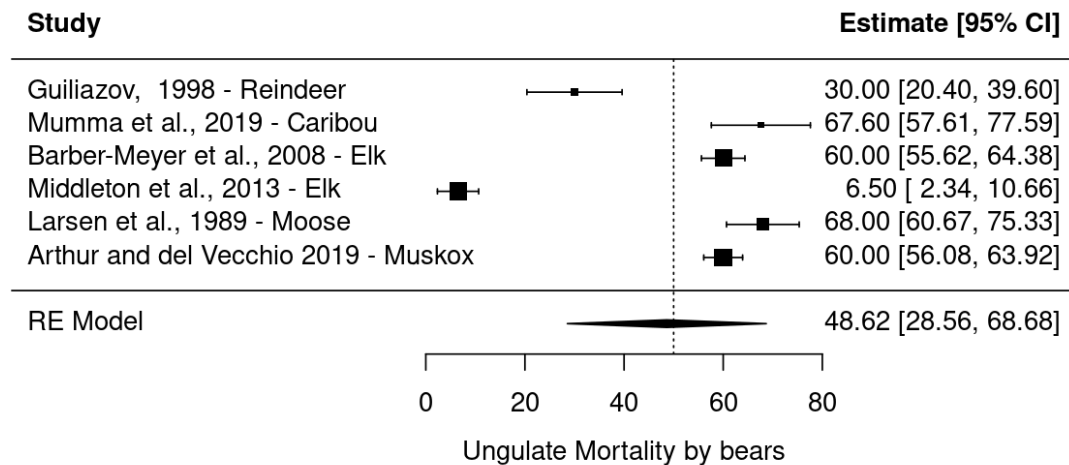
Figure 2.9: Forest plot describing the effect of bear predation on ungulate mortality (%) of the 6 papers that carried this kind of information. For each source are reported the confidence intervals graphically and numerically. The diamond shape at the bottom represents the overall pooled effect from the included studies. I^2 (total heterogeneity / total variability):I^2: 98.73%, $p - val < .0001$

Soil quality

Similarly to the general trend, most of the 11 articles focused on brown bears (n = 8); one studied brown and black bears without distinction (Harding et al. 2019) and another Asian black bear (Inagaki et al. 2020). Most studies (n = 9) investigated the transport process of marine-derived nutrients brought by Pacific salmon (*Oncorhynchus* spp.) into freshwater systems and transported into terrestrial ecosystems by bears. By incorporating nitrogen into terrestrial ecosystems, soil increases organic content, nutrients, and supplementing resources to invertebrate communities (Harding et al. 2019). The other two studies focused on the scavenging role of brown bears in the Dinaric mountains in Slovenia and Croatia and Asian black bears in Japan.

Bears improve soil quality by enriching the ground of terrestrial ecosystems in nutrients thanks to three main actions: i) consumption of salmons and trouts, and later distribution of faeces and urine in the forest; ii) by moving and leaving the carcasses of salmon inland; iii) Scavenging large carcasses and facilitating their decomposition.
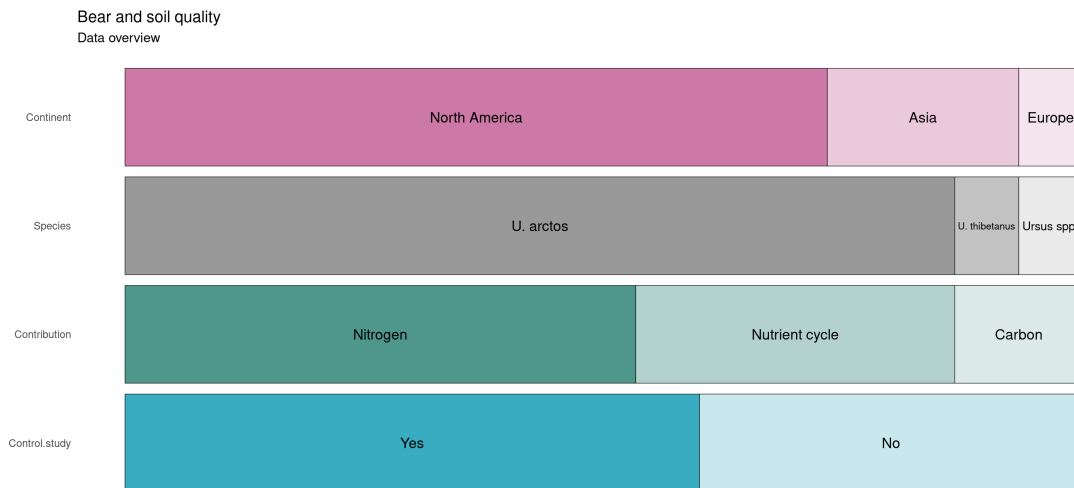
Figure 2.10: Overview of the scientific literature related to the contributions of bears to soil quality updated to 2023, N= 11. Bears' provision of Nitrogen and Carbon to soil has been measured mainly where they feed on salmon. MOst of these studies compared areas of bear presence and absence through controlled designs. Their contribution to the nutrient cycle in general is linked to scavenging activities

The studies on nutrient transport mainly described interactions with Pacific salmon, including species such as chum (*O. keta*), pink salmon (*O. gorbuscha*), and only one study incorporated data on sockeye (*O. nerka*), chinook (*O. tshawytscha*) and Coho salmon (*O. kisutch*). The seminal work of Hilderbrand et al. (1999) tracked nitrogen transport from salmon into the riparian forests through bears in Alaska. The researchers measured the isotope δ15N in the foliage of white spruce (*Picea glauca*) and found that bears distributed between 23.1 to 56.3 kg/year of salmon-derived nitrogen in sites closer to the stream. However, the amount of nitrogen associated with the salmon and distributed by the bears dropped as the distance from the stream increased (Hilderbrand et al. 1999). A study comparing sites close to the stream but with and without bear activity found 32 times more N2O and three times more soil ammonium, but nitrate and CO2 levels were similar in both treatments. When bears were removed from the experimental plots, the effects of bear activity were undetectable after one year, stressing the temporal component of the distribution (Holtgrieve et al. 2009).

In total, up to 24% of nitrogen in riparian forests could be associated with the presence and interaction of bears and salmon (Helfield & Naiman 2006). The mechanisms of how nutrients are transported into terrestrial ecosystems are strongly dependent on bear behaviours and the spatial configuration of the landscape (Helfield & Naiman 2006). By measuring nitrogen in the white spruce foliage, it was estimated that the redistribution for this tree species was mainly mediated by urine (96%), followed by faeces (3%) (Hilderbrand et al. 1999). A study in Japan found that the levels of δ15N in bear hair were higher after salmon spawning and that migratory salmon streams had higher levels of δ15N in the riparian vegetation compared to streams where salmon is not present (Koshino et al. 2013). In the Shiretoko peninsula in Japan, Koshino et al. (2013) estimated that brown bears transported 412 carcasses of pink salmon to the riparian zone per month during summer and fall. However, the monthly transportation of 412 carcasses of pink salmon represented half of the fish transported by floods only, highlighting the importance of

bear presence in soil quality (Koshino et al. 2013).

A study that focused on measuring the nitrogen levels of the soil at different distances from the salmon carcasses showed that the carcasses left along the riparian forests create pools of nitrogen in the soil with levels of over several orders of magnitude compared to sites without carcasses, However, these levels fade to the background level as close as 30 cm from where the carcass was left (Gende et al. 2007). In Alaska, a direct observation study estimated that bears transported between 42 and 68% of the carcasses into the forest in Alaska (Quinn et al. 2009). A 5-year study in British Columbia, Canada, conducted by Harding et al. (2019), showed that bear consumption increased in general in streams with larger spawning areas, but the amount of salmon transported into the forest depends on the species (Harding et al. 2019). They found that black and brown bears transferred 3,871 salmon carcasses and preferred chum, possibly because of their larger size; 1,079 were pink salmon and 2,792 were chum (Harding et al. 2019). This study revealed that the distance from the pink salmon and chum to land depends on habitat characteristics. For example, the number of carcasses of pink salmon, which is more abundant at lower reaches, decreased with increasing distance upstream, but no effects were detected for chum, which is more common at upper reaches. Bears as facultative scavengers are linked to the nutrient cycle by serving as weak links within food webs playing an essential role for the ecosystem stability and function (Inagaki et al. 2020). In an experiment where researchers monitored the carcasses of 42 sika deer (*Cervus nippon*), found that the Asian black bears are the largest carnivore and the dominant scavengers in Japan, having more time to feed on carrion and the ability to manipulate larger deer. They also found that the bear's role as scavengers is seasonally dependent, and they dramatically reduce the use of carrion in autumn when nuts and acorns are available (Inagaki et al. 2020). A study in Eastern Europe by Krofel and collaborators revealed the impact of kleptoparasitism driven by bears over the prey hunted by the Eurasian lynx (*Lynx lynx*). They estimated that bears scavenged 32% of prey and stole 15% of all the biomass killed by lynx (Krofel et al. 2012).

The crucial role of bears in the transfer of nitrogen of sea origin inland in boreal forests is well documented and studied. In other environments, given the plasticity and the nature of the omnivore diet, bears contributed to dismantling big carcasses, however, further research is necessary to quantify the incorporation of nutrients back into the forest by scavenging behaviour. Nevertheless, the impact on the ecosystem is expected to be important, also compared to other species, since the bears are the largest scavengers in Europe, Asia and Japan.

Seed dispersal

The role of bears as seed dispersers was reported in 29 publications, and all considered bear species at least registered a scientific study that evaluated their role as seed dispersers. Studies on seed dispersal follow the general trends of our results, most of our reports focus on black and brown bears (n=15), followed by black Asiatic bear (n = 7), sloth bear (n = 3), and Andean bear and Sun bear (n= 2, respectively). See Figure 2.3.4.

Brown bears (*Ursus arctos*) ingest more than 100 plant species throughout their global distribution (Garca-Rodriguez et al. 2021), preferring the consumption of fleshy fruits (Lalleroni et al. 2017, Wilson and Gende, 2004). Germination experiments performed in Europe and Asia showed that seedling emergence in brown

Figure 2.11: Seed dispersal and germination services provided by bears globally. Overview of the scientific literature up to 2023, N= 29. Bears can disperse seeds of shrubs producing berries and trees, but also of other plants including lianas and cycads, included in the generic group "Plants" of plant .type grouping. Bears help plant dispersion in several ways, line "Effects" increasing germination rate, distance. "Control" refers to the number of studies that had an experimental design with a control.

Table 2.1: Overview of the effects related to seed dispersal by bear, for each effects are reported the number of papers (N), unit of measure, mean, minimum and maximum values found in literature

Effect	Unit	N	Mean	Min	Max
Germination time	days	6	18.4	7.6	40
Germination rate	%	16	44.1	6.8	100
Intact seeds in scat	%	7	77.5	40	97.6
Distance (m)	meters	4	1525.7	393.1	4000

bear faeces is higher under natural conditions than in control experiments (55% of seedling emergence; Karimi et al. 2020, Tavşanolu et al. 2021), showing the same effect in North America, where seedling emergence was 50% higher in plant species of the genus *Rubus* spp and *Vaccinium* spp (Traveset et al. 2001). Brown bear seed consumption not only improves seedling emergence along its distribution, the number of seed consumption that varies from one to thousands of seeds by scat and the mobility of individuals (up to 8 km; Lalleroni et al. 2017) evidence the key role that species play in seed dispersion (Shakeri et al. 2018). *U. arctos* is considered one of the most important and efficient megafaunal seed dispersers in boreal and temperate regions, given its dietary needs due to hibernation behaviours, mobility, and plant phenology along temperate ecosystems (Garcia-Rodriguez et al. 2021). Seeds embedded in bear scats appear to germinate earlier than seeds on bare soil (Rivadeir-Canedo et al., 2008, Steyaert et al., 2019).

Black bears (*Ursus americanus*) consume an important amount of fleshy fruits before hibernation, reaching between 40 and 90% of importance of these dietary items in their diet (Auger et al. 2002). The effects of seed dispersal by black bear can be species-specific, being an effective disperser of species such as *Prunus* spp, *Mahonia* spp, *Oplopanax* spp and *Rhus* spp (Auger et al. 2002; Borchert et al. 2010). In northern North America, black bears can ingest huge amounts of seed (100.000 seeds/hour; Harrer and Levi 2018) which also increases the dispersion of specific plant species and same as brown bears their home range increases the distance of effective dispersion.

Similarly to American black bears (*U. americanus*), Asiatic black bears (*Ursus thibetanus*) have been reported to be one of the largest mammals in Japan associated with seed dispersal in temperate forests. The consumption of at least 72 fleshy plant species (Koike & Masaki 2019); detailed studies showed the dispersal of *Prunus jamasakura*, preferring the ingestion of fruits with a high sugar concentration and leaving more than 95% of the seeds consumed intact and increasing the germination rates between 44% and 63% (Koike et al. 2008). Other plant species dispersed by *U. tibethanus japonicus* in Japan (97.6%) were reported by Takahashi et al. (2008). In a sample of over 14000 seeds they identified 3 species of woody liana (*Schisandra chinensis*, *Akebia kinata*, *Actinidia arguta*) and 6 species of trees (*Morus australis*, *Cerasus leveilleana*, *Padus grayana*, *Swida controversa*, *Magnolia kobus*, *Pyrus pyrifolia* var. *pyrifolia*), being *A. arguta*, *A. kinata*, P. *pyrifolia* var. *pyrifolia* and *M. kobus* species with fruit sizes between 20-100 mm, highlighting black Asiatic bears as dispersers of large fruits in temperate forests.

Not only is the quantity and the intact seeds found in Asiatic black bears, is the bear movement to disperse the seeds. For *Prunus verecunda* a tree species in Japan, asiatic black bears dispersed seeds between 393.1 - 749.5 m away from the ingestion area (downhill and uphill), showing the importance and role of seed movement in

the highlands (Naoe et al. 2016, Naoe et al. 2019).

The roles of seed dispersal for *U. thibetanus* have also been evaluated in tropical forests in India. Consumption of at least 13 plant species, but seed germination evaluation was carried out with *Symplocos theifolia*, showing that feeding by asiatic black bears from these trees shortened the mean length of dormancy of the species (153 days) and improved the germination rate (up to 22%; Sathyakumar and Viswanath 2003).

Bear species with tropical distributions, such as the Sloth bear (*Melursus ursinus*) have been classified mainly as myrmecophagous, but the report of fruits in the bear diet highlights its role as seed dispersers. Sloth bears, like other bear species, prefer the consumption of fleshy fruits with a range of 14-20 plant species identified from their scats (Sreekumar & Balakrishnan 2002, Kumar and Paul 2021). From the plant species identified along the sloth bear diet, a decrease in germination time was reported after bear consumption on *Cassia fistula* (14.6 days to 7 days), *Artocarpus hirsuta* (9 days to 5.7 days) *Zizyphus oenoplina* (from 45.8 days to 43.6 days), *Cuchanania lanzan* (16.7 days to 14 days), *Syzygium comini* (8.4 days to 7.6 days) and *Manigifera indica* (21.1 days to 23.1 days). These results even if from very limited number of papers, show the importance of sloth bear as seed disperser given its size and the capacity of consumption of big fleshy fruits (Raju and Jonathan 1999, Kumar and Paul 2021).

There is a significant lack of seed dispersal studies in Andean bears (*Tremarctos ornatus*). Only two studies were reported along our search, in Perú germination experiments of seeds collected from Andean bear scats of *Styrax ovatus* a highland tree with seed size of 1 cm x 2.5 cm (Young et al. 1990) were germination rate of the seeds extracted from the scats were 89% not having control seeds. In Bolivia, consumption of fleshy species seeds from *Nectandra* cf. *cuneatocordata*, *Gaultheria vaccinoides* and *Symplocos* cf. *cernua* not affected seed viability. For *N*. cf. *cuneatocordata* time of germination decreased from 45.4 days for control seeds to 17.3 days for consumed seeds, same as *G. vaccinoides* decreasing from 77.8 days for control seeds to 60.3 days for consumed seeds. Andean bears can accelerate germination processes during digestion processes and degradation of pericarp tissues of the seeds, and increase germination success due to bear movements. It is clear that there is a knowledge gap on the relationships between Andean bears and seed dispersal in high-altitude ecosystems in South America.

Sun bears (*Helarctos malayanus*) are suggested to be seed dispersers, but as Andean bears, this ecological role has not been evaluated in detail for the species. In Borneo, the germination rates of defecated and undefecated did not change for fleshy fruits of *Canarium* spp., but the germination time changed significantly, decreasing from 30 days (control) to 26 days (defecated seeds). The consumption of *Ficus* (Moraceae) and *Erycibe maingayi* (Convolvulaceae) was reported, but there was no difference in germination rates due to sample size (McConkey and Galleti 1999). For fragmented areas in Borneo, it is suggested that sun bears can be important in restoration processes due to their dietary habits and tendency to fleshy fruit consumption (Lindsell et al. 2015).

Our results showed a clear geographical bias in seed dispersal studies, as temperate bear species with the most number of studies while tropical distribution bear species with low studies, it is necessary to increase seed dispersion studies in bears, due to size, mobility, and effect on time and germination success. These results could be valuable in the conservation of tropical ecosystems such as forests and lowlands in Asia and highland tropical ecosystems in South America.

Study		Estimate [95% CI]

Enders et al. 2012 - Prunus virginiana, Cornus stolonifera	20.00 [15.62, 24.38]
Garcia-Rodriguez et al., 2021a - Vaccinium myrtillus	100.00 [95.62, 104.38]
Garcia-Rodriguez et al., 2021b - Vaccinium myrtillus	16.00 [11.62, 20.38]
Koike et al. 2007 - Prunus jamaskura	66.00 [61.62, 70.38]
McConkey1999 - 3 species	30.00 [22.41, 37.59]
rivadeira_canedo2008 - Symplocos cernua	45.70 [41.32, 50.08]
rivadeira_canedo2008 - Gaultheria vaccinioides	6.80 [1.92, 11.68]
rivadeira_canedo2008 - Nectandra cuneatocordata	52.30 [47.92, 56.68]
Sambaradam et al. 2003 - Symplocos theifolia	22.00 [17.62, 26.38]
Sreekumar et al. 2002 - 14 plant species	7.00 [3.55, 10.45]
Tavşanoğlu et al. 2021 - Pyrus elaeagnifolia	39.60 [36.44, 42.76]
Tavşanoğlu et al. 2021 - Malus sylvestris	54.40 [49.56, 59.24]
Traveset and Wilson 1997 - Sambucus racemosa	14.00 [9.62, 18.38]
Traveset and Wilson 1997 - Rubus spectabilis	56.50 [52.83, 60.17]
Traveset et al. 2001 - Vaccinium sp	45.00 [38.80, 51.20]
Traveset et al. 2001 - Rubus spectabilis	50.00 [43.80, 56.20]
Young 1990 - Styrax ovatus	89.00 [84.62, 93.38]
RE Model	42.02 [29.17, 54.87]

Germination rate (%) of seeds eaten by bears

Figure 2.12: Meta-analysis of the literature providing an estimate of seeds germination rate (%) in bear scats. For each source are reported the confidence intervals graphically and numerically. N of papers=11, but some reported germination rates for different species, so are reported multiple times in the graph. The diamond shape at the bottom represents the overall pooled effect from the included studies. I^2 (total heterogeneity / total variability):I^2: 93.94% p-val ¡ .0001

2.3.5 Cultural

The CICES classifications supplied numerous Cultural ESS, which were grouped into the following categories for the sake of this research as follows: 1) Recreation and tourism: bear-watching and all the recreational activities involving direct engagement with bears and/or their natural habitat. 2) Symbolic: all the other non-material contributions to people that did not involve tourism or recreation and did not always implied a direct interaction with bears. Here belong: Heritage, Existence, Symbolic, Scientific and educational services. The contribution of a single species to the numerous cultural services is unevenly distributed among bears and regions, as seen in Table 2.3.5

Table 1: Overview of the bear related cultural ecosystem services literature

	Helarctos malayanus	Tremarctos ornatus	Ursus americanus	Ursus arctos	Ursus thibetanus	N
Existence			Kolosova et al. (2017b)	**Eurasian:** Kubo and Shoji (2014a); Aguilera-Alcalá et al. (2020); Bjerke et al. (1998) **Grizzly:** Darimont et al. (2021)		5
Flagship				**Eurasian:** Aguilera-Alcalá et al. (1999); Aguilera-Alcalá et al. (2020); Zailer et al. (2012); **Eurasian:** Tattoni et al. (2017); **Alaskan:** Skibins et al. (2012); **Grizzly** Chicas et al. (2008); Stoddart (2011); **Apennine:** (Tattoni et al., 2023)	Bhat and Sofi (2021)	9
Heritage	Loke et al. (2020)	Paisley and Saunders (2010)	Adams (2019); Jonker et al. (1998a); Campbell and Lancaster (2010a); Scott (2006) McGrath et al. (2019); Heneghan and Morse (2018)	**Eurasian:** Albrecht et al. (2017); Black (1988); **Grizzly:** Adams (2019)		11
Symbolic				Deroy et al. (2019) **Eurasian:** Kolosova et al. (2017a);	Knight (2008); Takeda (1972)	4
Umbrella				Schirpke et al. (2018)		1
Scientific				Hemati et al. (2020)		1
Bear watching			Donahue et al. (2003) Honey et al. (2016); Miller et al. (1998); Center for Responsible Travel (2014);	**Alaskan:** Keating and Kramnich (2020); DeBruyn et al. (2004); **Grizzly:** Honey et al. (2016); Miller et al. (1998); Center for Responsible Travel (2014); Skibins and Sharp (2017); Clayton and Mendelsohn (1993); Nevin et al. (2014); Swanson et al. (1994) ; **Eurasian:** ?Kubo and Shoji (2016); Kojola and Heikkinen (2012)	Sang-Yoel and Choong-Ki (2008)	14
Recreation			Lin and Sharp (2018); Norden and Tansey (2011)	**Alaskan:** DeBruyn et al. (2004); DeBruyn and Smith (2009); **Grizzly:** Goodbody et al. (2021); Gunther et al. (2018); Norden and Tansey (2011) **Eurasian:** Kubo and Shoji (2014b)		7
Virtual bear watching			Loomis et al. (2018); Skibins and Sharp (2019)	**Grizzly: Alaskan:** Richardson and Lewis (2022); Skibins and Sharp (2019)		3

Recreation

During the assessment, we identified 23 articles that discuss bear-related recreational activities.

Bear-watching was the most common activity among the articles reviewed (N=16),including 3 studies on virtual bear-watching. This sort of remote observation is becoming more popular as camera traps and internet connections make it possible to watch bears from the comfort of one's own home.

The seven publications dealing with what we labelled "Recreation" may involve bear-watching, but not exclusively. For example, Liu and Sharp (2018) focused on watching wildlife rather than bears, while Kubo and Shoji (2014b) considered various recreational activities, including hiking and other sports.

The brown bear (74%) was, unsurprisingly, the species most studied, especially the grizzly and American black bear together (17%) and the American black bear alone (4%). Only one study in South Korea related recreation to Asian black bears (Sang-Yoel and Choong-Ki, 2008).

One study in Finland satisfied our selection criteria for Europe (Kojola and Heikkinen, 2012), four in Asia (17%), and the remaining 18 in North America (78%). Figure 2.3.5 and Table 1 show an overview of the collected data.

Surveys were a widely used tool (65% of the studies) to collect data about bear-watching around the world, followed by data collection in the field or from reports or other sources 17% (Figure 2.3.5). In the other cases, researchers collected tour prices from parks or operators (Norden and Tansey, 2011).

The questionnaires were primarily addressed to tourists (35%), multiple stakeholders (26%), then Internet users (13%) and eventually to residents (9%) in one case to Park Managers DeBruyn and Smith (2009).

The Willingness To Pay (WTP) is an estimate the maximum price a customer would pay for a product or service, and this measure is used also to estimate the value of natural nonmarket goods (Martino and Kenter, 2023). There are many methods to evaluate the WTP, asking directly to the open questions, or evaluating by questionnaire with various design contingent valuation (CV), Confirmatory factor analysis (CFA), travel costs, and others. WTP was used to estimate that people were ready to spend 228 to 277 USDA per person for wildlife watching in the wild Clayton and Mendelsohn (1993) and up to 70 USDA for enjoying the view of a bear remotely (Skibins and Sharp, 2019). Kubo and Shoji, 2016 instead, investigated how to balance visitor satisfaction with safety bear areas. Black bears in Manchuria can be a tourist attraction, and most households were willing to pay the equivalent of 7 USDA per year for the long-term preservation of this large carnivore.

Discrete Choice Modelling (DCE, also known as Stated Preference Discrete Choice Modelling) is a powerful tool to understand how people make their decision based on multiple criteria, DCE is regarded as the most suitable method for estimating WTP.

To assess how people can compromise between the conservation of brown bears and the conflicts with their economic activities, Kubo and Shoji (2014a) used this technique in the Shiretoko Peninsula, Japan. DCE enabled the authors to disentangle how different stakeholders value the presence of these large carnivores and their other interests and values. In his various studies Kubo and Shoji (2014a,b) explored how human-wildlife conflict affected fishermen, sportsmen, or tourist operators and how differently they were willing to engage in conservation. During the DCE administered to hikers and tourists at Daisetsuzan National Park, Japan, Kubo and Shoji (2014b) offered different choices from a group of alternatives that included various

Figure 2.13: Overview of the bear-related recreational activities reported in the scientific literature up to 2023, N= 23. DCE Discrete Choice Experiment, Cont. Val contingent valuation, CFA Confirmatory factor analysis, for more details please see text . Target is the target population of surveys, NA occurs when studies had no questionnaires.

destinations, levels of crowding on the path and probability of bear encounter. The high risk of encountering brown bears on the trail was a problem for hikers, but they would not give up their visit if a guided tour was available. This example showed how DCE could provide more articulated answers to the complex problem of human-bear co-existence.

However, its experimental design is time-consuming and its administration is usually more expensive compared to a standard questionnaire.

Maybe it is one of the reasons why it was applied only in 3 studies (9%) and most researchers opted for standard statistical tools or other econometrics, including cost-benefit analysis (Herrero et al., 2005), confirmatory factor analysis (Skibins and Sharp, 2017), consumer surplus (Loomis et al., 2018) and 17% for CV (Figure 2.3.5).

In a very original approach, Goodbody et al. (2021) used Maximum Entropy Modelling (MaxEnt) to overlap grizzly bear recovery areas and human recreation zones. To do that, they retrieved images from social networks and used them to map the pressure of recreation and tourism in Alberta (Canada).

Intense recreation and tourism reduced foraging behaviour and increased rapid movement in radio collared grizzlies.

Two articles (9%) reported in a narrative way their findings about recreation (DeBruyn et al., 2004; Kojola and Heikkinen, 2012) and only two had a control experiment (Kubo and Shoji, 2014a; DeBruyn and Smith, 2009).

Symbolic, Heritage, cultural

We found 30 studies dealing with the diverse dimensions of the symbolic value attributed to bears worldwide. Most of them (N = 11) investigated the historical and traditional importance of bears in different cultures. Bears were found in 9 studies as a flagship species, whereas their role as an umbrella species was mentioned
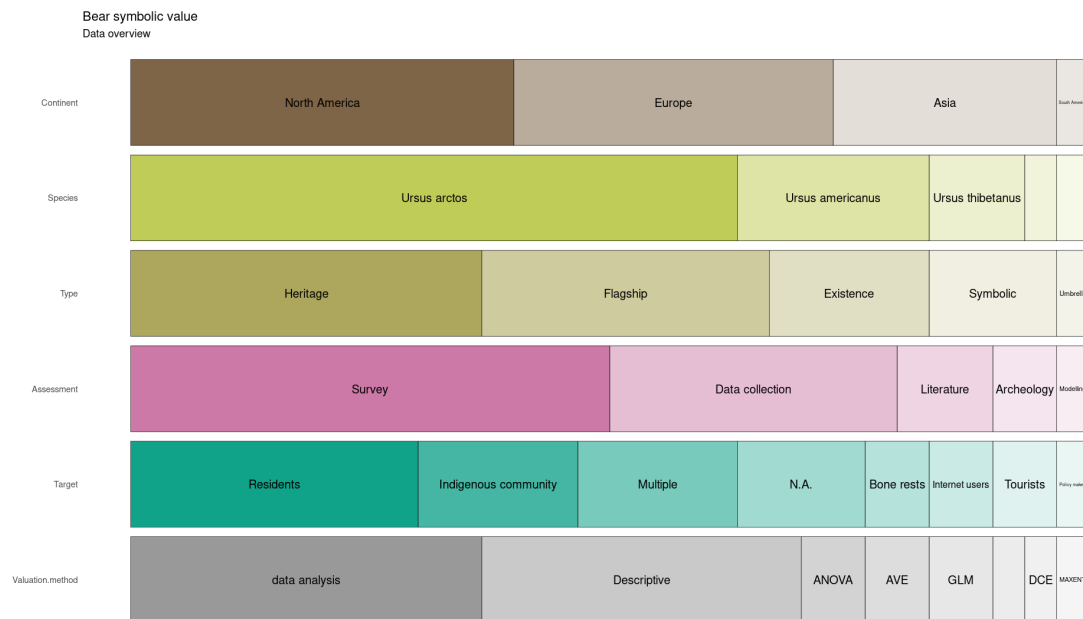
Figure 2.14: Overview of the scientific literature dealing with the cultural value of bears in the world up to 2023, N= 30. DCE Discrete Choice Experiment, N.A. not available. This is not a missing data but because not all the studies were questionnaires)

only once (Hemati et al., 2020). Symbolic and existence values were investigated in 4 and 5 articles, respectively.

Figure 2.3.5 and Table 1 show an overview of the collected data. Again, the most investigated species were the brown bear (63.3 %), including the Apennine brown bear (Tattoni et al., 2023) and the American black bear (20%), followed by the Asian Black bear (10%). The Sun and Andean bears appeared in a single study each (Loke et al., 2020; Paisley and Saunders, 2010). The geographic distribution of the studies followed that of the species: North America (40%), Asia (23%), Europe (33%) and South America (3%).

Scholars around the world used surveys to evaluate the diverse cultural ESS provided by bears. In fact, questionnaires emerged as the predominant method in 50% studies, facilitating the collection of qualitative and quantitative data on public attitudes, preferences and behaviours related to bears. Figure 2.3.5.

The questionnaires were primarily addressed to residents (30%) or indigenous communities (17%), then to tourists alone or together with other stakeholders and occasionally to internet users or policymakers (less than 7% each). Understanding the perspectives of residents, tourists, indigenous communities and managers, is crucial to developing evidence-based conservation strategies and promoting meaningful dialogue between human groups. However, only a limited number of studies addressed multiple stakeholders at the same time (Stoddart, 2011). This gap should be addressed in future research to ensure society's acceptance of large carnivores in the long term.

In 37% of the articles, the data was collected from different sources, including media (Zailer et al., 1999; Tattoni et al., 2017, 2023), web trace (Aguilera-Alcalá et al., 2020), and material rests in archaeological sites, often associated with burials, underlining the symbolic importance of these large carnivores for people (Albrecht

et al., 2017; McGrath et al., 2019). Literature was used in three papers (10%), including one about the covers of nature magazines in the USA by Clucas et al. (2008), the only one designed with a control case study.

About one third of the studies reported the collected data in a narrative, while the rest used a quantitative approach. Standard statistical methods such as t tests, correlations, chi-squares were commonly used to quantitatively assess the non-material contributions of bears to people (around 40% of the quantitative analysis, all grouped under the "Data analysis" label in Figure 2.3.5). GLM were used to explore complex relationships between emotions, hunting, and knowledge that apparently increase the acceptance of black bears in Alabama (Heneghan and Morse, 2018), whereas ANOVA were used to assess public attitudes toward black bears (Campbell and Lancaster, 2010; Jonker et al., 1998).

More specific techniques such as Maxent were applied to map conservation priorities": Hemati et al. (2020) used an integrated approach based on focal species, including brown bear, to develop ecosystem-orientated planning to ensure long-term wildlife and biodiversity reservoirs.

A more sophisticated survey design (Kubo and Shoji, 2014a) was used to study how Japanese residents make trade-offs for the conservation of brown bears and the mitigation of human-bear conflicts.

In this case, DCE (discrete choice experiment) required a specific survey design and logistic analysis to understand how and where people in the tourism industry and other stakeholders wanted to keep bears. The result sounded like "not in my backyard" attitude.

People dependent on tourism showed greater acceptance for bears, whereas farmers and others were eager to keep bears only in protected areas, away from their activities. Bears have significant symbolic value across different societies and regions, representing a blend of ecological, cultural and spiritual importance. Many authors highlighted the profound cultural significance of bears, particularly among indigenous communities across the globe. Bears are often regarded as symbols of strength, wisdom and spirituality, playing an integral role in traditional folklore, rituals, and cosmology (Paisley and Saunders, 2010).

In Europe, too, bears offered insight into the intricate relationship between language, culture, and ecological dynamics. In an extensive multi-language research, Kolosova et al. (2017a) found the word "bear" in the names of over 600 Eurasian plants, reflecting diverse motivations and cultural models, for example, the bear garlic *Allium ursinus*. Tattoni (2019) found that in Italy there are more than 600 toponyms including the word "bear," and she also proved that the locations of place names were markers for recolonisation and extinction patterns. All across the European Alps, symbolic species like the bear, eagle or ibex are not only part of the local folklore, but are depicted in coats of arms, coins, brands and used as names for hotels and restaurants (Schirpke et al., 2014).

Bears serve as flagship species in conservation initiatives worldwide, garnering public support and awareness of biodiversity conservation. Surveys conducted in the USA, Iran, and Canada (Clucas et al., 2008; Deroy et al., 2019; Adams, 2019; Heneghan and Morse, 2018; Hemati et al., 2020) demonstrate the public's willingness to pay for bear conservation, rejecting the symbolic importance of these iconic species in environmental stewardship. In regions such as Italy, Spain, and Austria, bears contribute to the touristic appeal of natural landscapes, improving the image of the destination and the local visibility (Tattoni et al., 2017, 2023; Schirpke et al., 2014; Aguilera-Alcalá et al., 2020). Despite occasional conflicts, studies reveal
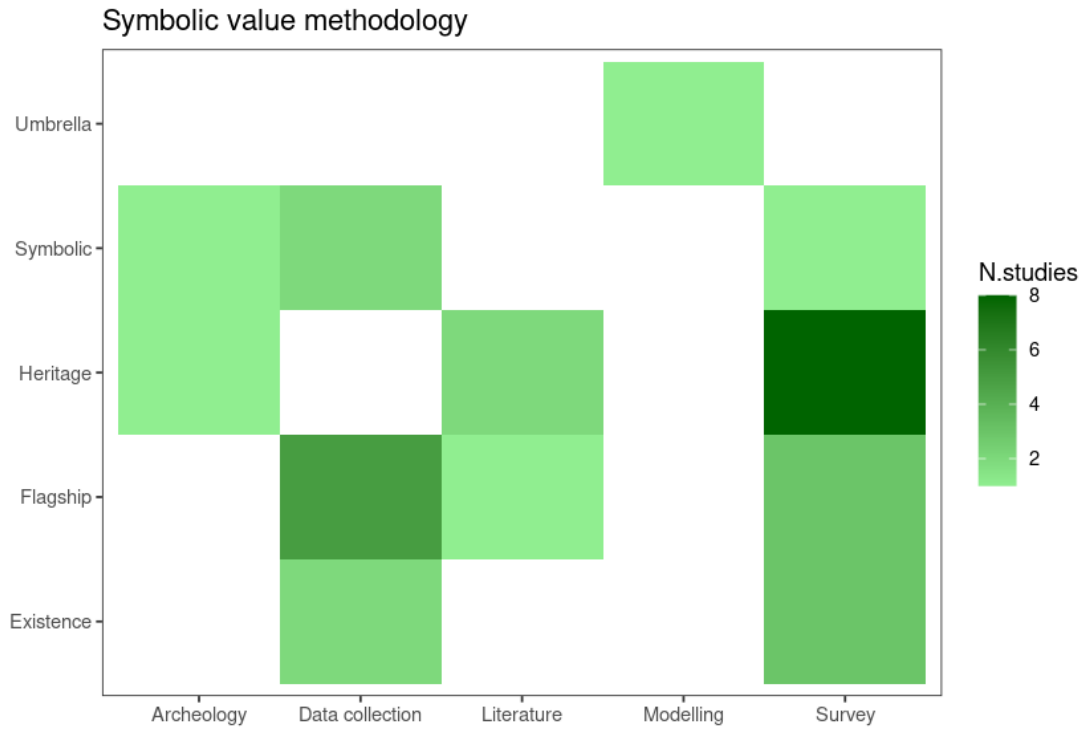
Figure 2.15: Overview of the methodologies used to assess the diverse symbolic values of bears in the world. N= 30

positive attitudes toward bears, with many considering them integral components of natural landscapes (Jonker et al., 1998) and traditions (Campbell and Lancaster, 2010).

The importance of biodiversity for medicine is widely recognised, and the development of new drugs from wild species has always existed in human history (Chivian, 2022). We often think of plants or bacteria as a source of new drugs, but bears can also contribute to human health. In fact, their metabolism can suggest a cure for disuse osteoporosis, a condition that affects people after immobilisation or prolonged rest. In these situations, net bone loss can increase the risk of fracture upon remobilization. This phenomenon also occurs in other hibernating animals (ground squirrels, golden hamsters, and little brown bats), but there is evidence that black bears do not lose bone mass during hibernation. Donahue and collaborators (2003) tested black bear bone metabolism using the same technique to evaluate osteoporosis in human patients. They confirmed that osteoblastic bone formation is not impaired in hibernating black bears. Further investigation of these mechanisms, including circulating hormone levels, could be of great value for future osteoporosis therapy.

In addition to recreation and other services, the existence of bears can provide us with potential medicines.

2.3.6 Economic evaluation

From all the literature collected for this study, the economic evaluation of the ESS provided by bears was reported in only 16 articles, published between 1994 and 2023,

Table 2.2: Average economic value of bears divided by species, values updated to US Dollars in 2023, N=17

Species	N	Mean ($)	SD ($)
Ursus americanus	1	164,447	–
Ursus arctos	9	116,591,839	225,232,272
Ursus spp.	5	23,600,916	18,366,787
Ursus thibetanus	2	4,972,525	805,026

providing in total 20 economic evaluations because of multiple species and/or services in the same study. This underlined how quantifying the economic value of bear-related ecosystem services had been a challenging task.

These studies, spanning various continents and bear species, offered insights into the climatic environment.

into the monetary worth of bear-related ecosystem services. In only three cases, it was not possible to report the price on a yearly basis.

For example, Richardson and Lewis (2022) estimated the willingness of internet users to pay for virtual bear-watching experiences, revealing varying price points and preferences among respondents that were not possible to convert on a yearly basis. Similarly, Clayton and Mendelsohn, (1993) reported that a wildlife watching tour to visit McNeil River (USA) could cost between 228 to 277 USD, although specific yearly estimates were hindered by the lack of visitor data.

Finally, Brookshire et al. (1983) administered a questionnaire to hunters to obtain the option prices for the availability of different quotas over time (1524$ year per hunter), but the total number of hunters was not published, so this result could not be generalised for comparison. Eventually, the analysis took into account 17 cases.

Ecosystem services associated with bears collectively contribute an average of 69.2 million USD per year to various economies worldwide. The economic value ranged from 0.5 million $ per year to as high as 605.2 million $ per year, reflecting the diverse activities and contexts in which bear-related services are valued (Figure 2.16). The economic evaluations encompassed the following species: Brown bears (N = 9), grizzly and American black bears together (N = 5), and Asian black bears (N = 2), with a study focussing exclusively on American black bears. Bears were evaluated as flagship species in Europe, the Alps and Apennine Mountains (Tattoni et al. 2017, 2023), and Asia in the Dachigam National Park, India (Asian black bear) (Bhat and So 2021), where their symbolic value was also evaluated in monetary terms. Bear and wildlife watching tours, access fees to parks like Yellowstone, where bears are a prominent attraction, contributed greatly to local economies.

Despite our efforts to convert all economic valuations to the same currency and unit of time, we found such great variability in the data that it was not possible to find a statistically significant difference among the monetary contributions of each type of bear-related activity (ANOVA test p¿0.05), Table 2.3.6.

This is probably also due to the small number of studies reporting the economic value of bears. In addition, data about the number and costs of tickets/hunting licences may have been reported in park reports or other grey literature that was overlooked by our study protocol of English-only academic literature. We acknowledge that our findings, relative to the economic aspects of bear-related ESs, are not exhaustive and must be used with caution.

The global contribution to bear hunting was 20,316,382 $/year, profits from bear
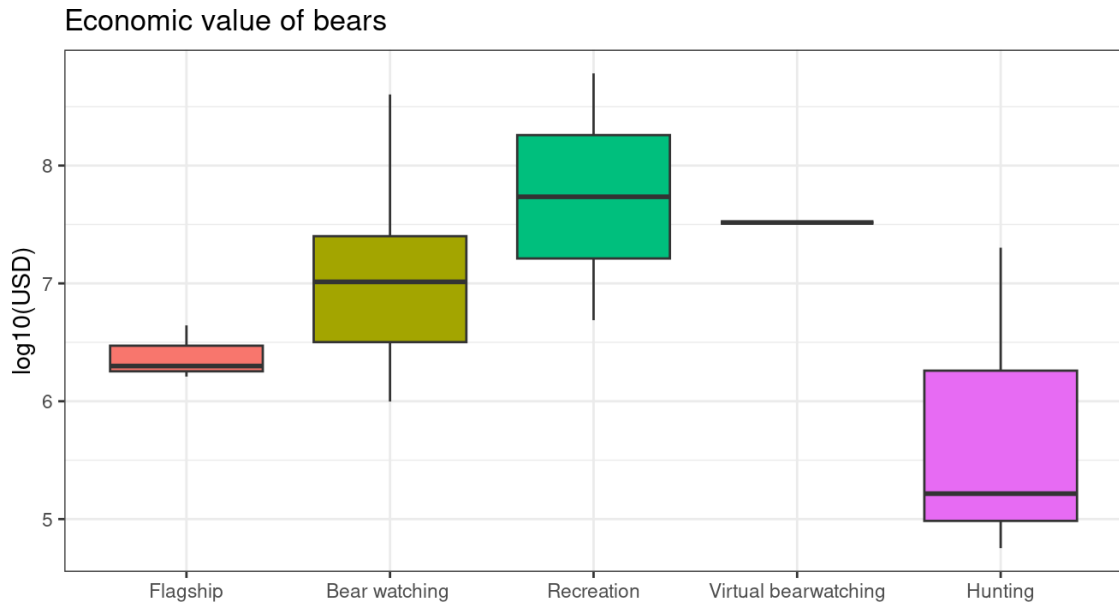
Figure 2.16: Economic benefits provided by bears N=19 (period 1994-2023) annually, updated to the value of US dollar in 2023. Recreation include general wildlife watching and tours (not bear only) and price to access Parks such as Yellowstone, where bears are present but not the only reason to visit the place.

recreation activities totalled 1,149,111,950 \$/year, while bears as a symbol are worth 8,012,291 \$ / year Even though statistically not significant, we considered that the proportion of a bigger contribution of recreation vs hunting still holds on a worldwide scale, as similar results were discovered in Canada for bears (Honey et al., 2016) and elsewhere for large mammals.

Overall, the economic evaluation of ESS provided by bears represents a critical area of research with implications for conservation policy, sustainable resource management, and community development. By quantifying the financial worth of bear-related services, stakeholders can make more informed decisions about land use planning, wildlife management, and conservation investment.

More research on the economic valuation of bear-related ecosystem services remains paramount in promoting biodiversity conservation and sustainable development efforts around the world.

Economic valuations could play an important role in various aspects of conservation, including setting priorities, assessing opportunity costs, evaluating co-benefits, and raising public awareness. This review confirmed the gap between North American bears, where the bear-watching industry is well established and its consequences on bears are also more studied (Penteriani et al., 2017). However useful, as any tool, the economic valuation of wildlife conservation *per se* has some limitations, which were well discussed in a recent review by Martino and Kenter (2023). Sometimes, economic evaluations overlook people's values, power structures, and equity considerations. To address these critiques, Martino and Kenter (2023) suggested incorporating them with new approaches, such as deliberative valuation methods and democratic monetary valuations. These alternative approaches demand a closer collaboration between conservation ecologists, economists and social scientists in order to establish legitimate, robust, and effective conservation policies to solve the com-

plicated large carnivore and human coexistence (Marino et al., 2021; Bennett et al., 2017).

2.4 Conclusions

The literature collected and analysed in this review reveals that all bear species play a crucial role in providing a diverse range of ecosystem services. While bears from North America and Europe have been extensively studied, species from South America and Southeast Asia have received comparatively less attention.

The adaptive foraging behaviours of bears enable them to provide ecosystem services to varying degrees depending on environmental conditions and resource availability. The survival of bear populations is essential to maintain healthy forest habitats and preserve biodiversity. Through predation, habitat modification, and trophic interactions, bears contribute significantly to ecosystem functioning. Therefore, conservation efforts must prioritize the protection of bear populations and their habitats to ensure ecosystem balance.

The consumption of seeds by bears diminishes the time of germination; this could be a priority in the context of global temperature change and could help to maintain global ecosystems.

Bears serve as vital agents for seed dispersal in forests, improving seed distribution distances, germination rates, and sapling growth. Although other species such as birds, squirrels, and small mammals also participate in seed dispersal, bears uniquely contribute as long-distance dispersers, complementing the roles of other animals (Lalleroni2016, Garcia_Rodriguez2021).

In particular, bears in North America contribute to soil fertility by transporting marine nitrogen into forest ecosystems. The scarcity of studies addressing soil fertility contributions by bears outside of North America underscores the need for further investigation of this topic in other regions to fully understand the global impact of bear populations on soil dynamics.

The symbolic value of bears transcends geographical boundaries, and communicating and acknowledging their connection with people can foster conservation efforts and co-existence. The bear holds a significant place in the names of European plants, reflecting diverse motivations and cultural models. In the European Alps, symbolic species such as the bear serve as cultural ecosystem services, offering insights into the intricate relationship between humans and nature.

The participation of the whole community in surveys and valuations is an issue affecting not only bear studies, but the evaluation of nature in general. A global review on the values of nature for sustainability stated that only 12% of studies explicitly consider design choices to improve the inclusion of stakeholders. We hope that by acknowledging this limit, the scientific community can move forward and become more inclusive of all views to develop the much needed effective strategies for sustainable living on the planet. Pascual et al., 2023 also underlines the importance of including valuations in the different steps of policy making: not only providing technical assistance for policy formulation but also facilitating adjustments and undertaking retrospective policy evaluations.

By promoting human-bear coexistence and implementing evidence-based management practices, we can ensure the long-term viability of forest ecosystems and the species that depend on them.

There is a knowledge gap on ESS provided by bears with tropical distributions, and the lack of resources, social dynamics, and access to remote areas presents a

limitation to the evaluation of the roles of bear species in tropical and highland ecosystems.

This chapter is a modified version of the following article, *Bears as providers of ecosystem services* . currently under review by the Journal of Ecology and Evolution.

Chapter 3

Cultural value of the brown bear

The evaluation of benefits in terms of EES has been explored in recent decades, as previously discussed in Chapter 2. However, only in relatively few cases there is a monetary estimate of the value of services, especially with respect to species outside the USA and more specifically with respect to cultural and recreational aspects (Penteriani et al., 2017). This chapter aims to fill this gap by providing a monetary evaluation of the cultural value of the Apennine brown bear (*Ursus arctos marsicanus*), an endemic subspecies found only in central Italy. This chapter presents a case study of Hedonic Price approach to estimate the value using the Advertising Value Equivalent (AVE) technique.

Flagship species such as bears could be an icon of the area where they live and attract tourists in search of nature and wilderness. The econometric technique Advertising Value Equivalent (AVE) was used to assess the value of bear appearances in newscasts and documentaries from 2015 to 2020. AVE is easy, cheap method to estimate the value of the bear as destination image. It has many limits . AVE is a controversial indicator. For instance, the AVE approach does not provide correlations between the physical location of an individual, in this case the newspaper reader or TV watcher, and the location of the ecosystem services most valued, Abruzzo nature, and the bears (Ryfield et al., 2019), not offering information about whom has been reached. To collect such socio-demographic indicators of people who value the benefits provided by bears and to measure the influence of indirect advertising on tourists, most costly and time consuming approaches would be required (for example interviews and stated preference methods, developed in Chapter 5). The research presented in this chapter was supported by WWF Italia UP H83C19000170006, within the framework of the Action A3, LIFE ArcPROM project, LIFE18 NAT/GR/000768 ArcPROM. Results presented here were an important step for the development of a bear friendly logo in another action of the same project. This evaluation of cultural value could be used to highlight the economic benefits provided by the bear and contribute to the discussions with managers and stakeholders.

3.1   Introduction

The coexistence between people and large carnivores is a complex issue, and the objectives of the conservation of a species such as bears are intertwined with the different interests of people who share same space with them. In many cases, the decline of large carnivores is caused by the conflicts with local residents, even if habitat loss and fragmentation contribute to reducing the number of animals (Macdonald,

2001).

Most of the human-carnivore conflicts can be viewed also as a consequence of the unequal distribution of the costs and benefits that predators brings at the local, national or global scale (Nelson, 2009). Many large carnivores, like bears are charismatic, "flagship species" (Clucas et al., 2008) whose existence is valued by people at national and global scales for cultural, aesthetic, or spiritual reasons, but this value has no market price (Macdonald, 2001). At the local level instead, carnivores cause damages and losses to economic activities such as agriculture and breeding and so the acceptance of their presence varies across countries depending on cultural and socio-economic factors (Linnell et al., 2000).

An effective communication of the benefits provided by large carnivores is a key to increase acceptance (Slagle et al., 2013) more effective than conveying simple biological information (Glikman et al., 2012).

The benefits are often presented in terms of Ecosystem Services (ESS), as in the review by Ripple, Estes, et al., 2014 where are reported many examples of how large carnivores contribute to the maintenance of biodiversity and other ecosystem functions.

Various research has been conducted to identify and quantify the ESS brought by bears: as seed dispersers, bears perform a vital ecological function for biodiversity (García-Rodríguez et al., 2021; Lalleroni et al., 2017), they also contribute to the cycle of organic matter (Aguilera-Alcalá et al., 2020; Crête, 1999; Hilderbrand et al., 1999) and control populations of insects (A'Bear et al., 2014). These ecological functions produce benefits that are difficult to quantify economically on the market and to communicate to the general public.

The cultural value of bears is also widely recognised (Kubo & Shoji, 2014a; Ripple, Estes, et al., 2014) and invoked in many conservation plans, however it is difficult to monetise and it has been rarely estimated in term of economic value (Martin-López et al., 2008; Norden & Tansey, 2011; Tattoni, Grilli, & Ciolli, 2017). For example, in North America, bears produce a measurable economic benefit at the local level with bear-watching (Norden & Tansey, 2011), providing a recreational option for tourists and a business opportunity for residents. According to the Common International Classification of Ecosystem Services (CICES), recreational bear-watching can be considered a Cultural Ecosystem Services (CES) as it is defined "the characteristics of elements of nature that provide opportunities" (Haines-Young & Potschin, 2018). bear-watching in Canada generates a greater economic value than trophy hunting, demonstrating that recreation is one of the most important CES that bears can provide (Honey et al., 2016). In Europe, and particularly in Italy, where bear tourism is still limited (Penteriani et al., 2017) measuring the economic impact of tourism through travel costs is still impossible. Nevertheless, some attempts have been made to estimate the cultural importance of the bears: many alpine villages have a bear in their coat of arms and many business activities boast this mammal in their name or logo (Schirpke et al., 2018) and hundreds of name-places linked to bears are distributed throughout the Italian peninsula (Tattoni, 2019).

In this work we address the market shortcut of carnivores' "local costs and global benefits" (Nelson, 2009; O'Bryan et al., 2018) by estimating one of the Cultural Ecosystem Services provided by the Appennine brown bear (*Ursus arctos marsicanus*) In the absence of an established bear-watching market in Italy, we propose to estimate its cultural value as destination promoter, improving the approach used by Tattoni, Grilli, and Ciolli, 2017 for the alpine bear population, by analysing the

volume and content of traditional media speaking about this mammal.

The Apennine brown bear is an endangered subspecies of the Eurasian brown bear (*Ursus arctos arctos*), endemic to Italy, that survives with about 80–100 individuals only in the mountains of central Italy, with the core population living in "Parco Nazionale d'Abruzzo, Lazio e Molise" (Benazzo et al., 2017; Gervasi et al., 2012). This bear subspecies is particularly suitable for promotional use because it is unique to the area and contributes to the emotional attachment of tourists to the Apennine and its National Parks (Folmer et al., 2013). The Apennine brown bear is often featured in documentaries and news paper articles that convey the image of the parks and territories that host it to potential tourists. As Common International Classification of Ecosystem Services (CICES) defines CES "as the characteristics of elements of nature that provide opportunities" (Haines-Young & Potschin, 2018), we would like to evaluate the effect of bear in the media as an opportunity for the area to be more visible for potential visitors. The content and tone used by the media to talk about bears are critical to understanding the relationship with people, and they can influence wildlife management. For example, in Spain, the media coverage of wolf damages was correlated with an increase in wolf culling, suggesting that management decisions were partly affected by the content of the press (Fernández-Gil et al., 2016). The coverage of the media also affects the volume and type of queries of internet users on search engines (Cerri et al., 2020).

In this paper, we coupled the content analysis of traditional media with an econometric technique to assess the effect of this bear in making the location more apparent to potential visitors.

- 1) measure the Apennine brown bear's CES in terms of indirect advertising in major Italian newspapers and television channels

- 2) Examine the emotions represented by those contents.

- 3) Compare the results with the management costs.

3.2 Material and methods

3.2.1 Data collection

We collected information about the Marsican bear on national press and TV channels in 5 years from the 1st of January 2015 to the 31st of December 2020.

The newspapers selected for the research were those with national circulation, having a number of printed copies exceeding 50,000 items according to the latest official data, published by "Accertamenti diffusione stampa"(Press Release Assessment) in 2019 (http://www.adsnotizie.it/_dati.as last visited in November 2021). The 16 national newspapers queried in this work were: *Corriere della Sera, La Repubblica, Il Sole 24 ORE, La Gazzetta dello Sport, La Stampa, Avvenire, Il Messaggero, il Resto del Carlino, Corriere dello Sport-Stadio, il Giornale, Tuttosport, Libero, Italia Oggi, il Fatto Quotidiano, La Verità, Il Mattino*

When available, we used the search tools of the online version of each newspapers and Google search engine otherwise, limiting the output to the domain of each individual newspaper. All the archives were queried with the same keywords (in Italian) in order to obtain comparable results: 'Marsican bear'; 'Abruzzo bear'; ' Apennine brown bear' and their plurals and feminine forms (the Italian search words

were: *ors* marsican*; ors* Abruzz*; ors* appennin** in order to include pliral and feminine forms).

We selected the following TV broadcast networks, freely visible in Italy (source www.wikipedia.it, last visited March 2021): Rai: Public service that broadcasts the Rai 1,2,3,4,5 Rai Storia, Rai Scuola and others networks; Mediaset: private company, broadcasts Rete 4, Canale 5 and Italia 1 and others free of charge; Sky Italia: paid service only; Discovery Italia: private company, broadcasts some channels such as Realtime, Dmax and others for free; Cairo Communication: private company, broadcasts La7 and La7d free of charge. Rete Blu: broadcaster controlled by the Italian Episcopal Conference, broadcasts the TV2000 channel Viacom International Media Networks Italy: private company, broadcasts some channels such as Super !, Paramount Network for free. Pay TV channels were excluded from this research because they reach a smaller and unknown audience.

We used the same keywords to query the websites of the selected TV networks. The search was supplemented by visiting the RAI archives in Trento branch, where the contents no longer available on websites are accessible to the public.

Every year Parco Nazionale Abruzzo Lazio e Molise (PNALM) publishes a detailed account of the costs of bear management. The amount of damages that bears do to beehives, agriculture, buildings and domestic animals and the veterinary expenses were summed together and compared the results.

Table 3.1: Advertisement price ranges (Euros) for 15 seconds of transmission for the various Italian TV channels that have transmitted content on the Apennine brown bear. Sources: published price lists of the various agencies (See text for details)

Channel	Minimum	Maximum
Rai1	6180	73710
Rai2	3036	19530
Rai3	2040	16500
Rai5	73	483
Rainews24	930	1125
RaiScuola	72	264
Canale 5	2000	4375
Italia 1	7400	7400
Rete4	600	1775
La5	1775	1775
La7	499	766

3.2.2   Estimation of Cultural ESS

The econometric technique used in this study is the Advertising Value Equivalency (AVE). The AVE The AVE is cost-based approach allowing to estimates how much an advertising campaign would have costed based on the space occupied on the page for the press and the duration of the television broadcasts (Jeffrey, 2005).

AVE is a technique born in the marketing field to understand the economic value of public relations and of all publications that speak of a subject. It expresses an estimate of the purchase cost of an advertisement that has the same size and the same position on the market, inside a publication or broadcast on a given day (Kee & Hassan, 2006). To calculate the advertising value, it is necessary to measure the space $\mathbf{S}$ of an advertisement and know the cost,$\mathbf{c}$ of sale of this space. Space refers to the number of columns or advertising modules for a printed page or

the broadcast time on television. The value is calculated by applying the formula (Jeffrey, 2005):

$$AVE = S * c$$

AVE has the advantage of being relatively simple to calculate and for this reason it is a widely used indicator, actually the third most used in PR studies (Watson, 2013). This technique has the known limit of neglecting the contents (Macnamara, 2006): the value is the same regardless of whether you speak positively or negatively about the bear, and we addressed this point by adding a sentiment analysis.

The cost of the advertising on the press is based on the "commercial module", the unit of measure of the minimum advertising space in the page. We contacted the main advertising agencies in Italy: "Advertising.it", "Manzoni" and "System24" that provided the technical characteristics of the commercial module and its list price in the various editions and versions (weekend or weekdays editions, black and white or colour). The size and number of modules per page varies according to the layout of the newspaper. The number of characters contained on average in the space of the single commercial form was calculated for each magazine. We calculated the number of characters for each article and subsequently, the number of modules needed to fill the space of each module according to the newspaper.

As far as TV is concerned, the various broadcasters publish price lists that describe in detail the cost of advertising. The unit of measurement in this case is a multiple of 15 seconds, the minimum duration of an advertising space and similarly to what happens for the press, the final price depends on the visibility by the viewers. The advertising price list provides different fees according to day, time of transmission and the schedule. For example, being the duration equal, it is more expensive to buy and advertising space during the football world cup final than during a documentary at 6 am. We found advertising rates on the websites of the advertising companies, and they varied according to the time of the day and of the year . Sipra (http://www.sipra.it/it/sipra/radio/offertaCommerciale/listini.html) is the enterprise that sells advertising on Rai channels, and Publitalia (http://www.publitalia.it/dinamiche/pubblicita_tabellare/listino.jsp) plays the same role for Mediaset channel.

All the videos were watched in full and for each of them we recorded the day, time and duration of the transmission in which the Apennine brown bear was spoken or shown.

3.2.3 Content analysis

Content analysis was performed in order to overcome the above-mentioned limitations of AVE (Macnamara, 2006) with respect to the tone used to talk about bears.

Digital text from newspapers was analysed in both qualitative (word clouds) and quantitative (content analysis) ways in order to organise the content. The amount of information that can be retrieved from a digital source is huge, and automatic or semi-automatic tools for content classification were applied. The available algorithms for content classification are based on word lists, emoticons and syntactic rules (Arbieu et al., 2021). As the content was in Italian, but most of the NLP (Natural Language Processing) algorithms are based on English vocabulary, we selected an appropriate lexicon database to be adapted to non-English speaking context and wildlife topic (Arbeiu et al.,2021).

Generally, these techniques are applied to polarisation analyses on social net-

Table 3.2: Advertisement price lists (Euros) used for the calculation of the AVE: size of the commercial module, average number of characters per module, the price in euros of the commercial module (excluding VAT), and if there are different prices depending on the edition, they are specified. * For *Il Sole 24 ORE* the price has been calculated per character and not per module. Sources: advertising agencies Advertising.it, Manzoni and System24)

Journal	Module (mm)	Character (n)	Price	Edition
Avvenire	42X33	334	328	All
Corriere della Sera	41X43	422	1050	All
Giornale	42X27	130	600	All
Il Fatto Quot.	41X23	200	586	All
Il Mattino	41X23	200	704	Weekend and holidays
Il Mattino	41X23	200	586	Weekdays
Il Messaggero	42X33	242	1199	National weekend and h.
Il Messaggero	42X33	242	999	National weekdays
Il Messaggero	42X33	242	140	Abruzzo weekend
Il Messaggero	42X33	242	126	Abruzzo weekdays
Il Messaggero	42X33	242	99	Frosinone weekend
Il Messaggero	42X33	242	85	Frosinone weekdays
Il Resto del Carlino	42X33	505	732	All
Il Sole 24ORE *			2.4	All
La Repubblica	42x21	200	529	All
La Stampa	45X30	305	250	Weekend and holidays
La Stampa	45X30	305	300	Weekdays
Libero	42x27	130	255	All

works, in which the contents to be analysed are thousands. The accuracy rate of these algorithms varies between 70 and 90%. However, most of the available tools are based on English vocabularies or are related to socio-economic or political contexts. Italian dictionaries are available but are not related to wildlife or conservation. We initially tested an automatic classification, but it provided odd results (for instance the words 'bear' and 'wild' had negative connotation in the available dictionary!). So we opted for a manual classification based on objective criteria, followed by the full reading or viewing of the collected material in order to understand the author's message. The criteria used were the following:

- The presence of words such as "fear", "terror", "dead", "killed", "torn to pieces", "failure", "error", "problem" suggested a negative content.

- The presence of words such as "exceptional", "beauty", "rare", "precious", "uncontaminated", "unforgettable", "success", "wealth" and endearments terms suggested a positive content

- An article was classified as neutral if the sentences were limited to the exposition of the facts, without taking a position for or against the Apennine brown bear.

Reading the text or watching the video made it possible to refine the initial skimming based on the above words. We extrapolated the sentiment towards the bear and the role that it had in depicting the Apennine mountains or Abruzzo region as a possible holiday destination, although a certain degree of subjectivity inevitably remained.

Table 3.3: Number of articles about the Apennine brown bear published by the main Italian newspapers from 2015 to 2020, their advertising value equivalent in Euros and proportion of the sentiment conveyed (%).

Newspaper	Articles	AVE	Negative(%)	Neutral(%)	Positive(%)
Il Messaggero	64	194,263.4	25.0	10.9	64.1
Corriere	58	892,809.8	25.9	6.9	67.2
LaRepubblica	45	322,489.0	8.9	24.4	66.7
La Stampa	34	112,208.0	14.7	14.7	70.6
Il Sole24ore	32	19,8422.4	37.5	15.6	46.9
Il Mattino	32	180,001.6	25.0	12.5	62.5
Il Fatto quot.	7	25,086.7	28.6	14.3	57.1
IlGiornale	5	21,200.0	20.0	20.0	60.0
Il Resto del C.	4	14,647.2	0.0	0.0	100.0
Libero	1	42,25.2	0.0	0.0	100.0
Avvenire	1	807.6	0.0	0.0	100.0
Totals	**283**	**1,966,160.8**	**22.3**	**13.4**	**64.3**

3.3 Results

3.3.1 Press

The research in the archives of the national press yielded over 300 articles about the Apennine brown bear, with varied results depending on the newspapers. As expected, sports newspapers (*La Gazzetta dello Sport, Corriere dello Sport-Stadio* and *Tuttosport*) never mentioned the Apennine brown bear and neither did *La Verità*. *Il Messaggero, Corriere della sera* and *La Repubblica* were the newspapers that dedicated the most space to the Apennine brown bear (Table 3.3).

All the articles were read in full and some were discarded because not relevant to the scope of the work. Among the excluded articles there were some in which the words 'Marsican bear' were used as a nickname for sports men or politicians of Abruzzo origin. The records in which the subspecies 'Apennine' was incorrectly attributed to Alpine bears or other bear species were also discarded. Generic articles on protected species or Italian parks with mention of bears were retained, but only for the parts related to the plantigrade. Articles dedicated to Abruzzo landscape and culture in general always mentioned the Apennine brown bears, even if the focus was on other aspects. In these cases too, only the sentences referring to bears were accounted for the calculation of the AVE and not the whole article. After this screening, 283 articles were retained for the analysis (Table 3.3).

On average, the national press published 40 articles per year with a maximum of 91 in 2019 and a minimum of 18 in 2016. The trend of the large carnivore's publications on the main national newspapers is illustrated in Figure 3.1. In general, peaks can be observed on the occasion of positive events in which many newspapers reported news of births or releases, as for example at the end of 2015 for the Morena bear affair (a bear cub that was captured, treated and released). Some peaks are also due to negative events such as the case of the bear that died during capture or of the bears that drowned in a water tank in 2018.

La Repubblica, Corriere della sera, Il Messaggero, il Resto del Carlino, Il Mattino, and *Il Giornale* use the agency "advertising.it" as their licensee, which publishes all the price lists and technical specifications online. *Il Sole 24 ORE, Libero,* and *Il Fatto Quotidiano* have instead their own advertising agencies that supplied the
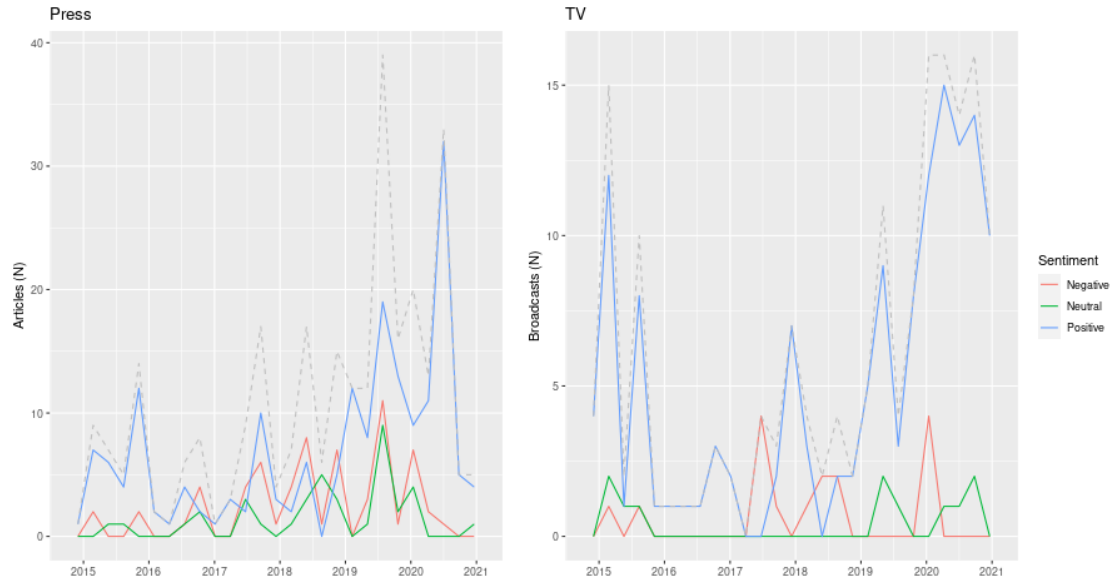
Figure 3.1: Trends of the sentiment conveyed by the Apennine brown bear on Italian national newspapers and TV channels from 1/1/2015 to 31/12/2020, the grey dashed-line is the total number of articles for the press and the total number of broadcasts for the TV.

price lists on request. For *Avvenire*, on the other hand, the editorial staff were contacted directly, as indicated by the publisher, but they never replied. In this case we used the price list of *Il Messaggero* that have comparable circulation.

The AVE brought by the press in Italy accounted for 1,966,161 euros from 2015 to 2020. The value of the releases for each newspapers is summarised in Table 3.3: the largest contribution was given by *Corriere della sera* with more than 892,000 euros of equivalent advertising value for 58 articles followed by *La Repubblica* with over 320,000 euros for 45 bear related contents. *Corriere della sera* 's contribution to the AVE was not only due to relatively high number of articles but also to the very high price of advertising: the purchase of a full page in this newspaper can cost as much as 100,000 euros, while La Repubblica's costs are at most 51,000 euros (see supplementary tables). Moreover, *Corriere della sera* dedicated some full-page articles to the Apennine brown bear, which correspond to the peaks of AVE reported in Figure 3.2.

The news published had overall a positive tone towards the Apennine brown bear around 64% of the times (N=182), negative 22%(N=63) and neutral 13% (N=38) with a variable degree across journals (Table 3.3). The negative articles mainly concerned episodes of road accidents, raids of bears in inhabited centers and discovery of dead bears, no attack to people was reported in the press.

3.3.2 Television

During the 6 years considered in this study (2015–2020), the Italian national channels broadcast 166 contents featuring the Apennine brown bear, for 17.89 hours of total broadcast time. Bears were on show for 15.55 hours in documentaries (N=122) and for 1.34 h in the news (N=14). The average broadcast duration for a documentary was 8.14 minutes (10 sec–50 min) while for a news story it was 1.83 min (5 sec–12 min)
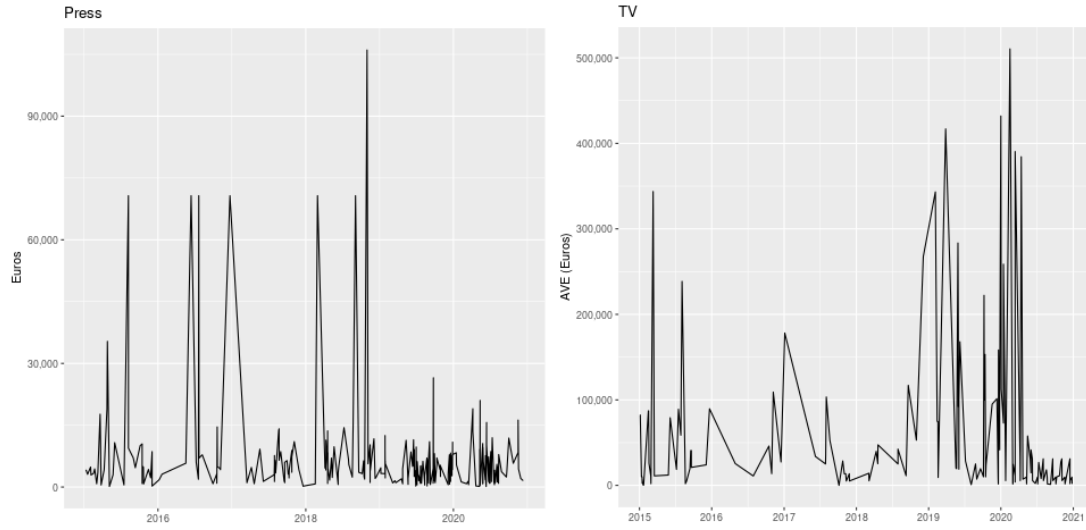
Figure 3.2: Trends in the AVE (Advertising Value Equivalent) of the Apennine brown bear in the Italian newspapers and TV channels of national relevance from 1/1/2015 to 31/12/2020

On average each year had 27 footages featuring Apennine brown bears, with a maximum of 64 in 2020 and a minimum of 6 in 2015, the general trend is shown in the grey line of Figure 3.1.

The passages on Rai networks were the majority, particularly on Rai3 and Rai5. This result, although realistic, given that even searching the archives on the internet alone reflected a greater interest in the bear by RAI, was influenced by the greater availability of reference sources for public versus private networks. Further details are given in Table 3.4.

Table 3.4: Type and number of television broadcast featuring the Apennine brown bear on air from 2015 to 2020 in the main Italian TV channels. Docs stands for documentaries, Total is the sum of documentaries and news, the advertising value equivalent (AVE) is expressed in Euros and the proportion of the sentiment conveyed in precent.

Channel	Docs	News	Total	AVE	Negative(%)	Neutral(%)	Positive(%)
Rai1	7	11	18	2,043,286.7	27.8	5.6	66.7
Rai2	10	6	16	1,139,903.3	0.0	25.0	75.0
Rai3	29	13	42	4,893,238.4	14.3	9.5	76.2
Rai5	58	0	58	570,818.4	0.0	0.0	100.0
Rainews24	1	1	2	22,140.0	0.0	0.0	100.0
RaiScuola	8	0	8	32,239.4	0.0	0.0	100.0
Canale5	4	12	16	352,941.7	25.0	12.5	62.5
Italia1	0	1	1	42,426.7	100.0	0.0	0.0
Rete4	2	0	2	10,080.0	0.0	0.0	100.0
La5	1	0	1	11,005.0	0.0	0.0	100.0
La7	2	0	2	252,900.0	0.0	0.0	100.0
Totals	**122**	**44**	**166**	**9,370,979.6**	**9.6**	**6.6**	**83.8**

Most of the content conveyed a positive messages of the Apennine brown bear and its natural environment: 16 videos were negative, 11 neutral and 139 positive (9.6%, 6.6% and 83.8% respectively) as reported in Table 3.4.

Table 3.5: Comparison of the management costs (Euros) sustained by Parco Nazionale Abruzzo Lazio e Molise (PNALM) and the advertising value equivalent (Euros) of the Apennine brown bear on the Italian media from 2015 to 2020. N indicates the number of TV passages or published articles per year. The costs of bear management includes veterinary expenses and reimbursment of damages made by the bears inside PNALM as published by the park.

Year	AVE TV	N TV	AVE Press	N press	AVE (press+TV)	Costs	% damages
2015	1,525,701.5	33	299,156.1	36	1,824,857.6	62,466.1	3.4
2016	232,776.7	6	284,383.9	18	517,160.6	136,969.9	26.5
2017	526,925.2	15	169,124.5	33	696,049.7	140,609.5	20.2
2018	653,965.5	12	475,940.1	44	1,129,905.6	51,247.4	4.5
2019	3,560,774.5	36	411,693.8	91	3,972,468.3	91,359.3	2.3
2020	2,870,836.2	64	309,921.7	61	3,180,757.9	52,399.2	1.6

The 16 TV passages classified as negative reported traffic accidents, the killing of bears or episodes of confident bears, while the 11 neutral mainly were about minor damages to agriculture or hen houses.

The AVE was calculated by applying the prices published by the agencies for the given day and time of the broadcast. In a few cases, the official pricing was not available for the date of interest and it was necessary to estimate the price based on a different period. For instance, Publitalia, the advertising agency of Mediaset networks, published the price lists only from 2018 onwards. For the 3 records of 2017 we used the price of the same day, time and format of 2018.

In Rai5 and RaiStoria channels, advertising was cancelled by law since May 2016. However, since the documentaries spoke positively about bears and Abruzzo, we decided that they can be considered as destination advertising. We encountered 50 of such cases and we used the latest available price list with an increase of 5% per year (source:*Il Sole 24 ORE*) to adjust the price to year of transmission.

The overall AVE for the Apennine brown bear from 2005 to 2020 exceeded 9 million euros (9,370,980). The most valuable documentary was entitled "Abruzzo, barefoot in the park" broadcast within the LineaVerde format for a total 500,000 euros. Wild Italy and Geo formats also transmitted bear documentaries (including replicas) 33 and 22 times. To our best knowledge, no bear documentary received any public sponsorship from the local Film Commission agencies.

3.3.3   AVE and management costs

The AVE of Italian TV and press taken together summed up to 11,321,199.7 euros, whereas the damages for the same period are 535,051.4 euros, a 4.7 % of the value of the services provided by the bear as destination promoter (Table 3.5).

The 166 appearances of the Apennine brown bear on TV have a higher value than the 283 articles in the newspaper and because they reach a wider audience.

TV coverage of the bears tends to have a more positive tone than in the press Figure 3.1.

3.4   Discussion

In this work, we tried to contribute to the plea raised by many authors, such as Nelson, 2009; O'Bryan et al., 2018; Ripple, Estes, et al., 2014, that research should
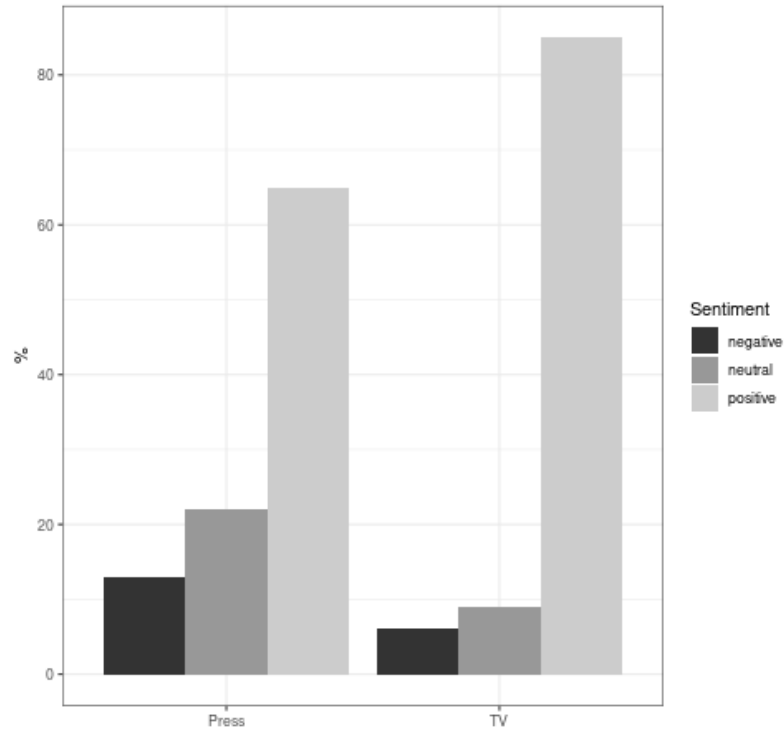
Figure 3.3: Mood expressed by the main Italian media about the Apennine brown bear from 2015 to 2020 (press: N=283; TV: N=166).

focus on defining the beneficial contributions of predators in economic terms instead of only assessing the costs. The possibility of accurately giving a monetary evaluation of a single species, and what these values really represent is being debated and Martin-López et al., 2008 in the cited review warns about possible methodological bias and interpretations and encourage the collaboration of interdisciplinary teams of ecologists and economists. In this study, we selected a widely used econometric indicator, the AVE (Watson, 2013) to estimate the value of the Appenine brown bear as an advertising agent for the area of Central Italy, the only place where this subspecies is found in the world, analysing media placements. and their contents from 2015 to 2020. Although criticised by some authors, as AVE does not allow projections on the revenues that can be generated following the realisation of that particular message (Macnamara, 2006), this technique is found to produce realistic estimates Kee and Hassan, 2006. However, in the case of the Apennine brown bear, the objection raised by Macnamara, 2006 did not apply, as the bear is not a market good from which revenues are derived. So we deem that AVE, coupled with sentiment analysis that showed that the majority of contents had a positive tone, provided a reliable estimation of the value of this bear as destination image.

The overall AVE of 11 million euros and the positive tones associated with the Appenine brown bear is probably an underestimation of the real value, because some contents might have been missed, especially on private TV, and we did not consider local newspapers and TV channels that reached only part of the population. Nevertheless, this figure could be particularly useful in communications between local government and stakeholders and could justify an increase in management measures to conserve the species, as this cost is less than 5% of the advertising value. The price provided by the agencies was the standard the market price, obviously agencies

can offer more or less convenient prices to some customers in relation to the volume of advertising purchased or other commercial agreements. The value calculated here could also be used to develop incentive-based approaches for bear conservation (Nelson, 2009), or in any other instance that requires an easy-to-calculate indicator.

In general, the number of articles and videos fluctuated with time, which likely reflects the biology of the animal, which is in hibernation for several months and therefore has no news during the winter months. Relative peaks are found in different years, with a maximum for the press at the end of 2019 and for TV in 2020 (Figure 3.1).

The comprehensive vision or reading of the material enabled us to explain the surge in media attention to specific events, particularly the peak of bad news in the newspapers:

- 2015. The peak at the end of the year was due to several articles and TV news about Morena, a bear cub captured and released, and the death of the old bear called Sandrino. Many repetitions of the documentaries "Big Five of the Mediterranean" on Rai5 and "A country for bears" on Rai scuola were responsible for a peak in TV.

- 2016. There were not many press releases: at the end of 2016 the investment of a bear is responsible for a negative peak, preceded by a positive peak for the news about some bears.

- 2017. Two peaks overlap, a positive one for news stories about bear cubs and for the documentaries 'Wild Italy 4' and a negative one due to bears loose in the village.

- 2018. Negative news outweighs positive news in the press. In spring 2018, several newspapers critically report on the death of a bear during capture, and in autumn several newspapers report on the drowning of three Apennine brown bears in a tank. On TV positive contents held thanks to the reruns of the Wild Italy 4 documentary.

- 2019. Good news peaks in the spring with the birth of 11 cubs and the resumption of courtship between two adult bears. Good news also peaked in autumn, when a bear cub is found and reunited with its mother. At the same time, there is also a negative peak due to some car accidents and the acquittal of a person who had killed a Apennine brown bear with a rifle. It was a positive year on TV too, due to reruns of the documentary Wild Italy 6 "The carnivores of the forest", and of various documentaries and interviews on GEO and other channels.

- 2020. The year begins with news of new litters (a record 16 cubs) including the exceptional female bear with 4 cubs who was spotted many times during summer 2020, and that went viral on social networks.

Media analysis is starting to be applied to natural sciences, especially toward iconic or endangered species (Di Minin et al., 2016; Fink et al., 2020). We also analysed the mood conveyed by the collected material, not only to overcome the limits of AVE but also because emotional and cultural attitudes are important in understanding the relationship between people and nature (Cerri et al., 2020). Large carnivores often receive biased and negative coverage, increasing fear in the public and lowering tolerance toward predators at a global scale (Bombieri et al., 2019;

Figure 3.4: The most recurrent 50 words about Apennine brown bear in the Italian press

Nanni et al., 2020). In our case study, instead, the national media's attitude toward the Apennine brown bear was generally positive. In the analysis time span, we found no news about bear attacks on people, not surprisingly, since this subspecies never attacked people in the recent past (PNALM, 2020). Due to the long isolation from other bear population, the Apennine brown bear developed peculiar physical and behavioural traits, including a particular shape of the cranial bones and reduced aggressiveness (Benazzo et al., 2017). In other parts of the world, and also in the Italian alpine population, occasional attacks by bears to humans, which remains a rare event in Europe (Penteriani et al., 2016), received a great amount of attention from the media, which polarised the debate and reduced tolerance towards the species.

In general, the press reported more negative information (22%) than television (9%), with some variation among sources, Figure 3.3. This difference among sources is likely due to the high proportion of documentaries on TV that portray a positive image of nature and bears and have no counterparts in the press. The positive tones associated with this bear encourage the usage of its image in logos, trademarks, and destination advertising, since those that adopt it may gain indirectly from the Apennine brown bear's media exposure. Some local firms, ranging from perfumes to bakeries, already have a bear in their name or emblem (CT personal observation). Documentaries and movies of bears in nature, in addition to providing an image of wilderness and environment, are thought to increase pro-conservation attitudes (Skibins et al., 2023) and thus the existence value of bears (Nelson, 2009).

3.5 Conclusions

Reasoning about the economic value of the Apennine brown bear is important to safeguarding the biodiversity of the Apennines, that is, all those species that share

Figure 3.5: The logo developed for bear friendly products

the territory with the bear but are not as appealing for the general public. The economic evaluation of natural resources and the services they offer makes it possible to provide a measure of their value not only in qualitative but also in monetary terms. Increasing awareness that biodiversity brings benefits locally could allow better acceptance of the social costs necessary for its maintenance, making management policies more effective because they are also shared by residents.

The acceptance of bears by residents increases when the benefits to them or the ecosystem are communicated effectively and that generally those who work in the tourism sector are more tolerant of bears than those who work in the agricultural or livestock sector (Kubo & Shoji, 2014a), so we hope that the results can contribute to the complex dialogue between the various stakeholders. The results of this work have been and will be presented at meetings with the various stakeholders, organised within the framework of the ARCPROM project, providing a different and complementary point of view from that of the conservation of the species (see page 104. The figures shown here are not the total economic value of the bear, but the value of the cultural service that this large carnivore brought in 6 years in terms of indirect territorial advertising. An AVE of 11 million euros and the positive tones associated with the bear encourage the use of the bear as destination image, as those who adopt it could indirectly benefit from the media visibility of the Apennine brown bear.

This research was carried out as part of the Life ARCPROM preliminary actions. The analysis presented here was used to develop a bear-friendly brand that, at the time of writing, has been adopted by 27 small producers (source WWF Italia) including beekeepers, farmers, truffle and olive oil agricultural companies.

Bear-Friendly producers are committed to spreading the message of human-bear co-existence. In return, the Majella Park is committed to promoting Bear-Friendly products and the producers themselves, who are allies of the Park in protecting the Marsican brown bear.

The Bear Friendly brand was created as part of the European LIFE ARCPROM project – Welcome Back, Friendly Bear. More information can be found at this link

This chapter has been published:

Clara Tattoni, Marco Galaverni, Antonio Pollutri, Damiano G. Preatoni, Adriano Martinoli, Jorge E. Araña (2024) Not only seeds: a cultural ecosystem service provided by the Apennine brown bear, Human Dimensions of Wildlife, 29:1, 14-29,

Chapter 4

Perception of the landscape and its services

This chapter delves into a case study that examines how individuals' preferences for Ecosystem Services (ESS) can be inferred through the analysis of postcard sales data. Over different time periods, the same landscape has shown varying degrees of ESS, influenced by changes in forest and grassland cover. Each postcard serves as a time-specific snapshot of the ecosystem, with the presumption that customers selected images they perceived as more natural or aesthetically pleasing. The estimation of ESS attributed to forest landscapes over time encompasses aspects such as biodiversity, timber production, CO_2 sequestration, and hazard protection. Notably, people showed a preference for historical landscapes that maximized a variety of ESS, despite these not representing the current environment they experience. This indirect approach to gauging preferences is beneficial because it does not require individuals to have an understanding of complex concepts such as carbon storage or biodiversity. Nevertheless, a limitation arises as the dataset employed in this analysis is distinct and derived from non-digital origins, posing challenges to replication. Despite these constraints, the findings offer insightful perspectives about integrating people's aesthetic values into park management.

4.1 Introduction

The European Alpine environment underwent a dramatic change from the 1950s to present due to socio-economic changes (MacDonald et al., 2000; Sitzia et al., 2010). The migration to cities, the abandonment of the traditional agricultural activities and, in some areas, the new nature-oriented silvicultural regime lead to an increase in forest coverage. This forest coverage increase can be considered as a re-naturalisation of the previously heavily exploited environment, at least until about the 1980-1990 (MacDonald et al., 2000; Tattoni et al., 2010). This change led to an increase of mammals and birds species as well as in the services provided by the forest: such as protection against landslides and avalanches (Schirpke et al., 2014) and carbon sequestration (Egarter Vigl et al., 2017). After the 1990s, the forest coverage continued to increase but the landscape tended to loose its diversity in terms of ecosystem mosaic, becoming more homogeneously covered by trees. The forest started to occupy grass meadows, which are classified as priority habitats by the UE (92/43/EEC) because of their richness in plant and animal species typical of the Alpine open areas(Tattoni, Ianni, et al., 2017; Tattoni et al., 2010). Despite the public incentives to mow the grasslands in order to keep those habitats free from

newborn trees, these measures were not effective everywhere, and the afforestation trend is generally still ongoing (Orlandi et al., 2016). Forests are also growing at higher elevation both due to climate change and land abandonment, invading the typical Alpine grasslands (Sitzia et al., 2019). Extensive agro-ecosystem, like the mountain traditional cattle breeding, are perceived positively by people because they are linked to a historical traditions, familiar economies and traditional values (Tattoni, Ianni, et al., 2017)

Schirpke et al. 2016 reports that the demand for pleasant landscapes is an important topic for tourists in the Alpine region, and several ecosystem services are linked to the complex structure of habitats that is perceived as landscape. The importance of the Ecosystems Services (ES) in the framework of sustainable governance is a well acknowledged concept (Cantiani et al., 2016) and several studies tried taking into account people's values and expectations about forest coverage and composition (Grêt-Regamey & Kytzia, 2007).

ES quantification and mapping are a priority for decision making (Peña et al., 2015), however an estimation of ES at a single point in time is not sufficient to fully inform managers (Renard et al., 2015). In order to understand the ecological, social and economic drivers that created the current situation it is paramount to take into account both time and space in the assessment of ES (MacDonald et al., 2000; Renard et al., 2015; Rhemtulla & Mladenoff, 2007).

Cultural Ecosystem Services (CES) such as aesthetic preferences are difficult to quantify and there is a lack of an established approach to their assessment. The use of photo surveys of various landscapes and their features has been proposed by (Peña et al., 2015; Schirpke et al., 2016) but the investigation of how the aesthetic value of a landscape changed over time has never been evaluated by photo surveys but rather derived by biophysical measures and ecological metrics.

Ode and colleagues (2008) proposed a framework to evaluate the relationship between landscape visual indicators quantitative landscape metrics. GIS based metrics derived from photos and maps proved to be appropriate tools for the descriptions of some features in the landscape, but the assessment of aesthetics cannot be based on quantitative information only. A combined approach using several data sources is considered to be the most appropriate (Frank et al., 2013; Ode et al., 2008). In a combined study by Frank et al, (2013), visual assessments of photographs resulted highly correlated with GIS calculated landscape metrics such as Shape Index, Shannon's Diversity Index, and Patch Density.

Visual choice tests are being used in forestry research, for example, to determine preference for the presence of trees in rural areas (Di Cristofaro et al., 2020) or for different forest management (Riccioli et al., 2018).

ES general trends over time and at large scale are crucial for national and EU policy making, nevertheless local analysis at small scale are equally important in order to account for stakeholder preferences, regional management and traditions and provides the data for up scaling and comparison with other areas.

The landscape of the past can be appreciated and reconstructed also from old postcards, even if some limitations exists due to uncertain dating and even image manipulation to create some effects in the photos(Sawyer & Butler, 2006). Nevertheless, some scholars successfully reconstructed the past environment from postcards in natural and urban areas (Arreola & Burkhart, 2010), and even measured past sea level (Motte & McInnes, 2019). Postcards are primarily icons of a touristic destination and people chose a postcard that evoke positive emotions towards that place and promote the desire to travel to that place (Yüksel & Akgül, 2007). Some

authors claims that postcards transmit the environmental values of people and nations (Winiwarter, 2016) and that the choice of an image can represent also the social function associated with a certain landscape (Markwick, 2001).

The aims of this work are 1) to analyse the state of different ES at time steps comparable with the historical postcards availability and 2) to evaluate the aesthetic preferences of the landscape over time from postcards. The first aim was attained collecting data from multiple sources and processing them with GIS when not directly available.

For the second goal, we used postcards to assess the aesthetic value of changes in an Alpine landscape over time. The assumption is that people indicate their preferences when selecting a postcard of a landscape, and that by analysing the sales of the various postcards, the aesthetic values of the changing landscape may be measured over time. Data from the postcard market for the past 20 years were utilised to quantify people's preferences for contemporary and previous landscapes, with generalised linear modelling applied to disentangle the effect of the various features in the photographs. Combining all the above results, we examined which ecosystem services are behind a perceived attractive landscape and suggest management solutions to maximise the benefits.
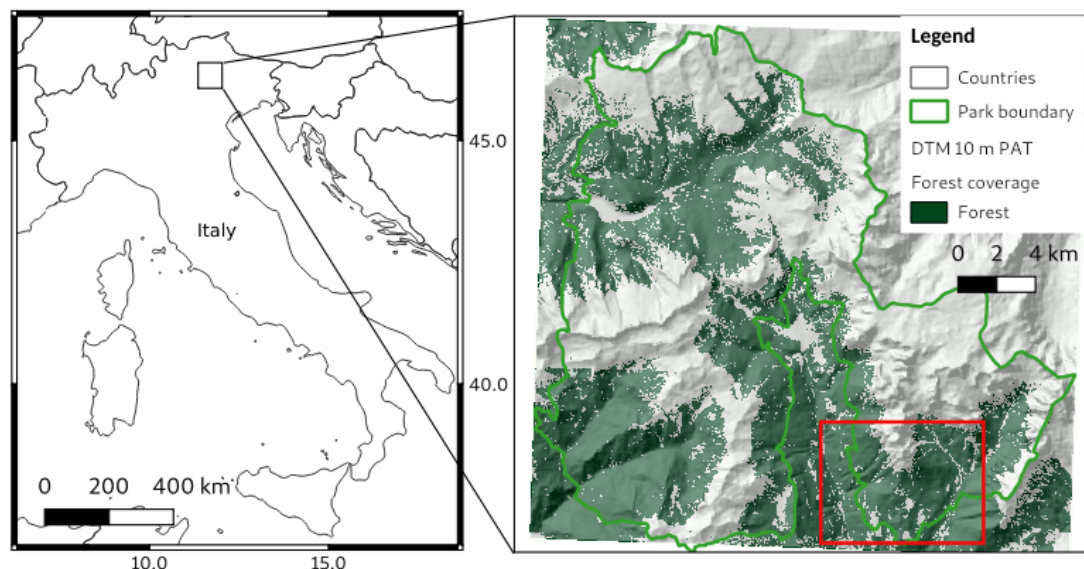
Figure 4.1: Location of the study area in the Italian Peninsula (left) and the enlargement of Paneveggio-Pale di S. Martino Nature Park (right). The background is the hill shade calculated from DTM (Digital Terrain Model, 10 m) and present forest coverage. The red square is approximately the area pictured in the postcards of Fiera di Primiero of Figure 4.2. The legend refers to both maps.

4.1.1   ES evaluation

In order to estimate ES over time a series of map and data were gathered from different sources. We used to the Common International Classification for Ecosystem Services (CICES), proposed by the European Environment Agency, because it is considered the reference for ecosystem services research (Burkhard & Maes, 2017), even though other functional classification have been proposed(La Notte et

al., 2017). Spatial analysis was conducted using the latest versions of GRASS GIS (GRASS Development Team, 2022) and QGIS (QGIS Development Team, 2015). All maps have a resolution of 10 m, projection UTM 32N.

Provisioning ES

Forest Multi temporal GIS data about forest coverage and open areas in PPSM from 1860 to present in were available from previous studies of the authors in the area (Ciolli et al., 2012; Tattoni et al., 2010).

Cattle Number of animals raised as cattle in the area. In the last decades bovine breeding decreased while sheep and goat breeding increased due to many factors, including economic convenience, people migration from and to the mountains, a complete description can be found in Zanella et al. 2010 (Zanella et al., 2010).

Priority habitats we measured the extension of the open (non forest) priority habitats present in the area according to Natura 2000 (European Environmental Agency) over time. We used the map of priority habitat provided by the PAT . The following habitats were considered: "open areas species-rich Nardus grasslands(Natura2000 code 6230)", "Semi-natural dry grasslands (Festuco-Brometalia)(6219)" and "Active raised bogs"(7100) and other bogs. The past extension of these habitats was manually digitized against historical aerial imagery, assuming that they extended where the forest invaded the area around the present priority habitats. This estimation is conservative, as former open areas could have hosted priority habitats but were not presently mapped because they completely turned into forest.

Timber The total forest growing stock almost doubled in Primiero between 1960 and 2015 increasing from 3,336,357 to 6,322,134 m^3 (Della Giacoma, 1992; Gottardo, 2015). The process was fostered by a nature-based silviculture approach implemented by the Trentino Forest Agency to guarantee sustainable forest management (Wolynski, 2009). With this approach, both tree density and species diversity increased, thus leading also to a more productive forest in terms of timber quality and quantity (Tattoni et al., 2010). Nevertheless, wood demand cannot be satisfied from the local wood supply chain and wood industry must rely on foreign markets.

Wildlife : we used the data of recreational hunting to assess how the presence of four species changes through time.

Data about recreational hunting in the hunting district of Primiero was kindly provided by the local hunting association (ACT/PAT). According to the hunting plan, 5% of individuals of game can be killed. Literature shows a good agreement between population size and legally killed animals. Poaching happens but it is not considered . So data from ACT provide information about hunting bags (recreational hunting) that can be used as a proxy for the population of various game species (biodiversity indicators). Hunting data during the time span considered in this study have been collected and archived with different methods. The most homogeneous unit of data aggregation is at "hunt reserve" level. For the purposes of this study we were interested in a general trend in hunting bags, so we considered the reserve of Primiero, that mostly overlap with the present boundaries of PPSM and with the

landscape pictured in the postcards. Probably, the actual number of game taken in the whole park area is slightly higher than the one reported here but we chose to be conservative and do not include large areas outside the park. The trends for all the species are consistent with those reported for the neighboring hunting reserves and for the whole province, so we considered it robust enough to be used for the purpose of this work.

The species considered in this work are

- Deer (*Cervus elaphus*) was extinct in the area in the 1950 for habitat loss and over hunting. In 1963, 7-8 individuals escaped from captivity and repopulated the area, ant then followed a reintroduction program (Nardin, 1994).

- Roe deer (*Capreolus capreolus*) was never extinct in the study area, even if the population was very small in the 1950s. Roe deer ecology requires an alternation of forests and open areas that are needed by the species for foraging. Competition with deer and open habitats loss led to a decrease in number and in average weight of the gamed individuals.

- Capercaillie (*Tetrao urogallus*) has always been present in the study area for the time span considered in this work. The capercaillie is an icon of the Alpine environment conservation, because it requires a series of different habitats to complete its annual life cycle: from open meadows for lek, to mature woodlands in the winter to thick under storey during chick breeding. The hunting of this bird was not regulated until 1973, then the number of game capercaillie was assigned by the local government based on counts until 1991 when the hunt was legally banned due to the decline of the population. (Angeli & Brignoli, 1994). Despite the ban, the species is still declining in the Park area due to habitat changes (Sitzia et al., 2019).

- Black grouse (*Tetrao tetrix*) The species is the only one of its family (tetraonidae) whose hunting is legal in Trentino. The black grouse, has similar ecological needs to those of the capercaillie, and the afforestation trend reduced and fragmented its habitat. The species can be considered stable since 1994, thanks to the forest management within the park with some exception in limited areas of the Park, like the Paneveggio forests, where it is still declining. The species can be hunted in only one sector of the park, but bird is now so rare that hunting is limited to one unit per year.

Regulating and maintenance ES

The study area, being a mountain environment, is prone to avalanches, boulder falling and landslide. The risk of these events were considered constant over time, but the protection provided by forest changed over time according to the extent and location of the trees. The maps of the various levels of risk were provided by the local agencies of "water and energy" and "risk prevention" of PAT as reported in the "General Plan of public water use" (PGUAP, 2006). For each time step, we estimated the area of forest that overlapped with the areas of moderate and high risk. All hazards were then grouped into a single class called Protection from hydro geological hazard, by summing the extent of protection forest in each reference year.

Flood protection Hydrological risk was ranked in 5 classes, from R0 (no risk) to R4 (very high risk), we considered as protection forests the areas that overlapped with classes (of moderate, average, high and very high risk).

Avalanche protection Avalanche areas where also taken from PGUAP. The area of protection forest was obtained by GIS overlapping forest extent over time with the risk map provided by the PGUAP

Landslide protection was similarly calculated from the PGUAP map

Boulder protection To estimate the amount of forest that protected from boulders we used the vector map of "forest with protective function against boulder falling" (1:10,000) provided by the Forest and wildlife service of PAT. We considered those area mapped as forests with direct protection effect in each reference year.

Carbon storage The carbon stored in the forest was estimated from the forest inventories available from the forest Service of the Province of Trento (Della Giacoma, 1992; Fauna & Ufficio Foreste e Fauna, 1988; Gottardo, 2015), biomass estimation and thus Carbon stock calculation was based on (Notarangelo et al., 2013). The total Carbon stock used in this work accounts for above and below ground biomass, dead wood, litter and soil.

Cultural ES: Aesthetic value from postcards

The industry of the postcards declined dramatically after 2010, many typographers moved to a different business or closed in Trentino (Pedrotti personal communications) as well as in other parts of Europe (Haynes, 2017). The habit of sending postcards used to be very common until the year 2007-2010, and reasonably captured a representative sample of the population across age (López Hurtado, 2013) and probably income, as postcards used to be cheap. Nowadays people still send postcards, but after the advent of smart phones with cameras, people share picture over social media (Milne, 2012). Postcards buyers still exists, generally are computer illiterate people, children or amateurs (Gilli and Pedrotti personal communications), so the sample of postcard buyers after the year 2010 would not be a representative sample of the population. This bias is known in the marketing sector, where online surveys are more likely to reach the new generations compared to older people with limited access to the internet (Bianchi & Biffignandi, 2017).

The hypothesis is that the act of buying a postcard can be considered as an experiment where the buyer expresses a preference for the landscape. The same view of the village and the iconic Dolomites as a background, Figure 4.2, was on sale in various versions, taken from approximately the same viewpoint over a time period of 40 years. The buyer could then choose her favourite look of the landscape.

Previous research suggested that postcard buyers demand pictures that correspond to their personal taste, and often attempt to replicate postcard landscapes taking photos with their own cameras (Stylianou-Lambert, 2012). On the other hand, postcard producers design postcards in ways that are most likely appreciated by buyers (Markwick, 2001). Therefore, the behavioural hypothesis of this study is that postcard buyers evaluate all available postcards and choose the preferred landscape based on their taste. In this way, buyers reveal their preferences for landscape attributes. The choice of a postcard is assumed to be made exclusively on landscape preferences, with no budget constraints or income effects. In fact, the cost of postcard is small and constant regardless of the landscape. The intrinsic idea is that if landscape is valued by buyers, it should explain postcard demand, and the trade-off between landscape attributes and other determinants of demand can be used to implicit value changes in landscape characteristics (Garrod & Willis, 1992).

Valuing Ecosystem Services is a hard task, since citizens can not buy or sell them in a standard market, and therefore traditional market-based economic models cannot be applied. There is a long tradition of methodologies developed to tackle this issue under the name of non-market valuation techniques such as the hedonic method (see Taylor, 2003 for an overview).

Figure 4.2: Set of postcards on sale depicting the typical landscape and the Village of Fiera di Primero in the Alps (Italy) over time. Images kindly provided by A. and O. Gilli

We considered the postcard selection for sale at the "Ottica Gilli" in Fiera di Primiero village, the town's main postcard store. Many of the photographs on display were taken by Mr. Gilli himself, and he was able to provide the date of the shoot. Both colour and black and white (BW) postcards of various subjects were on sale. The choice was among 57 colour postcards and 40 black and white ones featuring various subjects that were classified in the following classes: landscapes, churches, lakes, villages, hotels, Alpine huts, flowers, flowers and animals (the latter is a close up of an animal or plant or both). Since BW photographs were not easily

comparable to the rest of the collection, the analysis focused on the colour postcards only. We assumed that buyers of BW postcards could have a particular interests in history and/or photography, and their decision was thus motivated by factors other than the appeal of the landscape. Gilli had two providers, one for the colour postcards and one for the BW. The provider of BW postcards was unable to provide data about the business. Gilli is still remnant of the last big order of BW postcards he made in 2010.

Data about the sale of postcards from the shop Ottica Gilli, were obtained from the paper and hand written archives of the companies Hermes and Ghedina, which supplied the shop by printing photographs taken by Mr Ovidio Gilli on postcards. Pedrotti's printing firm, Hermes, had the exclusive right to print postcards in Trento from 1985 until the company's closure in 2008. Ghedina provided BW postcards only. We are thus captured the whole volume of the sales. From 1990 to the present, the shop has been selling the entire series of historical photographs of the same landscape taken by the shop owner and photographer over time Figure 4.2. All the postcards cost now 50 cents each and, even though the price has changed in the past, they used to be the sold at the same price. So the postcards choice has never been affected by its price.
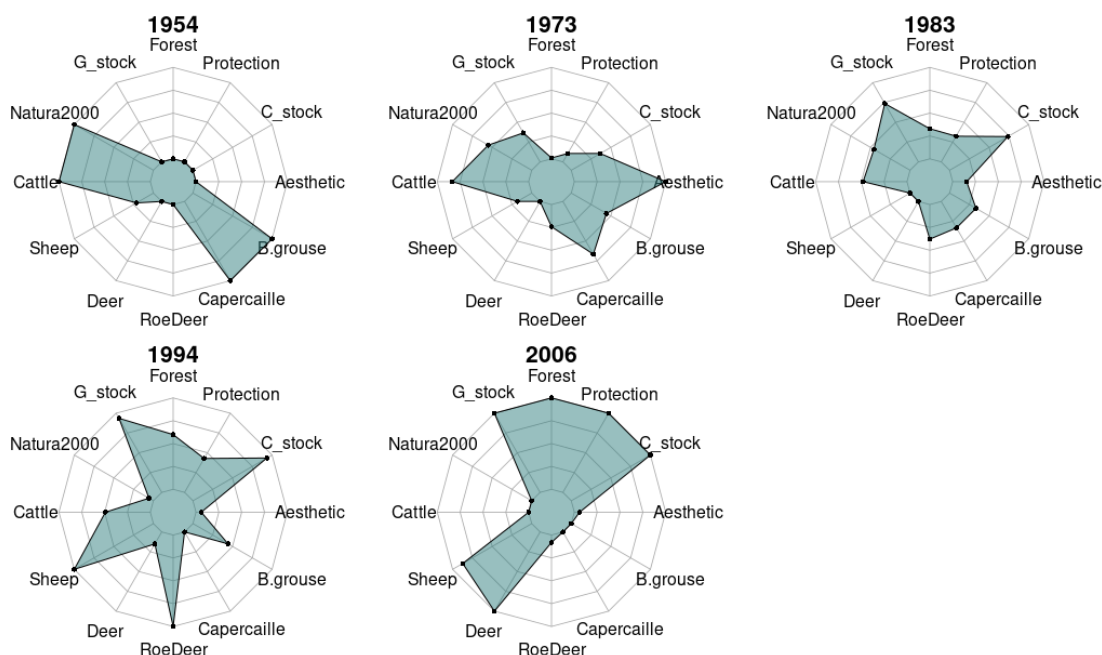
Figure 4.3: Ecosystem services change in the area of Paneveggio-Pale di S. Martino Nature Park (Italy) over time. Data have been re-scaled to 0-100 interval to facilitate comparisons. G_stock stands for Growing stock, C_Stock Total carbon stock, Aesthetic for Aesthetic value.

When available, we recorded the year of shooting for each picture, as well as a description of the main subject according to the following classes:

"Landscape" when the photograph depicted a landscape; "Church" when the photo depicted one or more churches, or details of a church, with no or very little landscape in the background; "Flowers and Animals" close-ups of flowers or animals with limited to no landscape in the background; "Hotel" a picture of the exact building with the name of the hotel on it; "Lake" when the photo depicted a lake in the foreground and and small amount of landscape; "Village" a photograph of

a group of houses, streets, bridges, stores or markets with little to no landscape; "Fiera in the 1950, Fiera in the 1970 , Fiera in the 1980 and Fiera in the 1990" same shot of Fiera di Primiero in that given year as in Figure 4.2; "Typical house" a photo of a typical house or details of it; "Alpine hut" the typical hut used for a mountain pasture for the grazing of cattle during the summer. We then ran a generalized linear model (GLM) with a Poisson link function with the number of sold postcards as response variable against the main subject of the image. The Poisson error distribution is suitable for count data as it forces all of the predicted values to be positive.

4.2 Results

The changes in ES from 1954 to 2006 are summarised in Table 4.1 and Figure 4.3. Forest coverage steadily increased in this period, and with it, timber availability (growing stock) and all the regulating services, including and Carbon storage. In the 1950s the forest occupied about 40% of the study area, it grew on abandoned pastures, marginal agricultural land, as well as natural grasslands covering about 52% of the area in 2006. The Natura2000 open habitats were reduced from 65.55 ha to 36.63, with a loss of 44% of biodiversity rich Alpine meadows (Table 4.1). This is due also to the reduced pressure of grazing cattle, whose number almost halved in the 50 year analysed. Sheep usually graze at higher elevation, above the tree line, on permanent grasslands. Capercaillie and black grouse populations decreased dramatically and since the 1980s both species were threatened.These birds need open area or mixed habitat to complete their life cycle, and even with the hunting ban they were not able to recover. Roe deer population increased until the 1990s, then declined again due to the competition with deer and loss of open areas (Table 4.1). Figure 4.3 show how bundles of ES evolved in the period examined.

We found 51 different colour postcards on sale, each identified by a unique catalogue number by the providers. The total number of postcards provided to the Gilli's shop from 1990 to 2007 was 320,400 and the average selling per year was 17,800 postcards. Photos of landscape were the most popular, with over 209,000 postcards bought (including Landscape and Fiera categories from Table 4.2), followed by 37,900 houses (Alpine huts and houses) and 21,000 churches. Among the landscape postcards, 78,000 (24.3%) items depicting Fiera di Primiero village in different years were provided to the shop. The postcards with the view of the village in the late 1950s accounted for 3,000 items, the same view from the 1970s 55,000, the panorama of the 1980s 11,000 and the one from the 1990s 6,000 items.

Table 4.1: Ecosystem services provided by the forest over time in the area of Paneveggio Nature Park (Italy). Open areas priority habitats include natural and semi natural grasslands according to Natura2000. Shrubs priority habitats include *Pinus mugus* and *Rhododendron hirsutum*. **Hunting data for roe deer, capercaillie and black grouse have been recorded since 1965, so for those species we used the data of 1965. **Growing stock available since 1960.

Service	Source	1954	1973	1983	1994	2006
Provisioning						
Forest cover %	(Tattoni et al., 2010)	41.7	41.8	45.09	47.87	52.01
Natura2000 (ha)	This work	65.55	52. 52	49.83	38.24	36.63
Growing stock (m³)	(Della Giacoma, 1992; Gottardo, 2015)	336357**	4371132	5416336	5976859	6159652
Cattle (N)	(Tattoni et al., 2010)	2120	1999	1736	1744	1381
Sheep (N)	(Tattoni et al., 2010)	734	637	108	3028	2655
Roe deer(N)	ACT data	42*	105	140	301	63
Deer (N)	ACT data	0	0	0	24	159
Capercaillie (N)	ACT data	3*	2	1	0	0
Black grouse (N)	ACT data	10*	5	4	5	1
Regulating						
Protection from Slides (km²)	This work	34.9	34.8	38.9	39.3	46.0
Protection from avalanches (km²)	This work	5.6	5.6	5.8	5.8	7.6
Protection from flooding (km²)	This work	210.2	209.4	210.4	216.6	231.8
Protection from Boulders (km²)	This work	6.6	7.1	7.7	8.0	8.8
Total carbon stock (m³)	This work	1757881	2303071	2853756	3149078	3245386
Cultural						
Aesthetic value (Postcards sold)	This work					

Table 4.2: Number of postcards printed for each category from 1990 to 2008.

Postcard main subject	Printed items	Percent
Church	21000	6.5
Fiera in 1950	3000	0.9
Fiera in 1970	55000	17.2
Fiera in 1980	11000	3.4
Fiera in 1990	6000	1.9
Flowers and animals	7000	2.2
Hotel	6000	1.9
Lake	15500	4.8
Alpine house	8000	2.5
Landscape	114000	35.5
Village	17000	5.3
Alpine hut	29500	9.2

The main subject of the photo was a good predictor of the number of postcards sold, according to GLM (Table 4.3). Except for the presence of a village without landscape, all the categories yielded highly significant results. Fiera in 1970 had the highest significant coefficient , indicating that the amount of items sold increases if they fall into this group. On the contrary, negative estimates were given to postcards depicting Fiera in the 1950s and 1990s, indicating that these images had a lower number of item sold. Portraits of nature, including the categories "landscape" and "flowers and animals" were expected to be sold better than the ones with buildings (categories houses, hotels or huts).

Table 4.3: Results of GLM model: the response variable is the number of postcards sold modelled against the main subject of the picture. Significant level of at p α ¡ 0.05

Postcard main subject	Estimate	Std. Error	p-value)
(Intercept)	8.343	0.007	¡0.01
Fiera in 1950	-0.336	0.019	¡0.01
Fiera in 1970	0.679	0.008	¡0.01
Fiera in 1980	0.269	0.012	¡0.01
Fiera in 1990	-0.336	0.015	¡0.01
Flowers and animals	0.511	0.014	¡0.01
Hotel	-0.336	0.015	¡0.01
Lake	0.207	0.010	¡0.01
Alpine house	-0.049	0.013	¡0.01
Landscape	0.502	0.008	¡0.01
Village	0.012	0.010	0.25
Alpine hut	-0.130	0.009	¡0.01
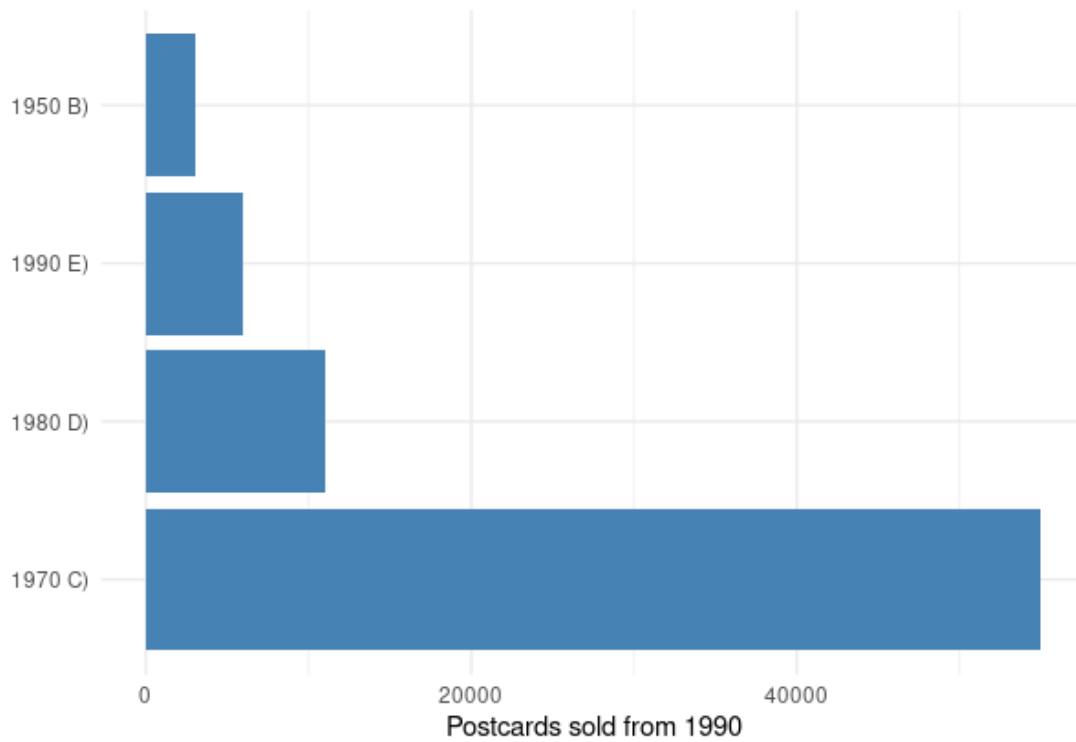
Figure 4.4: Selling of the postcards depicting Fiera di Primiero in different years from 1990 to 2010, the letters refers to the images of Figure 4.1.

4.3 Discussion

4.3.1 Ecosystem services over time

Since 1954 forest reclaimed large part of the open areas of PPSM and its surroundings (Tattoni et al., 2010). Many studies highlighted the irreplaceable role played by agro-ecosystems in the preservation of biodiversity and enhancement of the multi functionality of the forest through the historical balance between open and wooded areas in the Alps in general (Brambilla, 2019; Brambilla et al., 2015; Sitzia et al., 2010) and in Trentino in particular (Ciolli et al., 2012; Tattoni, Ianni, et al., 2017; Zanella et al., 2010). The progressive afforestation led to an increase of many ES, including protection from hydro-geological hazards, wood production and forest diversity. The latter is very important for the resilience of the ecosystem in case of extreme events.

A thicker forest coverage together with biodiversity improvement contributed to enhance both soil quality and quantity through time leading to significant improvement of forest resilience to major disturbances like fires, storms and pests. The amount of active soil is directly connected with the capability of a forest environment to restore its previous state after a catastrophic event.

On the other hand, from 1954 there was a the reduction of priority habitats and species typical of open areas. Many bird species of agro-ecosystem have been reported to be threatened by such changes (Chamberlain et al., 2016), including the capercaillie, black grouse but also the corncrake (*Crex crex*) (Brambilla & Pedrini, 2013) a priority species for European Union.

The greater aesthetic value was given to the landscape of the 1970s, a moment

in the history of the study area when none of the other ES considered were at its maximum. On top of that deer was absent and roe deer population was still low (Figure 4.3). The perceived beauty of the landscape is linked to open areas, that are also host priority habitats and birds. The loss of priority habitats since 1950 is of about 30 ha (Table 4.1), in an area of more than 200 km². Removing a well selected amount of forest from a small portion of the study area could likely restore open areas and provide habitat for birds, without reducing significantly the protection and carbon storage provided by the trees. Our results could guide specific interventions to create a different scenario from the one depicted in Figure 4.3, that maximise the provision of the various ES.

The abandonment of traditional agriculture and the loss of biodiversity triggered a discussion at local political level about the possible recovery of some open areas (Osservatorio del Paesaggio, 2014, 2015). In 2000 the PAT started to give subsidies to farmers for mowing grassland to prevent forest re-invasion and conserve these habitats. From 2014 to 2018, the Forest Department cut 61 ha of newly formed woods in order to restore turf grass meadows in the district of Primiero, (Giovannini, 2017) investing public money to recreate a balance between open (pastures and meadows) and wooded areas, peculiar of the traditional Alpine landscape (MacDonald et al., 2000). These interventions aimed to restore lost habitat without affecting the forests functions and the ES they provide that increased over the last decades. A diverse and multi-functional landscape is considered the key factor to make the environment more resilient and to promote societal and economic sustainability.

These restoration measures, even if they have a cost are likely to be accepted by the taxpayer because they tend to recreate a landscape that is perceived more beautiful and closer to local identity than a compact forest. Aesthetic value only should not guide decision making, the aim of interventions should be sustainable maintenance of ES over time. The historical analysis can be useful to simulate the effect of different management options on ES to create a sustainable scenario.

4.3.2 Aesthetic preferences assessed trough postcards

We evaluated the aesthetic preference for the landscape using over 320000 postcards in nearly 20 year of business. Other studies assessing cultural value of the landscape are based on interviews or questionnaires, administered to 50-500 people (García-Nieto et al., 2013), exceptionally more (Peña et al., 2015; Schirpke et al., 2016) but usually less than 1000, whereas using postcards allowed to collect landscape preferences for a sample size of a thousand time greater. However, using postcards does not allow for a socio-demographic analysis, because this information could not be retrieved from postcard selling. A potential limit of this approach could be that the same picture can be purchased multiple times by the same person, and/or the same person likely bought multiple and different postcards at the same time. Another limit of using postcard sale lies in data gathering, contacting providers and screening the photographic material can be time consuming.

Nevertheless, we deem that our results are reliable because of the large sample size and because the habit of sending postcards reasonably captured a good sample of the population. In addition, we were able to obtain publishers records for over 20 years and the date of the images, precious information that is not always available in other studies based on postcards (Winiwarter, 2016), and allowed us to have a quantitative approach.

The selling of postcards clearly showed that landscape pictures were the most

chosen (35 %) to represent a holiday in the study area, followed by the view of Fiera di Primiero in the 1970s (17.2%) that also resulted highly significant in the GLM.

Nearly a quarter of the postcards sold in the shop depicted the village of Fiera di Primero and the Dolomites, making this view the icon of the area. The photo of Fiera included various natural and cultural elements: the village, the forest, the open areas and the Dolomites in a single image, conveying an idea of balance between people and the environment.

The great majority of people chose the postcard of Fiera taken in 1970s, even if it was different from the landscape they could observe in reality. The least preferred image was the one taken in the 1950s, where the exploitation of the forest environment was most evident, followed by the most recent one, where forest covered nearly all the sides of the mountains. The preferred image portrayed an intermediate situation between wilderness and exploitation that conveyed the idea of a traditional agro-ecosystem where forest and grassland were balanced. In this 1970 postcard, the mountains around Fiera di Primiero presented several meadows encased in a flourishing forest (Figure 4.2), giving the idea of a place where people lived and worked, compared to the present perceived wilderness and abandonment.

The preferred postcard represents the 1970s forest landscape. This period was neither the best in terms of ecosystem services nor a stable situation. It was rather a period of transformation from an overexploited environment into a more healthy forest and resilient one that still continued to show the tracts of traditional anthropic activities. It also represented a turning point in which the agro forest local economy began its transformation into a more tourism oriented reality that brought a significant economic growth. In the 1970ies the impact of tourism was still relatively sustainable in terms of numbers of tourist and impact of infrastructures.

Our results are in agreement with the findings of Schleyer et al., 2019, who reported the local stakeholders perceive the loss of historical landscape as the main threat to tourism. This fact also support the idea that postcards on sale in tourist destination could reveal relations among actors in the tourist industry and other stakeholders (Foltête & Litot, 2015). According to the questionnaire administered to local stakeholders in 2019 (Schleyer et al., 2019), it appears that the combination of natural and agricultural areas is seen as key to create the landscape that can revive the tourism in Primiero region.

In any case, focusing on biodiversity enhancement appears to be the true win-win option for achieving a long-term balanced equilibrium (Attenborough, 2020)that does not deplete natural resources or discourage local population activities. It must be obvious that this biodiversity must be investigated through the lens of landscape ecology. Concentrating local funding and activities on real problems that are also considered aesthetically positive, such as Natura2000 areas or grouse leks, may help to focus on more achievable goals. If this principle of biodiversity maximisation could be embraced by the local community, it could could promote sustainable local growth and it may help to reach more resilient communities and also reduce wildlife conflicts. These activities are often seen as practical and easily incorporated into local planning. A complex landscape can meet all of the objectives, and a small number of well-targeted initiatives may really make a difference while not interfering with ongoing positive ES trends (e.g., carbon stock) and enhancing the aesthetic value of the Alpine environment.

4.4 Conclusions

Aesthetic preferences for a mountain landscape in the Alps were quantified from postcard sales over a 20-year period, thanks to the ability to retrieve valuable information on the date of photography, which is not always available in previous postcard studies (Winiwarter, 2016). This is both our approach's strength and its biggest limitation in terms of repeatability.

We do believe, however, that assessing landscape preference from photos may be applied to online photos. The number of photographs circulating on the internet is large, both on official tourism sites and on social media, particularly Instagram, which is image-based and employs tags. The number of likes or shares of an image could be used to assess the preference for a specific landscape, with the added benefit that social media allows users to gather (some) socio-demographic information that postcards do not.

People's preferences for the landscape at a given time gave a measure of its aesthetic value; however, there is much more behind the image of that landscape: cultural perspectives, traditions (Marques et al., 2020), and different levels of various ES that that environment provides. The individual who chose a specific image may just be aware of some of the ES or may be completely unaware of them.

In other words, preferences for the landscape in a given time reflects a certain level of the ES that can be approximated by the "market share" of different postcards. Some of the services could be appreciated directly in the postcards, for instance forest coverage whereas others, such as wildlife presence cannot be directly perceived from them, but can be measured and employed in a hedonic model to test whether or not they do affect buying behaviour. Therefore, by restoring a beautiful landscape a particular policy changes the quality of many of the Ecosystem services associated with it. By identifying, measuring and using such ES measures to explain postcards demand, preferences for different ES can be elicited. These preferences are useful to inform managers to chose among alternative restoration policies and the non-market benefits associated with them Our results suggest that in the Alps a complex landscape can meet sustainability goals and be perceived as pleasant at the same time.

This chapter has been published:

Chapter 5

Estimate bear total value with SPM

In this chapter, I estimated the total value of the bear with a DCE approach, according to the framework presented in the Introduction of Chapter 1.

5.1   Introduction and state of the art

Bears are a key species in many ecosystems, providing a variety of ecosystem services that benefit humans, including seed dispersal, nutrient cycling, and tourism. However, these services are often undervalued or ignored in decision-making processes. Choice experiments have emerged as a useful tool for estimating the value of ecosystem services provided by bears, by allowing researchers to quantify people's preferences for different attributes of bear-related services. Several studies have used choice experiments to estimate the value of ecosystem services provided by bears. For example, Chan et al. (2015) conducted a choice experiment with Hong Kong residents and tourists to estimate the value of black bear conservation. They found that people were willing to pay a higher price for bear conservation programmes focused on education and public engagement, compared to programmes focused on enforcement and regulation. Similarly, Rode et al., 2018 conducted a choice experiment with visitors to Denali National Park in Alaska to estimate the value of grizzly bear viewing. They found that people were willing to pay a higher price for guided bear viewing tours that emphasised safety and conservation, compared to self-guided tours.

In another study, Liu et al. (2019) conducted a choice experiment with residents in a forested region of China to estimate the value of ecological services provided by Asian black bears. They found that people were willing to pay a higher price for forest protection programmes focused on bear conservation and ecosystem restoration, compared to programmes focused on economic development.

Notaro and Grilli, 2021 researched tourists' preferences for conservation of large carnivores in the Italian Alps using a discrete choice experiment. However, their choice cards provided totally unrealistic levels: for example, they asked about the desired number of the golden alpine salamander, an endemism of a very small area of the Alps that is very unlikely to occupy the whole study area expecting to see this creature in Trentino, while that is biologically impossible to happen. The levels of the desired number of animals ranged from 0 to 90 despite the different ecology of the species. People were also asked about the WTP for maintaining populations of wolf and lynx of 10 or 20 individuals, figures well below the minimum viable

population. In addition, the lynx is extinct in the area and it is very unlikely to return. Although the experiment is interesting, since it is the only one in our study area, the results do not have a management application.

The study of the Ethiopian wolf T. K. Estifanos et al., 2020 is a good example of realistic attributes and levels with potential application for park managers. Instead of asking only the desired number of wolves, quite a technical aspect that requires scientific background to be evaluated, people were asked the desired area of presence for the species and the possibility to see them.

In the review of Chapter 2, I showed various gaps in the usage of questionnaire to assess people's preferences and economic valuations regarding bears that can be summarised as follows:

- few authors targeted all the stakeholders in their interviews (except Kubo and Shoji, 2014a, 2016), and thus failed to have the whole picture;

- only 16 articles, published between 1994 and 2023, reported an economic evaluation of the ESS. In general, only a single or a couple of services were quantified;

- the few works that used DCE used not realistic attributes or levels, except those carried out in Japan.

The aim of this work is to fill the aforementioned gaps in the existing literature by employing a bio-economic framework (see Figure!1.2) to estimate the comprehensive value of bears. To achieve this, I developed a discrete choice experiment (DCE) questionnaire designed with realistic attributes and levels, alongside a robust methodological economic approach. This contributed methodologically to the body of knowledge, with results that hold potential utility for policy formulation. Furthermore, our approach will simultaneously engage various stakeholders. The identical questionnaire will be distributed to both the general public and experts, in order to assess the impact of the informational context on their responses.

5.2 Study area

The research area is the Autonomous province of Trento, Italy ($46 \circ 26'44''N, 11 \circ 10'23''E$), a harsh mountain region of 6,200 km^2 in the Central-Eastern Alps. This region has a population of approximately 500,000 people living also in the mid-altitudes with an average of 87 inhabitants/km^2. In Trentino, forests encompass about 63% of the province, the composition is typically alpine: The Norway spruce forests represent 32 % of the coverage, Beech 14 %, Larch 13 and Silver fir 11%, the rest are covered by mixed forests of various broadleaves and conifers. Lower elevation areas are highly anthropic with intensive agriculture, especially grapes and apples, urban areas, and infrastructures.

Life Ursus Project

The brown bear is a species of Community interest requiring strict protection (Habitats Directive (92/43/EEC),Annex II and IV). There are two populations in Italy: one in the Central and Eastern Alps and the endemic Appennine brown bear mentioned in Chapter 3. In the 1990s the species was present in the Alps only in Trentino, with 3 male individuals left. Since natural recovery of the population

was impossible, the brown bear was reintroduced in the central Alps thanks to the LIFE *Ursus*. The European funding started in 1996 by the Adamello Brenta Nature Park, in collaboration with the Autonomous Province of Trento and INFS (National Institute for Wild Fauna, now merged into ISPRA) and lasted for a total of 8 years. Numerous partners collaborated in the initiative. Operative agreements were made not only with the four provinces bordering Trento, but also with the Trentino Hunters' Association, which still collaborates on bear monitoring, with the WWF - Trento and with numerous other bodies, organisations, and associations.

The reintroduction was preceded by a feasibility study (Dupré et al., 2000), which analysed the suitability of reintroduction in the central Alps from an ecological and socio-economic point of view. In particular, the surveys made it possible to estimate that the minimum number of bears needed for a viable population, i.e., one capable of self-sustaining itself in the medium term, consisted of 40–60 individuals. Furthermore, the demographic survey conducted on the local population in the project area (between the provinces of Trento and Bolzano, Lombardy and Veneto) in those years indicated that the majority were in favour of a reintroduction intervention to save the remaining bear population from extinction.

Eventually, nine bears (3 males and 6 females between 3 and 6 years old) were taken from Slovenia, the genetically closest population, and released in the Park. From these sponsors, the bear population recovered to the present estimated population of 78 bears (genetic estimate 2021 range 73-92) (Provincia Autonoma di Trento, 2022), thus confirming the correctness of the forecasts obtained in the feasibility study, which predicted an annual growth rate between 5 and 10%, and thus estimated the possible attainment of 70 individuals in 18 years.

The decrease in genetic variability represents an important threat in the medium to long term for the conservation of the alpine population, and is due to the low number of founder individuals (two males and five females), the lack of gene flow with the closest population, the Dinaric population, and the poor connectivity over a large area. This problem can be solved by creating ecological corridors towards the east. In Trentino, the first case of human mortality caused by a bear (April 2023) triggered a strong emotional reaction and a media storm of enormous proportions. The incident opened up reflections and discussions on the management of the entire bear population in the central Alps.

Since 2000, less than 10 cases of attacks by bears on people have been recorded, one fatal. The management of problem bears includes the removal of individuals classified as such, which may take place through permanent captivity or culling; these actions are also covered by European legislation.

5.3   Materials and methods

5.3.1   Pre survey activities

Pre-survey activities are necessary to design a working and understandable set of questions and choice cards. To develop, test and refine the questionnaire before administration, we adjusted the work flow proposed by Bishop et al., 2017: focus group, one-to-one interviews, and pilot survey. The original steps also included reading the questions aloud to small groups (Bishop et al., 2017), but after the success of the one-on-one interviews, we decided to go straight to the pilot administration.

Focus group

The focus group was held at the University of Trento on 14 June 2023 with 10 attendants, 3 women 7 man aged from 23 to 70 years (Fig C.5). The aim of the meeting was to test which attributes could me more interesting for the public and which graphics better conveyed the idea of the attributes and their level.

All the group members were willing to talk and also asked some information about bears and about the questionnaire, that were answered. The meeting lasted about an hour and a half. Apparently, the benefit of berry picking is not very appealing, they already get as much berry and mushroom as they like. All but two people were very sceptical about choosing a price. The wording used for the payment was not clear and they did not understand why someone not living in Trentino should pay for the management or signs on the trails. The bee sting attributes were also not very clear. Most of the respondents would prefer to see just the number of wasps and not the probability of being stung. The vehicle payment issue was quite relevant to everyone. In the group we were able to intercept some free riders thinking that one shouldn't pay and then enjoy while visiting Trentino. So we asked more questions to clarify whether those subjects were real zeros or protest answers. Real zeros are citizens who are not willing to pay (or trade off anything) for the sake of ecological preservation. This is fine, and understanding the value is ZERO for some citizens. Protest answers are subjects who chose the status quo because they don't like the vehicle payment or have any other external issues (like not trusting in the government using the money for the project, not believing the project would work, ...). The last group would be willing to pay with another payment for a vehicle. So we asked questions and eventually we found that some attendees would be willing to pay for a tour, others liked the idea of a visitor tax, a few liked the proposed vehicle payment (*una tantum* tax) after further explanation. We were satisfied to have captured some people with WTP=0, which is fine and understandable (and it is actually good to have a portion of the respondents there).

Based on the outcome of the focus group, we prepared a revised version of the survey, using the working graphics for attributes and different wording. The script of the meeting is available in Appendix C.2.

One-on-one interviews

Feedback from the focus group resulted in a revised version of the questionnaire that we tested in person with volunteers to check how it worked.

In July 2023 about 10 one-to-one interviews were conducted in Italian to volunteers outside the academic environment.

The interaction with people was useful to understand the effectiveness of the wording and graphics. In addition, hearing people's comments and reactions was crucial to identify critical points and observe how they made their choices. Some of the volunteers, in fact, spontaneously commented on which benefit was driving their choice and why for them it was the most important or not important at all.

This first version was successful concerning the wording of ESS and benefits, and the graphics worked. We proposed two versions of the graphics for the security attribute, and most of the people preferred the icons against photographs of real signs showing warning and access restrictions. We prepared the final version accordingly.

Most people loved the idea and the icons. One person commented that it is totally irrelevant today to pick berries and mushrooms and suggested removing it from the questionnaire. Another participant told me that she always chose the

Figure 5.1: Word cloud of the 50 more recurrent words used during the focus group

scenario with more berries because she loved to pick them. These kind of comments reinforced the idea that the availability of berries was indeed an ESS to include in the final version since it was the graphics that everyone wanted to give their opinion about.

One-to-one interviews also highlighted some issues that needed to be addressed before the administration to a larger panel. The instructions of the choice cards were not clear enough and most people needed an extra explanation. After that, they liked the idea and were happy to answer.

Some people did not appreciate the organisation and order in which the questions were presented in the form. Some people would have preferred an explanation first and then all the questions.

In this version, the upper limit of the cost was 50 euros. When this choice was given, everybody considered it too expensive, but at the same time they did not like the other scenarios they opted to avoid answering. This is of course an unwanted situation, so the maximum price level was set to 30 in the final version.

Experts'opinion

We chose attributes with a sound ecological background after a thoughtful review of the literature. However, we deemed it important to test the chosen attributes and benefits with some bear experts, in order to understand their opinion on how to use them in a survey and if they fund them meaningful for the study area. From 22 May 2023 to 31 July 2023, I conducted one-on-one interviews with bear experts either in presence or online. After briefly explaining the aim of the study and the DCE method, I introduced one service and benefit at the time and listened to their comments. The interviews lasted 20 to 40 minutes.

In total, 15 experts provided their opinion and completed an online survey that allowed them to remain anonymous if they wished to. They were asked about the

importance of the services, the pertinence, and their opinion about the graphics to convey the benefit to the general public. The experts were chosen among members of the Italian Mammal Society (ATiT), IBA (International Bear Association) colleagues and wildlife practitioners. . The most important feedback from the experts was their agreement about the importance of bears as seed dispersers, promoter of animal biodiversity and "ecosystem engineers" in the Alps, not only in North America or North Europe where most of the studies were carried out. The majority (57%) also supported the idea that bear-related tourism could benefit the community, if managed with due care. Although acknowledging that the social acceptance of bears should be considered, 71% of the experts deemed that asking people the number of bears they wanted was too technical. Experts were divided about the effect of bears on controlling the number of ants, bees and wasps. In fact, very few studies have been conducted on the topic. Since we had good feedback from the general public and we had access to unpublished data confirming this hypothesis, we kept this attribute in the final version of the survey.

Experts freely suggested including Scavenging and "non-material" services (learning, cultural values, conservation value, spiritual value, aesthetic and tourism).

All opinions were taken into account for the design of the final survey.

The online survey of the expert and a summary of their answers are reported in Section C.1.

Pilot test

Before conducting the full experiment, it is important to pilot test the choice sets and survey instrument with a small but significant sample of participants. This phase is necessary to identify any problems or issues with the design or wording of the questions, as well as to test the feasibility of the experiment. In addition, protest answers, context-specific choices, or minor errors can be detected during the pilot. The pilot study was conducted by a private company in September 2023. After collecting 100 answers with no significant issues, the company continued the administration in 4 European countries (Italy, France, UK and Germany) until December 2023. At the end of all pre-survey activities, I obtained the final choice of attributes and levels, reported in Table 5.1.

5.3.2 The survey

We use as a baseline for the development of the final questionnaire the approach used by Bishop et al., 2017, according to the following steps:

Define the attributes and levels

Choose the attributes that are most relevant to our research question and define the levels for each attribute. Each level represents a different value or characteristic of the attribute that participants will have to consider when making their choices.

Design the survey

The attribute and levels identified from the literature were tested with experts and the focus group.

Design the choice sets: Create choice sets by combining the different levels of each attribute. Each choice will contain two options that differ in their attributes

Attribute	Acronym	Description	Levels
Forest Diversity	FD	Maintenance of habitat	Low, Medium, High
Avoidance of bee stings	Bee	Population control of insects	Low, Medium, High
Availability of wild berries	Berries	Seed dispersal	Low, Medium, High
Size of bear area	Area	Spatial availability of ESS	West Trentino, Central Alps, All Alps
Safety	Safety	Importance of information and safety	No information, Warnings signs, Trial closure
Cost	Cost	Euros	0,10, 15, 20, 30

Table 5.1: Attributes and levels chosen for the experiment, including the acronym used in the model and a short description of the service provided

and levels from the status quo. The number of choice sets and options per set depend on the complexity of the research question and the available resources. In this case, we designed 9 choice sets with 8 cards each. The complete design is reported in the Appendix C "Experiment details" C.4 and an example of a choice card is reproduced below.

Validating choice card design

The final survey (DCE) included nine sets of choices, each of which contained three alternatives. In our DCE, we asked the person to choose between two conservation programmes and the *status quo*. Each alternative consisted of a different combination of the levels of each attribute. In order to optimise the design and the shuffling between levels of the different attributes we used the approach proposed by Street et al., 2005. We used the R package `ExpertChoice` by Stephens, 2020 to develop choice sets and to verify that there is no violation of necessary criteria to determine the efficacy by estimating the D-efficiency of the design according to Street et al., 2005. The D-efficiency of the final discrete choice design was 100%, indicating that the fractional factorial design achieves full orthogonality with no loss in variance relative to the full factorial.

Finally, nine choice sets with 8 scenarios each were created in order to be administered to the people.

In Figure 5.2, a fictional choice card is presented, showing all attributes and levels in a single card for demonstration purposes.

Data collection

Based on the preceding preliminary steps, we designed the final choice sets and survey text and provided them to a private company for data collection.

Management programmes A and B are illustrated here, compared with the current situation. Imagine that these are the only three options available. Which would you choose?
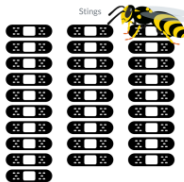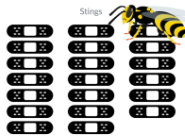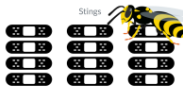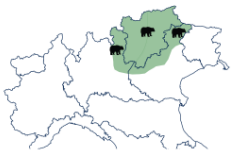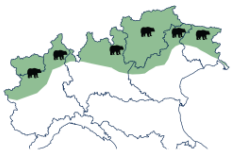
	Current situation	Programme A	Programme B
Forest diversity	Low	Medium	High
Wasps	High	Medium	Low
Security	**No information**		
Area	Low	Medium	High
Wild berries	1/4 basket	Half basket	Full basket
Cost	0	30€	10 €

Figure 5.2: Example of choice card

5.3.3 Econometric modelling

Discrete Choice Experiment (DCE) is a method based on the utility function introduced by Lancaster, 1966 that was selected to estimate the total value of bear. DCE belongs to the stated preference family (see Chapter 1 1.1.1) and, as explained in the introduction, is a valuable, still widely used tool for informing environmental and resource management policies (Hanemann, 1989). In this case it is primarily used because it allows evaluating the multiple services provided by bears , allowing for the valuation of each attribute separately.

DCE foresees the development of a questionnaire where individuals make choices between hypothetical scenarios characterised by different levels of relevant attributes. The responses allow analysts to estimate the economic value (WTP) associated with changes in these attributes, particularly for goods and services not typically traded on markets (Bonner, 2022).

The design of a DCE is crucial for obtaining reliable results. This is the reason for the efforts made in this thesis to select the relevant attributes and their levels. Constructing choice sets efficiently and ensuring that the questionnaire is clear and understandable to respondents is also a crucial aspect that was taken in consideration, with expert consultation and pre-testing, as explained in the pre-survey part.

As with every modelling approach, DCE also has some limitations and can lead to misleading outputs.

The main limitations include the fatigue of the respondents and the heterogeneity of the preferences. In fact, the DCE methodology has evolved significantly to address the weakness.

The DCE survey involves evaluating numerous choice cards with various attributes and levels, which often cause fatigue. Participants must analyse different sets of choices with diverse attributes and levels, which can lead to fatigue and loss of focus. This can result in the neglect of some attributes or diminished attention in later cards. For this reason, we kept the number of choice cards at 9, providing a design with catching images. We also tested for fatigue after the survey (DeShazo & Fermo, 2002). Poor design of choice tasks can lead to dominant options, reducing the significance of responses. It is critical to maintain a careful balance in the number of attributes and levels, as excessive quantities may result in information overload, whereas insufficient ones may inadequately reflect preferences.

DCEs assume consistent preferences from people, but it is not always the real-world scenario. Preference heterogeneity emerges when the choices differ between respondents and over time. The Mixed Logit (MIXL) and Latent Class (LC) models aim to tackle this challenge, despite the difficulty in capturing preference diversity.

The main models for processing DCE responses include the following:

Multinomial Logit model (MNL) :is the fundamental discrete choice model to predict the probability that an individual will choose one alternative from a set of available options based on the utility of each alternative. The standard MNL model assumes that the stochastic components of the utility are distributed independently and identically. This assumption is crucial because it is what leads to the logistic form of the choice probability. Generally, it is assumed that the systematic component of the utility is linear in the parameters to be estimated. This facilitates the application of estimation techniques such as maximum likelihood (Hess & Rose, 2009).

Mixed Logit model(MIXL) allows for random preference variation (Train, 2009) it is an extension of the MNL model, which relaxes some of these assumptions to address preference heterogeneity. The MMNL model allows for preference heterogeneity across individuals by treating some or all of the parameters in the utility function as random variables. Instead of being fixed across the population, these parameters (β_n) are assumed to follow certain distributions in the population. The choice probability is then the average of the standard logit probabilities over the assumed distribution of these random parameters.

Latent Class model (LC) accounts for unobserved heterogeneity in individuals' preferences by segmenting the population into a finite number of unobserved groups, known as latent classes (Greene & Hensher, 2003). Individuals are assumed to choose the alternative that maximises their utility, but this maximisation is based on the specific parameters of the latent class to which they belong. Individuals within the same latent class share similar preferences, represented by a common set of utility model parameters (betas). Each individual belongs to a given latent class with a certain probability. Class allocation probabilities are often modelled using an offset (δ_s) and parameters (γ_s) that capture the influence of individual characteristics. Within each latent class, the choices of the individuals are modelled using a standard discrete choice model, often a Multinomial Logit (MNL) model (Hess & Palma, 2019). The optimal number of classes can be determined through theoretical considerations or model fit criteria.

The utility function for the MNL model is calculated as the utility of the alternative jj for individual i with X attributes and z levels

$$U_{ij} = \beta_{1j} \cdot X_{1j} + \beta_{2j} \cdot X_{2j} + \ldots + \beta_{nj} \cdot X_{nj} + \epsilon_{ij} \tag{5.1}$$

In the Multinomial Logit (MNL) model, coefficients called $\beta_s hit$ can be added to account for the effects of covariates (e.g., socio-demographics, attitudes) on choice probabilities.

In a latent class model, individuals are assigned to a latent class C, and each class has its own utility parameters. The utility function for the alternative jj for the individual i in class c is framed by the following equation. Where $\beta_c 1$ represents the parameters for class c.

$$U_{ijc} = \beta_{c1} \cdot X_{1j} + \beta_{c2} \cdot X_{2j} + \ldots + \beta_{cn} \cdot X_{nj} + \epsilon_{ijc} \tag{5.2}$$

To compute Willingness to Pay (WTP), when models run in the preference space, the following equations were used:

$$WTP = -\frac{\beta_{\text{attribute}}}{\beta \cos(t)} \tag{5.3}$$

Where $\beta_a ttribute$ is the attribute coefficient and $\beta_c ost$ is the cost coefficient.

With increasing complexity of the models, it is necessary to distribute a large number of surveys to estimate all parameters. There is also another issue that can occur when respondents do not believe their choices will influence real-world outcomes, they may overstate or understate their preferences, or make protest votes.

If the sample is representative, the total economic value of these ecosystem services can be extrapolated to the general population by multiplying by the total population size.

$$\text{Total Value} = \sum(\text{WTP}_{\text{attribute}} \times N) \tag{5.4}$$

where N is the number of individuals affected or willing to pay.

Data analysis

The data returned from the company were first screened using Exploratory Data Analysis (Zuur et al., 2010) in order to check or consistency, missing data, and remove protest votes.

A protest vote refers to a choice or preference expressed by individuals not based on their true preference for an option, but rather as an expression of dissatisfaction to the available alternatives or the context of the decision.

For example, respondents kept selecting an "opt-out" option (in our case the status quo) not because they genuinely prefer that option, but because they reject the survey's premise, do not understand it, find the options unacceptable, or disagree with aspects of the scenario presented. Protest votes can distort model results as they do not reflect a genuine comparison between alternatives based on the usual utility-maximising behaviour assumed in choice models. Thus protest votes were identified and removed from further analysis to avoid biased estimates and incorrect inferences about preferences.

There are two main spaces for estimating discrete choice models:

- Willingness-to-Pay (WTP) space: Parameters are directly interpretable as the monetary value individuals are willing to pay for attribute changes.

- Preference space: The parameters represent the marginal utility derived from the attribute levels.

The preference space is the more traditional and general approach.

The analyses were carried out using the Apollo package developed by Hess and Palma, 2019) in R and Rstudio ((R Studio, 2015) to estimate the relative importance of different attributes and their impact on people's choices with standard Basic MNL and a Latent Class model frameworks. We then compared the fit of the models using Akaie Information Criteria (AIC) and selected the best modelAkaike, 1973

5.4 Results

5.4.1 Overview

The company contacted 2538 persons, evenly distributed across the countries, each answering 8 choice tasks. An answer was discarded because the person did not complete the questionnaire, and the other 424 were protest votes and were excluded from the analysis. The final dataset accounted for 2113 valid interviews distributed as reported in Table C.1.

We assessed the presence of a fatigue effect, which was absent. As illustrated in Figure 5.3, no consistent pattern emerged in the responses, indicating that the survey length was appropriate.

Italy had the highest share of protest votes and protesters were more often women (257) than men (167). An overview of the socio-demographic responses is reported in the Appendix C.6 "Exlporatory Data Analysis".
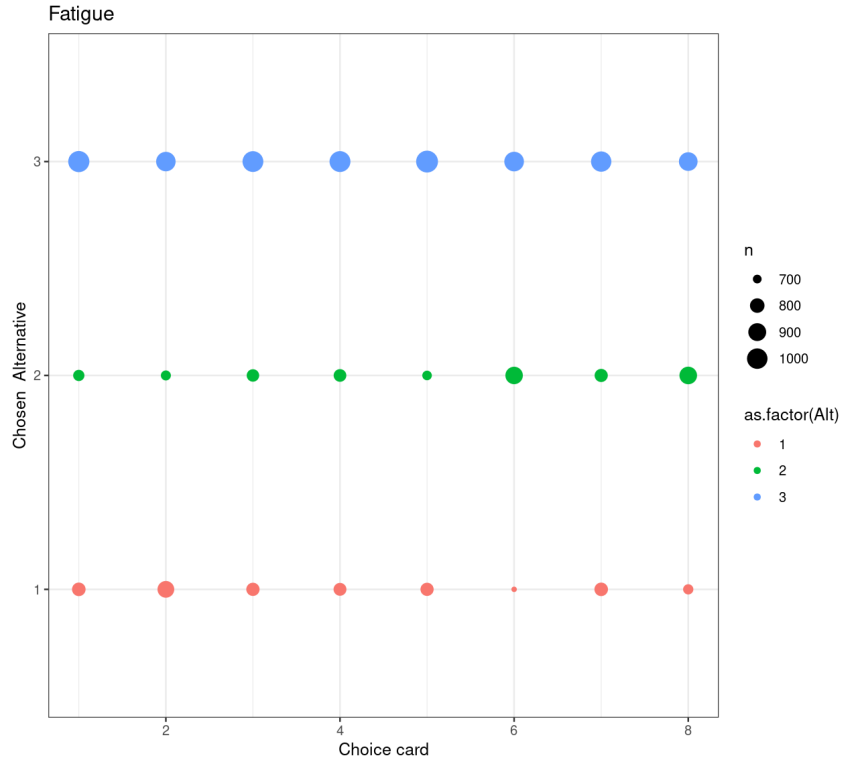
Figure 5.3: Proportion of each alternative chosen during each session

The responses of the Likert scale were transformed as follows: "Strongly Disagree" (-2), "Disagree" (-1), "Unsure" (0), "Agree" (1) and "Strongly agree" (2). Each question was assigned a sign based on its language and the resulting scores were summed to generate three indices:

- **Environmental Attitude** Index (env.attitude): Negative values indicate a more anthropocentric viewpoint, while positive values indicate a more ecocentric perspective (mean 4.38. Range: -8 to 12). Figure C.8

- **Bear Attitude** Index (b.attitude): Negative values reflect a more anthropocentric stance, whereas positive values suggest greater acceptance of bears (Mean 0.37, Range: -7 to 7). Figure C.9

- **Bear Management Attitude** Index (tn.attitude): Negative values indicate scepticism towards the management approach by the Province of Trento or other institution, and positive values reflect agreement with it (Mean: -0.55 Range: -6 to 6). Figure C.10

5.4.2 DCE Modelling

Several models were run in the Apollo framework; in this section, we present an overview of the 10 more interesting trials and the full result of the best model. Models can be estimated in preference space or WTP space; in the latter case, the algorithm, instead of estimating the marginal utility of an attribute, the model directly estimates the monetary value a person is willing to give up to obtain a better level of that attribute. This approach was less performant than the preferred space. The models were run with and without covariates, in WTP and preference space and with a different number of latent classes Hess and Palma, 2019; Hess and

Train, 2017.. Table 5.2 reports the quality parameters of 10 different trials used to select the best model.

Despite the slightly better performance of the Latent Class model trial 7, an analysis of the classes showed that one of the classes did not have significant betas and the other consisted almost entirely of males from two countries. This suggested that the classes reflected a demographic effect rather than a true heterogeneity of preferences. This may lead to unrealistic WTP. Some latent class models tend to overfit by capturing noise rather than true behavioural segments. I tried using different sets of covariates and classes, but the LC models did not always converge. Finally, since the output can lead to the development of guidelines with decision makers, I believe that MNL is the best option because the results are easier to explain.

Hereafter, I will present the results of the second-best model, number 4 in Table 5.2. This model was an MNL model fitted into the preference space with the inclusion of all the covariates including income. Answers in which income was not provided were excluded, so the final set included nearly 2000 responses (1985), from 2113 valid questionnaires.

The following equation 5.5 explains the utility function estimated for the final MNL model.

$$U = b_{\text{FD}} \cdot \text{FD} + b_{\text{BEE}} \cdot \text{BEE} + b_{\text{SAFETY}} \cdot \text{SAFETY} + b_{\text{AREA}} \cdot \text{AREA} + \\ b_{\text{BERRIES}} \cdot \text{BERRIES} + b_{\text{COST}} \cdot \text{COST} + (\text{covariates}) \tag{5.5}$$

Trial	Model name	Est. Parameters	LL	AIC	BIC
7	LC 2 classes	16	-16415	32865	32997
4	MNL full	19	-16531	33100	33246
5	MNL Income sel.var	16	-16589	33210	33333
8	LC 2 classes- income	19	-16648	33335	33348
10	LC 4 classes	39	-17555	35188	35490
9	LC 3 classes	28	-17616	35288	35505
3	MNL no income	15	-17734	35498	35614
1	MNL no covs	6	-17986	35983	36029
6	MNL_dummy	11	-18247	36516	35614
2	MNL no covs WTP space	6	-21713	43437	43484

Table 5.2: Model comparison including estimated parameters, log-likelihood (LL), AIC, and BIC values. MOdels are sorted in order of fitting according to AIC.

The estimated coefficients presented in Table 5.3 and Figure 5.4suggested that environmental attitudes, sex, travel involvement in alpine mountains (having been there or planning to go) and cost significantly influenced the choices. In addition, the perceived reputation of Trentino pushes respondents to choose alternatives, and being employed also affected the pattern of choices.

The estimated parameters for the choice attributes provide insight into the preferences and trade-offs of the respondents when selecting between alternatives.

All attribute coefficients (except COST) were positive, indicating that respondents generally prefer alternatives with higher levels of these attributes compared to the reference option (the current situation or status quo). The cost coefficient was negative (-0.0208), as expected. This suggests that an increase in cost decreases the probability of an alternative being chosen.
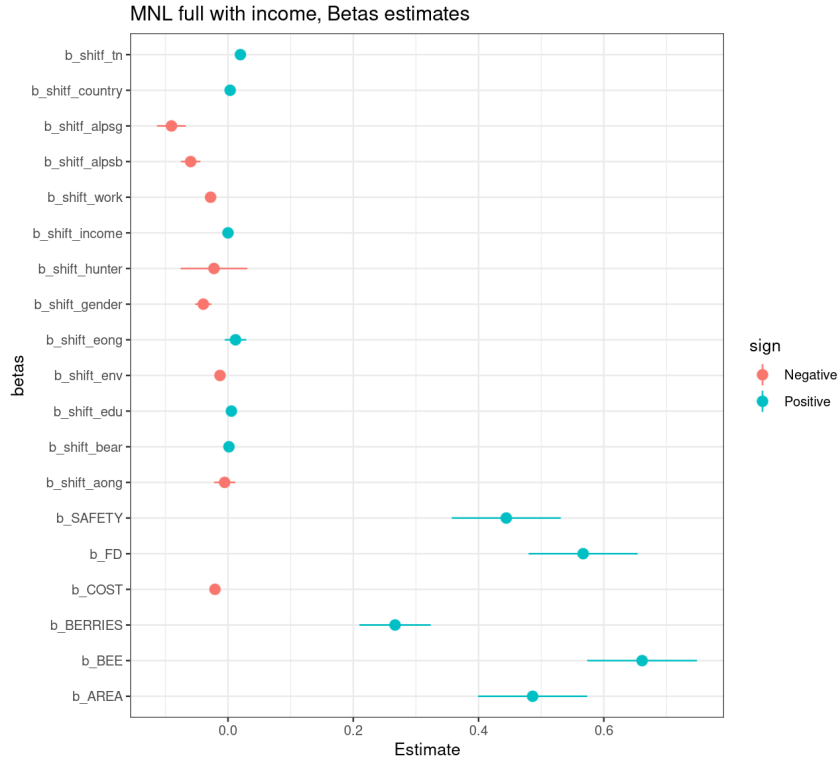
Figure 5.4: Plot of estimated beta coefficients with error bars (95% Confidence intervals) and the shift effect of the covariates

Avoidance of bee stings BEE (0.66) is the most influential attribute, suggesting that respondents place a strong preference on not being stung outdoors.

Forest Diversity (FD) also has a high and significant coefficient, indicating that respondents strongly value a beautiful and diverse forest when making their choices.

Concerning the SAFETY attribute (0.44), the presence of information and the possibility of trail closure had a positive but smaller effect compared to the first two attributes, which means that it influences choices, but it is not the dominant factor.

The attribute AREA (0.49) was also positive and significant, meaning that people value the diffusion of bears outside the current area.

The possibility of collecting berries was also a desirable feature, but the least important was BERRIES (0.27). Finally, COST (-0.021) had a negative sign, as expected, as people are less willing to pay more for a service. The ratio of any attribute coefficient to the cost coefficient was used to estimate the WTP of table 5.4.

The effect of covariates on choice can be roughly summarised as follows: Negative values indicate that higher values of the covariate decrease the likelihood of choosing an alternative, while positive values indicate that higher values of the covariate increase the likelihood of choosing A or B rather than the status quo.

In detail, environmental attitudes ($b\_shift\_env = -0.0134, p < 0.01$) had a slighlty negative impact, suggesting that people with stronger environmental values were less likely to choose alternative A or B. People who have been to the Alps or plan to go there are also more keen to choose the SQ

Gender ($b\_shift\_gender = -0.0398, p < 0.01$) had also a significant effect, implying systematic differences between male and female respondents in their choices.

Country-specific effects were also tested but were not statistically significant, suggesting that country of residence alone does not strongly predict the choices in this model. So, distance from the Alps does not affect the perception of bears and

the ecosystem services they provide. Other covariates that were not significant in explaining the choices were education, attitudes toward bears, and being a hunter or part of an ONG association.

The small but positive coefficient suggested that individuals with higher income are slightly more likely to choose alternatives, but the effect is weak and not statistically significant.

	Estimate	Std. Error	t-ratio	p (1-sided)	
b_FD	5.7e-01	7.4e-02	7.7	7e-15	***
b_BEE	6.6e-01	7.4e-02	9.0	¡2e-16	***
b_SAFETY	4.4e-01	7.4e-02	6.0	8e-10	***
b_AREA	4.9e-01	7.3e-02	6.6	2e-11	***
b_BERRIES	2.7e-01	4.5e-02	5.9	2e-09	***
b_COST	-2.1e-02	1.7e-03	-12.0	¡2e-16	***
b_shitf_country	3.5e-03	5.2e-03	0.7		0.3
b_shitf_alpsb	-6.0e-02	1.4e-02	-4.3	7e-06	***
b_shift_env	-1.3e-02	1.8e-03	-6.9	3e-12	***
b_shift_bear	1.6e-03	2.9e-03	0.5		0.3
b_shitf_tn	2.0e-02	3.5e-03	5.7	6e-09	***
b_shift_gender	-3.9e-02	1.1e-02	-3.6	2e-04	***
b_shift_edu	5.4e-03	5.1e-03	1.1		0.1
b_shift_aong	-5.3e-03	1.4e-02	-0.4		0.4
b_shift_eong	1.2e-02	1.4e-02	0.8		0.2
b_shift_hunter	-2.2e-02	4.6e-02	-0.5		0.3
b_shitf_alpsg	-9.0e-02	2.1e-02	-4.3	1e-05	***
b_shift_work	-2.8e-02	6.6e-03	-4.2	1e-05	***
b_shift_income	5.2e-06	4.8e-06	1.1		0.1

Table 5.3: MNL model parameter estimates with standard errors and t-ratios. Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

The respondents are willing to pay the highest for a reduction in bee stings (31.9 €), followed by forest density (27.3€). The safety measure and the advertising of bear presence rank fourth, had the second lowest WTP (21.4 €), suggesting that it is relatively less valued compared to other attributes. Having a wide spread of bears in the Alps is also important (23.4 €) and berry picking is the least desired attribute, even if people are willing to pay 12.9€ to do that. The effect of covariates is small compared to the WTP space, as shown in Figure 5.5.

Attribute	WTP (Euros)
FD (Forest Diversity)	27.3
BEE (Bee sting reduction)	31.9
SAFETY (monitoring and signposting)	21.4
AREA (Area of bear presence)	23.4
BERRIES (Berry Availability)	12.9

Table 5.4: Willingness-to-pay estimates for each attribute
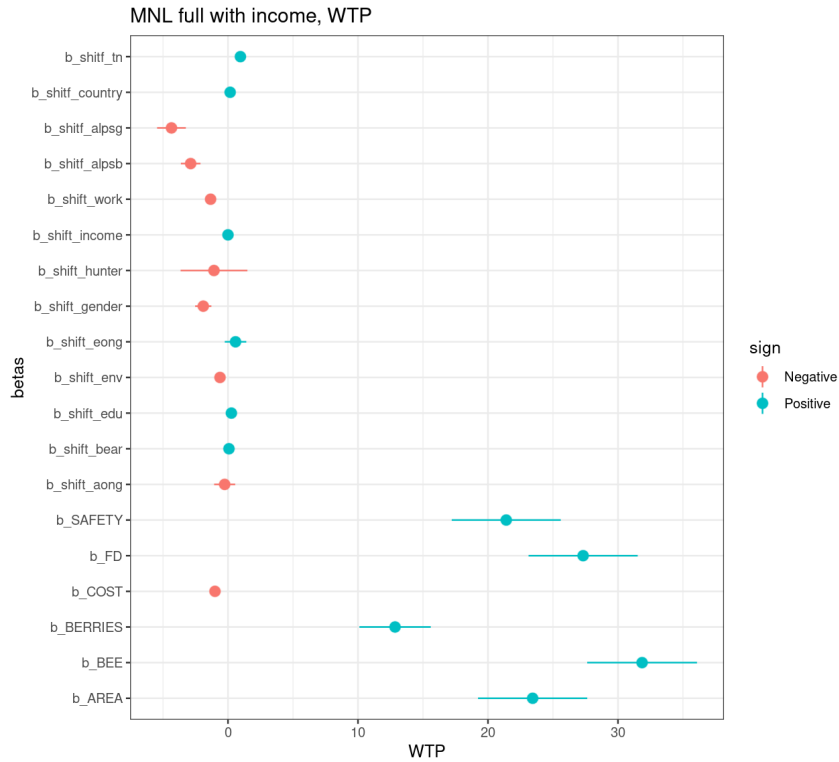
Figure 5.5: DCE results: WTP evaluations for the attributes and the effects of covariates

5.5 Discussion and conclusions

The results of the Multinomial Logit (MNL) model provide insights into the factors influencing individuals' choices regarding bear-related preferences, incorporating both alternative-specific attributes and socio-demographic covariates. The model achieved convergence with a final log-likelihood of -16,589.46 and an AIC of 33,210.92, suggesting a reasonable fit to the data. While the AIC is slightly higher than that of the Latent Class (LC) model, the MNL model offers a more interpretable framework without the complexity of class segmentation. Therefore, I chose to prioritise interpretability over complexity. Generally, the Multinomial Logit (MNL) model yielded results that were easier to interpret, whereas the Latent Class (LC) model introduced a segment or class that did not provide a meaningful interpretation. The assumption of homogeneous preferences is a choice made by many authors (T. Estifanos et al., 2021; Throsby et al., 2021). The MNL model effectively captured the main effects, making it potentially more advantageous for formulating policy recommendations.

The estimated coefficients for the alternative attributes were all statistically significant (Tabe 5.3, confirming their role in influencing people's choices, reinforcing the idea that all the pre-survey efforts paid off and helped to identify meaningful attributes (Bishop et al., 2017). The positive and significant coefficient for FD, forest (bio)diversity suggested that individuals are more likely to choose alternatives associated to a more complex and beautiful forest. A service provided by bears acting as forest engineers (Zyśk-Gorczyńska et al., 2016). The service of controlling insect populations, including bees and wasps, was the most appreciated by the respondents because it reduces the number of insects in the forest and thus the risk of stings. On the other side of safety, positive and significant estimates supported
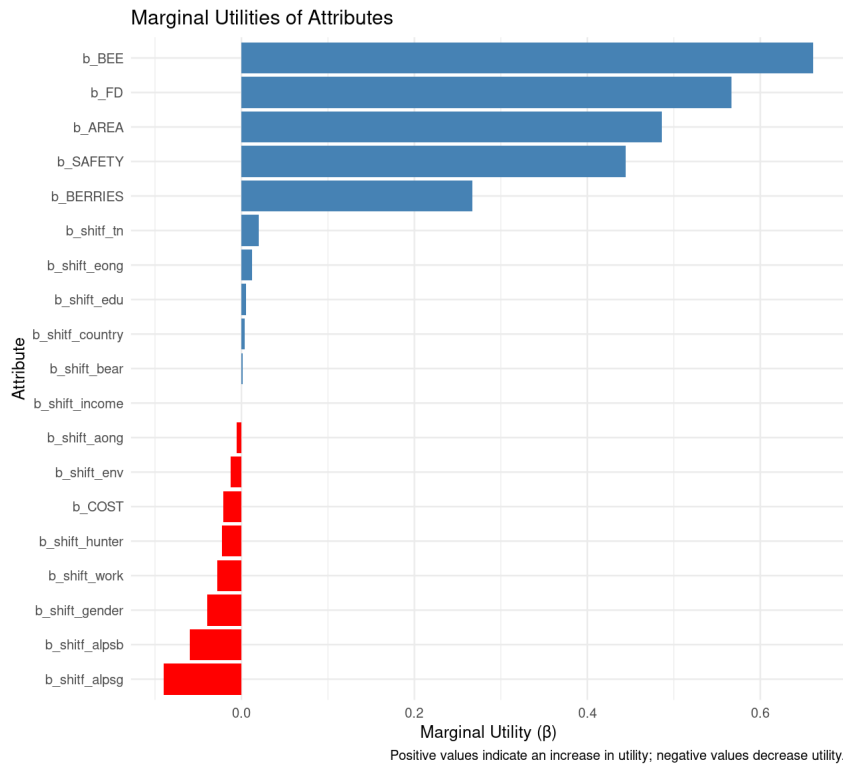
Figure 5.6: MNL marginal utilities , VERSION 2

the importance of safety measures in influencing choices, reflecting a general preference for some risk-mitigating policies even if it was considered the least important element. The willingness to pay for safety suggests that people are also considering human-wildlife co-existence aspects, People are also willing to pay to have a healthy population of bears spreading across the alps, suggesting support for policies that increase their distribution. Respondents also favour alternatives that promote berry availability for them and maybe also for bears that through the service of seed dispersal increase the diffusion and diversity of forest fruits in the wild. The negative coefficient for cost confirms that cost negatively influences choices, as expected, with people showing a lower preference for more expensive alternatives.

The inclusion of socio-demographic covariates provides further insights into individual heterogeneity in preferences, even if the relative shift in WTP is quire small Figure 5.5:

Quite surprisingly, the country of residence did not affect the choice, a quite unusual outcome in a questionnaire on large carnivores (Notaro & Grilli, 2021).

Notaro and Grilli, 2021 also demonstrated that tourists are willing to pay for the conservation of large carnivores in the Italian Alps, but their WTP is much lower than in this case, 4-12 euros for lynx and wolf. Bears can be perceived as more attractive (Clucas et al., 2008) and or less dangerous than other carnivores.

In the case of the Ethiopian wolf, WTP is not driven solely by the desire to increase its population. It is a complex function of the specific attributes of the conservation programme, the individual characteristics and prior experiences of the tourists, and their perceptions of the ecosystem and recreational opportunities within the Bale Mountains National Park. The study highlights the importance of considering these heterogeneous preferences when designing an effective and publicly supported conservation strategy, and their WTP is influenced by the size of the animal populations and their socio-demographic characteristics, including their

place of residence and upbringing.

People with stronger environmental attitudes are associated with a slightly lower support for certain alternatives, possibly due to concerns about human-wildlife conflict or management. For example, they may refrain from picking wild fruits and leave them to bears. Male respondents are less likely than female respondents to support the proposed alternatives regardless of the educational level, engagement with environmental or hunting organisations. This can be explained by the relatively low number of people who fall into these categories.

The small and non-significant coefficient of income suggests that income level does not play a substantial role in determining choice preferences in this context, and the amount of money proposed was appropriate.

The impact of socio-demographic characteristics, particularly environmental attitudes and gender, underscores the need for targeted communication strategies to engage different segments of the population. The results of these studies suggest that choice experiments can be a useful tool for estimating the value of ecosystem services provided by bears and can be extended to other charismatic species of species that have a strong impact on the ESS but are not so appealing to the public.

Future research could explore more flexible models that account for unobserved heterogeneity, such as Mixed Logit with random parameters or hybrid choice models incorporating psychological constructs. Additionally, further refinement of cost estimates and income effects could provide more precise policy recommendations regarding willingness to pay for bear conservation initiatives. Although alternative models may capture preference heterogeneity more explicitly, the MNL model presents robust and interpretable results that can inform policymakers and conservation practitioners.

Despite these limitations, choice experiments offer a valuable approach to estimate the value of ecosystem services provided by bears. By providing insights into people's preferences and willingness to pay for bear-related services, they can inform decision-making and policy development that ensures the sustainable use and conservation of bear populations and their associated ecosystems.

5.5.1 Policy recommendation

The findings of this choice experiment provide valuable insights for designing socially informed and ecologically effective bear conservation policies, especially on the side of communication. The estimated willingness to pay (WTP) for bear conservation in this study is higher than the values reported in the previous literature, which means that the public value the presence of bears and the ecosystem services they provide.

- **Communication** should be tailored to specific groups. Male respondents were consistently less supportive of bear conservation alternatives, regardless of their level of education or environmental participation. Institutional communication in some male dominated environments (for instance hunters or fisher associations) could stress on human safety, outdoor traditions, or the economic benefits of healthy ecosystems. Likewise, communication to environmentally conscious citizens should emphasise non-intrusive measures, such as habitat preservation and respect for wildlife autonomy.

- **Conservation programmes** should be flexible, offering multiple participation options to suit different motivations and concerns (e.g., safety-orientated

programmes versus biodiversity-driven initiatives). The observed variation in preferences across socio-demographic segments suggests that one-size-fits-all policies may be less effective.

- **Ecosystem services** The output of this chapter showed that people value ESS especially when translated into tangible, everyday benefits. For example, communication materials can show how bears contribute to healthy forests, which in turn support clean water, carbon storage, and tourism. Using infographics, storytelling, and locally relevant examples can help bridge the gap between abstract ecological functions and public concern. This is crucial for communications with residents, in my opinion.

- The significant WTP suggests **strong societal support for bear-related** conservation initiatives and reinforces the relevance of including such non-market values in policy decision-making. A monetary evaluation can support investments in bear conservation as part of broader environmental planning and land use decisions.

- Ensuring **transparent use of funds** and providing feedback on conservation outcomes can further build public trust and reinforce the value of contributing to shared environmental goals. Transparency can partially reduce protest votes because people trust more the institutions.

The weak and non-significant effect of income in our models suggests that financial contributions toward bear conservation are broadly acceptable across income groups, indicating a shared willingness to support these initiatives. This finding underscores the importance of designing affordable and inclusive conservation schemes.

Chapter 6

Conclusions

6.1 Summary of Key Findings

This doctoral research has contributed to the intersection of economics and conservation science by analysing the alpine environment and the presence of brown bears in Italy. Using a multidisciplinary approach that integrates conservation biology, environmental modelling, and economics, I explored the role of brown bears as providers of ecosystem services and the societal perception of their presence. A key outcome of this research is the holistic framework developed to link conservation evidence with economic valuation techniques.

Following the literature review and the analysis carried out in this work, I can propose an applied framework with the main functions, services and benefits provided by bears in the study area Figure 6.1.

The study highlights the role of the brown bear as a flagship species that can increase public awareness and contribute to conservation efforts. The results presented in the chapters demonstrate the strong interconnection between ecosystem functions, social acceptance, and the economic value of biodiversity.

1. **Identification of Ecosystem Functions and Services:** Through a literature-based review and structured analysis (Chapter 2), this work has identified ecosystem functions and services provided by brown bears globally. This chapter provides the first systematic evaluation of ecosystem services for brown bears . Although there is a literature on ESS valuation in Europe and the United States, significant gaps remain in other parts of the world. In addition, cultural ecosystem services related remain understudied and undervalued. The findings of this chapter were essential for the design of the DCE. In fact they were used to propose realistic attributes and levels during the pre-survey activities, ensuring that the choice experiment was scientifically grounded.

2. **Economic Valuation of Brown Bears as a Destination Image**: Chapter 3 explored the economic contribution of brown bears through their role as a flagship species. By applying the Advertising Value Equivalent (AVE) methodology to media appearances from 2015 to 2020, I estimated the economic value of the cultural ecosystem services provided by the Apennine brown bear. The value of 11 million Euros far exceeded the costs of management and compensation for damages in the same period. These findings underscore the cultural and economic benefits of bear conservation and provide a valuable tool for negotiations with managers and stakeholders. The media-based evaluation supported the positive perception of bears by the public and can be a viable
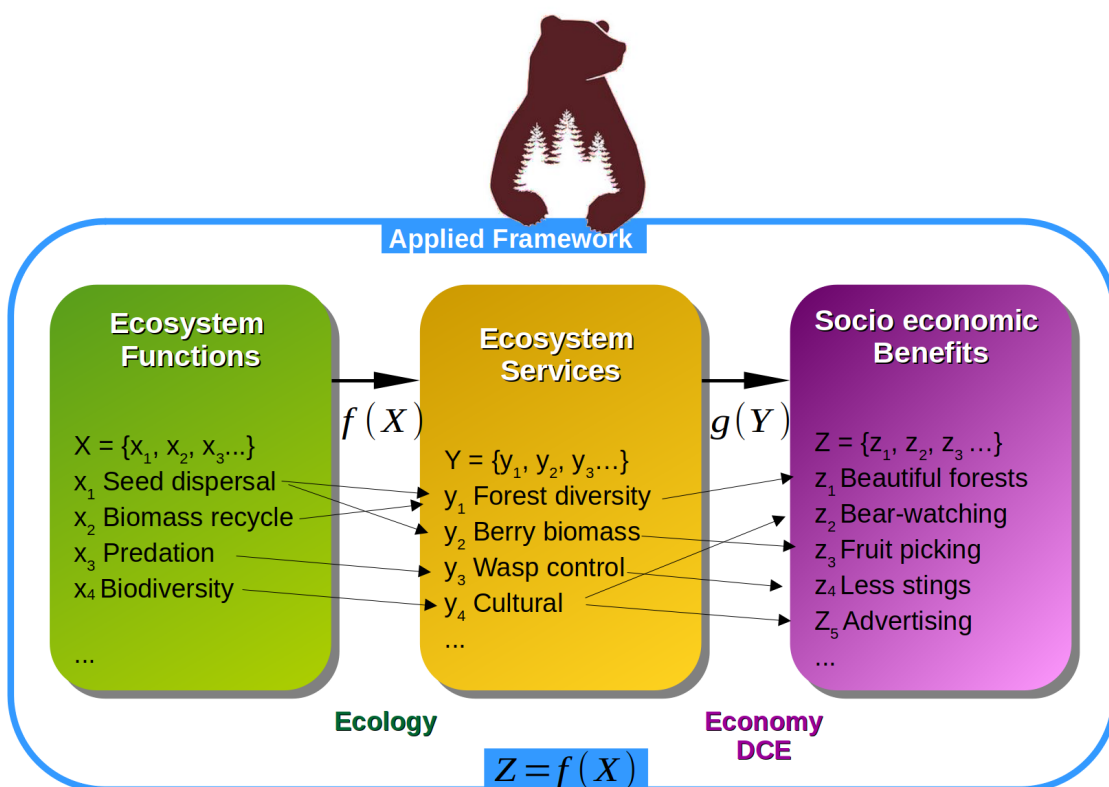
Figure 6.1: The ecological-economic framework proposed in the introduction, populated with some of the information reported in each chapter

option when financial or time constraints exist. However, this method does not provide a full understanding of the socio-cultural dynamics surrounding human-wildlife interactions. The output of this research supported the creation of a bear-friendly brand.

3. **Aesthetic value of forests and perception of ESS over tine:** Chapter 4 assessed the changes in forest ecosystem services in a region of the Italian Alps since 1954, driven by natural afforestation and species protection laws. Using GIS-based estimations and historical records, this study highlighted an increase in forest-related ecosystem services such as growing stock, hydrogeological protection, and carbon storage, alongside rising deer populations. Aesthetic preferences were analysed through the sale of 300,000 postcards over two decades, revealing a preference for landscapes featuring a mix of forests and open spaces from the 1970s. This result suggest that when people made a choice that maximise their aesthetical preference, they were also choosing a specific asset of ecosystem and services. The findings reinforce the framework that we proposed, linking benefits, such as a beautiful landscape to function and services that are more difficult to explain and understood by the general public.

4. **Estimating the Total Economic Value of Brown Bears**: Chapter 5 developed a stated preference model (SPM) using a discrete choice experiment (DCE) questionnaire to estimate the total value of brown bears. Based on 2,113 valid interviews, the results revealed that respondents significantly preferred alternatives with high levels of forest diversity and control of bee population, followed by bear distribution in the Alps. The DCE design was particularly robust, as the attributes were derived from a global literature review and refined through discussions with experts and local stakeholders in focus groups. This methodological rigour ensured that the estimated willingness to pay (WTP) values were higher than those reported in previous studies, reflecting the strong significance of the estimated coefficients. While safety concerns have been heightened, particularly after a fatal accident, the findings suggest that people prioritize ecosystem benefits such as forest diversity and berry availability over fear-related aspects. This indicates that fear of bears, while present, is not the dominant factor shaping public preferences and remains under control. The weak and non-significant effect of income in DCE models suggests that financial contributions toward bear conservation are broadly acceptable across income groups—indicating a shared willingness to support these initiatives.

The results indicate that brown bears, as flagship species, hold significant potential for fostering conservation awareness and generating indirect economic benefits. However, effective management requires a holistic approach that considers ecological processes, economic valuation, and public perception.

The DCE was robust as designed, resulting in a higher willingness to pay (WTP) compared to other studies, and produced statistically significant coefficients. The importance of forest diversity was found to outweigh concerns about safety, even in light of recent fatal accidents, indicating that fear is not a dominant factor in public perception.

This research underscores the importance of interdisciplinary approaches in conservation economics. By combining ecological insights with economic valuation, it is

possible to develop more effective and socially acceptable conservation policies. The case of the brown bear serves as a model for integrating conservation biology with environmental economics, ultimately contributing to more sustainable and inclusive wildlife management strategies.

Overall, this research enhances the understanding of human-wildlife interactions in the context of ecosystem service valuation and offers valuable contributions to both academia and policy making. The insights gained here can inform more effective and socially acceptable conservation strategies for large carnivores, particularly in regions undergoing rapid ecological and socio-economic changes.

6.2 Policy recommendation

This thesis contributes to the fields of environmental economics and conservation social science by integrating economic valuation techniques with ecological realities. The research findings provide policymakers with actionable insights into how conservation strategies can be designed to improve public engagement and acceptance.

Bears and the forest ecosystems they inhabit provide a variety of ecosystem services, such as seed dispersal, nutrient cycling, and tourism appeal, that benefit society as a whole. These services are classic examples of public goods: they are non-excludable (everyone can benefit) and non-rivalrous (one person's use does not diminish another's). As such, their protection and sustainability depend on collective investment and stewardship. In addition, recognising bears and forests as intergenerational public goods means that we have an ethical obligation to preserve them not only for ourselves but for future generations. Conservation programmes should incorporate this forward-looking perspective into their messaging, helping the public understand that their contributions today help secure a thriving and biodiverse natural heritage for their children and grandchildren.

From a policy perspective, this research highlights the necessity of incorporating ecosystem service valuation techniques into local and EU conservation policies. By explicitly linking the ecological functions of large carnivores with their social benefits, conservation strategies can be better aligned with local stakeholder interests, thus improving policy effectiveness and community support.

Here follows a list of possible actions to improve bear conservation and policies.

- **Highlight ecosystem services** Awareness campaigns and interpretive materials should emphasise ESS to build public appreciation and willingness to support conservation. People value ESS especially when translated into tangible, everyday benefits because understanding the ecological roles of bears, such as seed dispersal, scavenging, and their broader contribution to biodiversity, can be limited.

- **Exploit the bear as an icon** in this work I demonstrated how positive and valuable the visibility of bears in the media is, a result in line with the literature examined, reinforcing the concept that bear is indeed a Flagship species. The development of **Bear friendly brand** in PNM is an example of how the image of bears can help reduce the conflict between local producers and bears.

- **Tailored Communication** The findings of DCE showed socio-demographic patterns in bear conservation support. Designing socially informed and ecologically effective bear conservation policies. Communication should be tailored

to specific groups. Male respondents were consistently less supportive of bear conservation alternatives, regardless of their level of education or environmental participation. Institutional communication in some male-dominated environments (for instance hunters or fisher associations) could stress human safety, outdoor traditions, or the economic benefits of healthy ecosystems. Likewise, communication to environmentally conscious citizens should emphasise non-intrusive measures, such as habitat preservation and respect for wildlife autonomy.

- **Flexible conservation programmes** should be devised and offer multiple participation options to suit different motivations and concerns (safety-orientated programmes versus biodiversity-driven initiatives). The observed variation in preferences across socio-demographic segments suggests that one-size-fits-all policies may be less effective.

- he significant WTP suggests **strong societal support for bear-related** conservation initiatives and reinforces the relevance of including such non-market values in policy decision-making. A monetary evaluation can support investments in bear conservation as part of broader environmental planning and land use decisions.

- Ensuring **transparent use of funds** and providing feedback on conservation outcomes can further build public trust and reinforce the value of contributing to shared environmental goals. Transparency can partially reduce protest votes because people trust more the institutions.

- **Institutional monitoring and data sharing** this research made great use of the available data collected by public bodies. It is important that institutions continue to collect data about the environment and keep them public, in line with the Eu directive, to allow long-term studies that can help to understand how the environment and its perception cange over time.

6.3   Future Research Directions

Discrete Choice Experiments (DCEs) are powerful tools that delivers valuable socio-demographic insights, and has all tools they also have limitations. Developing a DCE is resource-intensive approaches in terms of both time and cost compared to other kinds of valuation. Additionally, certain links between choices and individual decision-making processes were not fully disentangled. In fact, DCEs often assume rational and compensatory decision-making, which could overlook deeper ethical, emotional, or relational values.

Deliberative approaches, such as citizen juries, focus groups, or participatory mapping, can complement DCEs by revealing the motivations behind choices, uncovering value pluralism, and exploring dimensions such as fairness, moral obligations toward wildlife, or perceptions of procedural justice. These methods help uncover how people justify their choices, reflect on trade-offs, and consider ethical concerns, particularly in conservation contexts involving complex human–wildlife relationships. Combining DCEs with deliberative approaches can therefore provide a more holistic understanding of public attitudes and support more inclusive and transparent policy development. However, deliberate approaches are even more time consuming and more expensive than DCEs, so that would fit in a larger project.

It would also be interesting to conduct longitudinal studies to assess how public perception of brown bears evolves in response to conservation initiatives and policy interventions. Analysing the proximity to the Alps could provide valuable insights into how people's attitudes toward environmental issues might change based on where they live, the so-called "not in my backyard" attitude.

Applying the methodological framework developed in this thesis to other large carnivore species to evaluate the generalisability of the findings.

Appendix A

List of abbreviations used in the thesis

AVE	Advertising Value Equivalent
CES	Cultural Ecosystem Service
CICES	Common International Classification for Ecosystem Services
DCE	Discrete Choice Experiment
ESS	Ecosystem Services
GIS	Geographic Information Systems
PAT	Provincia Autonoma di Trento
PNAB	Parco Naturale Adamello Brenta
PNM	Parco Nazionale della Majella
PNALM	Parco Nazionale d'Abruzzo, Lazio e Molise
PNM	Parco Nazionale della Majella
SPM	Stated Preference Methods

Appendix B

Scientific output

B.1 Published papers

- **Tattoni C**, Galaverni M, Pollutri A, Preatoni DG, Martinoli A, Araña JE. 2023. Not only seeds: a cultural ecosystem service provided by the Apennine brown bear Human Dimensions of Wildlife https://doi.org/10.1080/

- **Tattoni C.**, Grilli G, Araña JE, Ciolli M. The Landscape Change in the Alps—What Postcards Have to Say about Aesthetic Preference. 2021. Sustainability. 13(13):7426 https://doi.org/10.3390/su13137426

- Riccioli F, Fratini R, Fagarazzi C, Cozzi M, Viccaro M, Romano S, Rocchini D, Espinosa Diaz S, **Tattoni C.** 2020. Mapping the Recreational Value of Coppices' Management Systems in Tuscany. Sustainability.12(19):8039. https://doi.org/10.3390/su12198039

B.2 Paper submitted or in preparation

- **Clara Tattoni**, I. Mauricio Vela Vargas, Ganesh Marin, Odbayar Tumendemberel, Francesco Bisi, Giacomo Cremonesi, Jorge E. Araña, Adriano Martinoli, Damiano G. Preatoni, John Lad Koprowski *Bears as providers of ecosystem services* currently under under review

- **Clara Tattoni**, Jorge E. Araña, et al. *A DCE approach to value bear and Ecosystem services* - in preparation

B.3 Conference and workshops

- Tattoni, C. & Araña Padilla, J. Potential benefits of brown bear eco-tourism in the South Eastern Alps Human-nature interactions and conflict management in mountain environment. Eurac research center, Bolzano, Italy 26–27 November 2018, 2018

- Tattoni Clara & Araña Padilla JE Majić Skrbinšek, A. (Ed.) Potential benefits of Brown Bear eco-tourism in the South Eastern Alps 26th International conference on Bear Research and Management, Ljubliana, Slovenia 16–21 September 2018, University of Ljubljana, Slovenia, 2018, 45-45

- Menapace, M., **Tattoni, C.**, Tondini, N., Zatelli, P., Ciolli, M. Human-wildlife conflict and road collisions with ungulates. a risk analysis and design solutions in Trentino, Italy The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, 2023, XLVIII-4/W7-2023, 125-131, Conference proceedings of FOSS4G2022, Firenze, Italy

- Del Greco F, **Tattoni C**, Gibeau M, Clevenger AP, Groff C, Ciolli M, 2022. Cost benefit analysis to identify the best type and location for a wildlife crossing structure (conference poster) XII Congresso Italiano di Teriologia: Cogne June 2022. Hystrix It. J. Mamm.;33(XII ATIt Congress Supplement)

- Tattoni, C., Zatelli, P., Grilli, G., Ciolli, M. in Nared, J.; I. Potočnik Slavič, Ž. N. , E. Frank, V. B. (Eds.) Dynamics of ecosystem services in response to land-use and climate change: a case study in the Italian Alps The Alps – a Refuge of Bio- and Geodiversity!? Proceedings, ForumAlpinum 2024. 13–14 June 2024 Kranjska Gora, Slovenia, 2024, 49

B.4 Public presentations

- Radio interview to Radio 1, programme La vita meravigliosa "Bears: their role in the ecosystem and the balance between abundant natural resources, predation and damage to agriculture", 15/6/2025

- "The value of bear: a tool to promote coexistence and preserve the ecosystem" WORKSHOP with stakeholders, especially honey farmer – LIFE ARCPROM, 2024 - Parco Nazionale delle Majella, Sulmona, Italy 21/1/2024

- "The Bear Friendly label in the Majella National Park: a tool to promote coexistence and preserve the ecosystem" Networking-Workshop Ecotourism Junior citizen-programmes, LIFE WOLFALPS EU, 16/3/2023 Online workshop https://www.lifewolfalps.eu/wp-content/uploads/ 2023/04/Networking-Workshop_EcotourismJunion-citizen-programmes_ Book-of-abstracts.pdf

- Interview to Radio deutschlandfunk, Orsi in Trentino https://www. deutschlandfunk.de/, 3/05/2023

- Interview to web magazine Materia Rinnovabile "What is the cost of removing bear from Trentino?" Quanto costerebbe all'uomo l'abbattimento dell'orso in Trentino?, https://www.renewablematter.eu/articoli/article/ Quanto-costa-agli-ecosistemi-abbattimento-orso-Trentino-Andrea-Papi, 12/04/2023

- Public presentation at Museo di Scienze Naturali di Bolzano: "Large carnivorse and outoor activity"- Grandi Carnivori e attività outdoor, 28/11/2020

- Interview to Local newspaper Alto Adige: "LArge carnivores and tourism, what science has to say" "Grandi carnivori e attività turistiche Ecco cosa sappiamo Scienza" 27/11/2020

- Interview to Radio Radiouno, Rai Alto Adige programma Greenwich: "Grandi carnivori in Trentino Alto Adige" "Large carnivores in Trentino alto adige" 12/09/2020

Figure B.1: The author presenting at a workshop organised by LIFE project AR-CPROM with stakeholders interested in the bear friendly logo - Parco Nazionale delle Majella, 2024

- Public presentation at Museo di Scienze Naturali di Bolzano:Museo di Scienze Naturali di Bolzano: "Brown bear and tourism" Orso bruno e turismo, 11/4/2018

B.5 Funds

Appendix C

SPM Experiment details

C.1 Online questionnaire for experts

The online survey was created with the Google Form tool and was available for about one month at the following address.

https://tinyurl.com/yhcmpckz

Fifteen bear experts, academic and managers, were invited personally by email in July and allowed one month to respond. No reminder was sent. Seven experts replied, including Tom Smith, Francesco Bisi, Johanna Platzgummer, Barbara Chiarenzi, Mauricio Vela-Vargas and Filippo Zibordi, the others chose to remain anonymous. The following figures show the appearance of the survey.

Bears and Ecosystem services

Dear bear Expert,

I would like to ask your help for the research that I am doing as PI , in collaboration with the University of Las Palmas de Gran Canaria, the University of Insubria, Italy and the University of Trento.
We are preparing a questionnaire on the topic of bears and ecosystem services in the Alps.

The aim of this work is to understand how people value the ecosystem services that bears can provide.

After the incident that lead to the death of a young man by a female bear with cubs, the Italian public opinion about bears is very polarized. We believe it is critical to show people the great number of benefits that the presence of the bears can provide to the environment and to the people.

At this stage, after a long literature review, I have selected a few services that I consider the best suited for the Alpine case study.

I would be glad if you can answer this short survey in order to help me rank the ecosystem services that will eventually end up in the questionnaire. There are also other simple questions that will help me in the process. The survey will be later administered to the Italian population.

Feel free to contact me for clarifications or more details on this research.
Thank you for your time and consideration,

Clara Tattoni

clara.tattoni@gmail.com Cambia account

Non condiviso

* Indica una domanda obbligatoria

If you wish to be acknowledged in future papers, reports and so on, please write your name here, otherwise the questionnaire will remain anonymous.

Figure C.1: Expert online survey, screenshot 1

Seed dispersal is an important ecosystem service provided by brown bears. This *
has been proved in North America and in other European countries (for example,
but not limited to Harrer et al., 2018 and García-Rodríguez et al. , 2021). Do you
think bears can disperse the seeds of berries also in the alpine environment?
Please state your agreement

	1	2	3	4	5	
Disagree	◯	◯	◯	◯	◯	Agree

Since bears have been associated with berry seed dispersal, there are likely to be *
more berries in the forest. Does this image explain the availability of berries to
the general public?

◯ Yes

◯ No

◯ Altro: _____
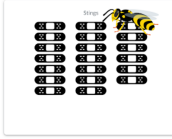
From scat analysis at Parco Adamello Brenta and from literature, bears consume *
great quantity of bees, wasps and other hymenoptera (for example, but not
limited to Pereira et al, 2021, Seryodkin et al, 2016) . So we can support the
idea that population control of ants, bees and wasps is an important
ecosystem service provided by brown bear.

	1	2	3	4	5	
Disagree	◯	◯	◯	◯	◯	Agree

Figure C.2: Expert online survey, screenshot 2

Even if you disagree with the previous sentence, let's assume that bears really control the number of insects. In this case, there are likely to be less wasps and hornets in the forest. So the likelihood of being stung when hiking decreases. Which image would you choose to explain this idea to the general public? *

○ Wasp swarm/ number of insects   ○ Sting risk

○ Altro:
_____

Brown bears in Europe contributes to create forest biodiversity because they are "ecosystem engineers" (Zysk-Gorczynska et al 2021) and because they contribute to nutrient cycle in several ways. Do you think this statement holds also in the alpine environment? *

	1	2	3	4	5	
Disagree	○	○	○	○	○	Agree

Brown bear presence increases animal biodiversity. Please state your agreement with this sentence *

	1	2	3	4	5	
Disagree	○	○	○	○	○	Agree

Figure C.3: Expert online survey, screenshot 3

The possibility of bear watching or bear related tourism can be considered a benefit for the community, if managed with due care. Please state your agreement: *

	1	2	3	4	5	
Disagree	○	○	○	○	○	Agree

Do you think the general public should be asked about HOW MANY bears they want in a given area? *

○ Yes

○ No

○ Altro: _____

Do you think the general public should be asked WHERE do they want bears in a given area? (Inside or outside natural parks for example) *

○ Yes

○ No

○ Altro: _____

Do you think I missed some important ecosystem service?

La tua risposta

Do you have any other comment?

La tua risposta

Figure C.4: Expert online survey, screenshot 4

C.1.1 Expert's answers

Seed dispersal is an important ecosystem service provided by brown bears. This has been proved in North America and in other European countries (for example, but not limited to Harrer et al., 2018 and García-Rodríguez et al. , 2021). Do you think bears can disperse the seeds of berries also in the alpine environment? Please state your agreement

Copia

7 risposte

Since bears have been associated with berry seed dispersal, there are likely to be more berries in the forest. Does this image explain the availability of berries to the general public?

Copia

7 risposte

111

From scat analysis at Parco Adamello Brenta and from literature, bears consume great quantity of bees, wasps and other hymenoptera (for example, but not limited to Pereira et al, 2021, Seryodkin et al, 2016) . So we can support the idea that population control of ants, bees and wasps is an important ecosystem service provided by brown bear.

7 risposte
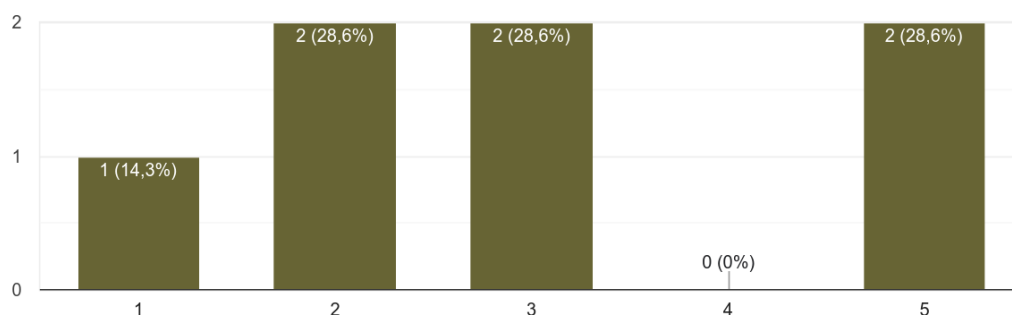
Even if you disagree with the previous sentence, let's assume that bears really control the number of insects. In this case, there are likely to be less wasps and hornets in the forest. So the likelihood of being stung when hiking decreases. Which image would you choose to explain this idea to the general public?

7 risposte
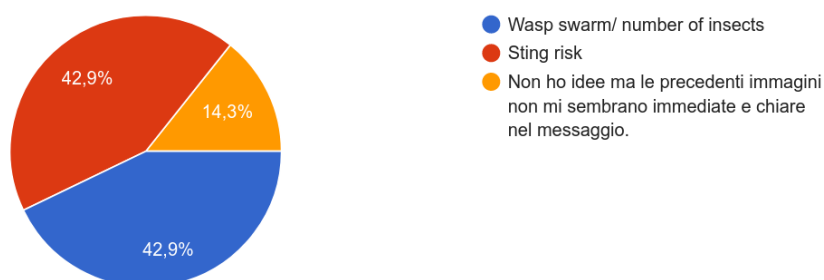
● Wasp swarm/ number of insects
● Sting risk
● Non ho idee ma le precedenti immagini non mi sembrano immediate e chiare nel messaggio.

Brown bears in Europe contributes to create forest biodiversity because they are "ecosystem engineers" (Zysk-Gorczynska et al 2021) and because they contribute to nutrient cycle in several ways. Do you think this statement holds also in the alpine environment?

7 risposte
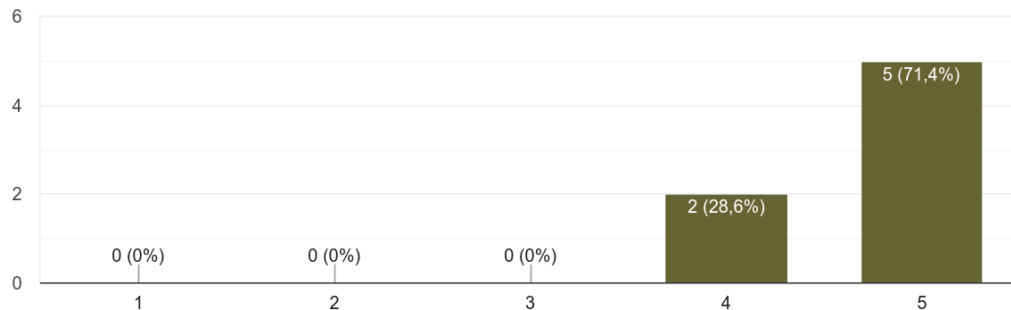
Brown bear presence increases animal biodiversity. Please state your agreement with this sentence

7 risposte
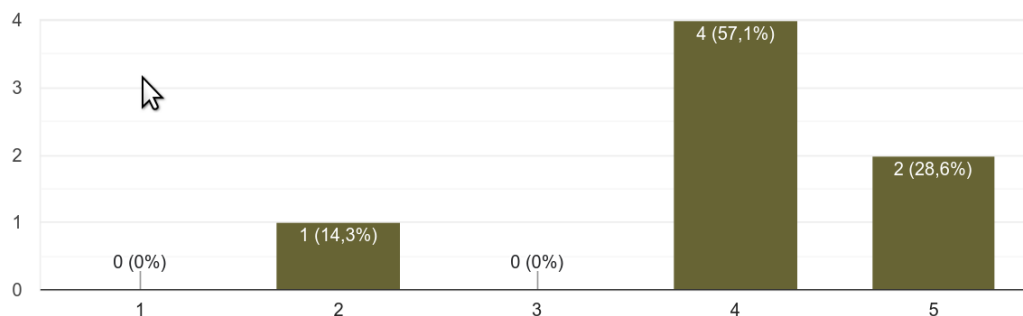
The possibility of bear watching or bear related tourism can be considered a benefit for the community, if managed with due care. Please state your agreement:

7 risposte
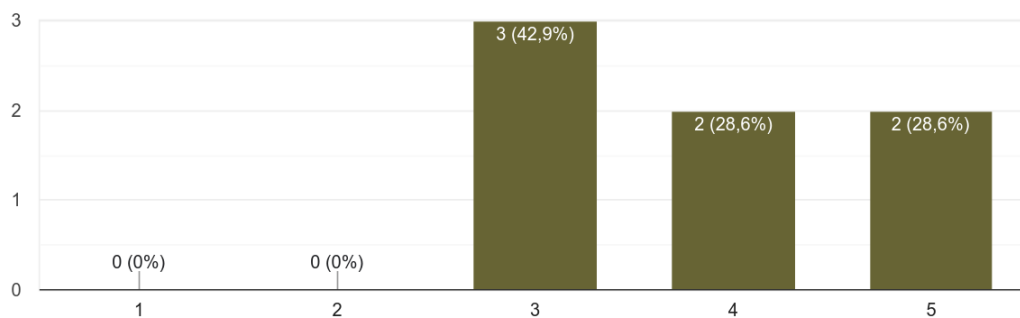
Do you think the general public should be asked about HOW MANY bears they want in a given area?

7 risposte
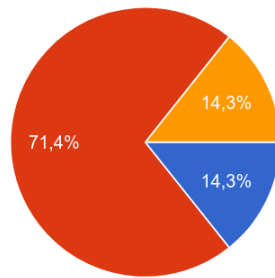
- Yes
- No
- In a certain way yes: I mean, the social acceptance should be considered (e.g., by proxies such as the number of damages, aggressions)

14,3%
71,4%
14,3%

Do you think the general public should be asked WHERE do they want bears in a given area? (Inside or outside natural parks for example)

7 risposte
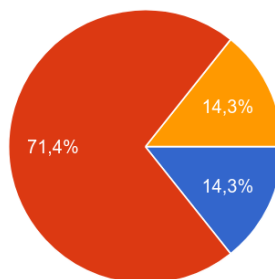
- Yes
- No
- In a certain way yes (see previous answer)

14,3%
71,4%
14,3%

Do you think I missed some important ecosystem service?

3 risposte

No
Scavenging, "non-material" services (learning, cultural values, conservation value, intrinsic/inherent value, spiritual value)
A believe that all the services related with aestethic and tourism would be good to include. And bears as facilitators of energy movements at the ecosystems.

C.2 Focus group flyer

C.3 Focus group transcript

Bear ESS focus group transcript

14/06/2023

Clara: Grazie Per aver partecipato a questa riunione perché noi stiamo facendo un progetto di ricerca nell'ambito dei progetti di biodiversità in cui Marco è leader di un VP sulla tematica dei conflitti uomo e fauna selvatica. Una delle attività che abbiamo in programma è un questionario. Da somministrare alla popolazione italiana sul tema dell'orso. Per la preparazione di questo questionario abbiamo organizzato questo focus group. Non so se avete mai partecipato. Un focus group è una occasione in cui si chiede il parere delle delle persone. Quindi se siete venuti qua sperando di avere una conferenza sull' orso vi deludo subito. Cercheremo di farvi parlare il più possibile per cercare di capire quali sono le parole anche giuste da usare nel nostro questionario. Vi faremo vedere alcune immagini che abbiamo scelto per il questionario e voi ci farete da cavie per vedere l'effetto che fa e ci interessa davvero sapere che cosa ne pensate. Quindi vi ripeto, non serve essere a favore o contro l'orso, anzi, più variegato è il pubblico, meglio è. Più variegate sono le opinioni, più interessante per noi.

Come vi avevo scritto questa riunione verrà video registrata in modo che poi a solo uso interno noi la guarderemo per per vedere se ci siamo persi qualcosa quindi se non siete d'accordo sulla registrazione ditelo liberamente. va bene a tutti. grazie.

Condurrò io, il focus Group, ma cercherò di farvi parlare il più possibile.Quindi di nuovo grazie.

Ecco, io vi farò delle domande e voi dovrete magari rispondermi con una parola o più di un secondo di quanto avete voglia. Iniziamo a parlare un po'su sui temi generali. Noi viviamo in montagna cioè viviamo e lavoriamo qui nel Trentino quindi sapete tutti che ci sono gli orsi , sapete tutti che qui vive una popolazione di orsi reintrodotta. In questo momento si parla tantissimo della gestione dell'orso . e la prima domanda per voi è secondo voi tra i vari problemi che ci sono sulle Alpi la gestione dell'orso è uno dei più importanti oppure no? Cosa ne pensate? Qualcuno rompe il ghiaccio.

Claudio: Io distinguerei tra problemi veri, problemi immaginari
Intorno alle difficoltà degli intellettuali di. L'identità per cui credo è è un problema che esiste ma è molto complicato mediare rispetto a tutti i problemi che ci sono. Se non ci fosse la pressione mediatica forse non sarebbe così rilevante.
Direi di sì, ma indirettamente.

Clara :E ci sono dei problemi più importanti secondo te, per l'ambiente alpino in questo momento?

Claudio: Dal punto di vista ambientale o in generale.?

Clara: Ambientale.

Claudio: Beh ovviamente i cambiamenti climatico drammatici immagino nei prossimi decenni e questo sia dal punto di vista del rischio ma sia dal punto di vista delle.

Clara : C'è qualcuno altro che pensa che vuole dire la sua opinione su quanto è importante il problema dell'orso per le Alpi? Una cosa di cui bisogna occuparsi oppure ci sono cose più importanti di cui occuparsi?

Lucia
Secondo me in questo momento è necessario.
Reagire all'evento tragico che è accaduto ad aprile. Quindi non si può ignorare quello che è accaduto quindi una reazione serve. E poi questa sia una reazione di. .

Se diciamo di tutto l'arco alpino non nell'immediato però una secondo me una valutazione di quello che è accaduto è una valutazione quindi se la gestione corrente del.

Del progetto Orso, chiamiamolo così eh è corretta, Secondo me va fatto. Capisco un problema generale che sono problemi più grandi di quel cambiamento climatico però bisogna. In questo momento è richiesta una reazione chiamiamo una reazione politica. Però non non puoi essere indifferente rispetto a quello che è accaduto cioè l'indifferenza vuol dire accettiamo quello che è accaduto però deve essere esplicitato che sta nelle cose che in questo momento sembra magari che sia l'unico problema che. Riguarda l'ambiente forestale o la zona del parco però ce ne sono anche altri.

Sara: No beh insomma ovviamente che che che si può dire no io personalmente credo che che sono d'accordo sul fatto che bisogna reagire però mi sembra che questa attenzione mediatica eh sia legata fondamentalmente alle elezioni siamo sotto le elezioni e allora prima ci stavano dentro ci stavano altre cose eh. la dei laghi che c'è stata in questo momento eh oppure che ne so però che aspetti la TAV a un certo punto che.

Dico sinceramente. Beh, ovviamente c'è stato il caso di arbitri che si dicevano però attenzione eh se se il caso di aprile lo intendiamo come il fatto che un uomo è stato ucciso a causa di un animale selvatico è un delitto. Però sapete quante persone muoiono per incidenti stradali legati alla detenzione? Da noi cioè i giornali ve ne parlano, ma è capitato un sacco di volte. Io conosco persone che si sono fatte malissimo perché si sono scontrate col capriolo che è uscito per strada. Quindi il discorso della morte, quello che colpisce di questa cosa è il fatto che lui si è stato rappresentato come assassino, cosa che secondo me bisogna provare ampiamente perché questa era vincente voglio dire ragazzi. Qualunque animale di questo tipo. Comunque detto questo è chiaro che bisogna pigliare posizione bisogna pigliare posizione nel senso di eh combattere queste esagerazioni cioè quando io leggo un giornale anche l'elettrodotto assassino a motore insomma perché è falso è totalmente falso. Ecco in questo senso direi di reagire ma. Cioè le persone che conosco io non sono un esperto per carità mi piace leggere queste cose però bisogna reagire dicendo guardate non dite queste cavolate cioè che l'orso che mangia gli uomini bianchi perché loro forse gli orsi quei grizzly non solo non facciamogli insinuare però una boiata.

Secondo me sì, è un problema, ma è un atteggiamento . Politico però direi che i problemi seri in questo momento il cambiamento climatico l'eccesso di pressione turistica eccesso proprio eccesso all'effetto di un turismo. Come al solito, prima di tutto i numeri che devono crescere ogni anno perché questa è la logica del mercato sciistico. però poi io la vedo così cioè mi sembra una cosa su cui sono d'accordo bisogna pigliare posizione ma secondo me soprattutto per difendere il progetto che io vedo come una cosa invece molto bella cioè il fatto di riprendere un animale selvatico. proprio la catena quindi estremamente importante per il controllo del sistema eccetera e che è stata che è ritornata. è stato gestito probabilmente non nel modo ottimale perché non hanno fatto per esempio i passaggi da una zona all'altra che avrebbero dovuto fare, le strade le ferrovie le cose separano ancora il territorio in cui poi è chiaro che sembra ovvio cioè io io così non lo so cioè io direi che la posizione radicale su queste cose qua. Chi ne sa, come voi , vedete deve fare il diavolo a quattro dicendo "ma che cavolo state dicendo"ai politici , è una boiata pazzesca scusate io dico di sì.

Clara: In questo studio quello che vogliamo mettere in evidenza è se le persone percepiscono i quali sono i vantaggi che un ecosistema che contiene tutta la catena trofica fino ai massimi predatori ,come il lupo e l'orso può portare.

Un'altra domanda che volevo farvi Se avete qualcosa da dire sull'importanza dei problemi delle Alpi, c'è qualcun altro che vuol dire qualcosa?

Sara: Siamo perfettamente d'accordo sulla priorità del problema delle Alpi, prima di tutto climatico. La questione del turismo anche tantissimo e anche legata in alcuni ambienti al consumo di suolo legata quindi alla pressione turistica. E però forse il tema del lusso non so se è un problema di sicuro adesso è per tragedia che ci sta è un problema però probabilmente prima la questione della gestione cioè il fatto che non sia stato gestito bene il progetto allora nel senso mi viene da pensare appunto che la non gestione è stata un problema è diventata un problema che ricaduta anche forse insomma ad alcune condizioni in alcune situazioni che hanno portato a questa tragedia nel senso. E allora prima ecco qui che adesso che le che è successa la tragedia che è un problema cioè nel senso che una contingenza da da da capire è prima anche no forse era una questione cioè proprio è una condizione umana di non essere che che che che esiste anche che quindi va gestita in qualche modo quindi di sicuro è parte di più occuparsene ecco non solo questo direi io.

Clara: Ok grazie mille passiamo alla domanda successiva che come molti di voi sapranno l'orso è un animale che vive principalmente nei boschi nell'ambiente forestale spesso esce dal bosco soprattutto in alta quota. Il suo ambiente sono le foreste e quindi la domanda per voi è: voi andate nelle foreste e cosa fate quando andate nelle foreste? il fatto che ci siano degli orsi cosa cambia per voi?.

Lucia: Allora io vado nelle foreste, seguo i sentieri ufficiali. Sì, io vado a camminare, faccio escursionismo estivo, invernale, primaverile, autunnale, insomma tutte le stagioni. E non mi sono mai posta il problema dell'orso. Eh, devo dire che da aprile non ho più camminato, ma non perché è accaduto l'evento, è perché in questo periodo mi sto dedicando più alla bicicletta. Non so se ci porremo il quesito come andare a camminare? Ehm, quello non lo so. Per fortuna non sono da sola, quindi un po di rumore lo faccio.

Clara: Tutti gli studi dicono che la 99% degli attacchi di orsi avvenuti nel mondo è avvenuto a persone da sole. Quando c'è un gruppo, non sono praticamente quasi mai avvenuti attacchi. Pare che in America il numero magico sia tre, sopra tre persone non è mai stato registrato nessun attacco di orso.

Lucia: Riporto il caso non del mio compagno, dei colleghi, del mio compagno che per lavoro vanno nei boschi. Eh si, son posti il problema da soli. Cioè devono andare a vedere, per dire, la sicurezza dei pali telefonici devono fare delle misure. Si sono posti il problema.

Sono persone sole nel bosco in orario di lavoro. Ok, quindi credo che dalle 08:30 alle 16:30 quindi forse fuori orario orso , forse però per quelle persone è un problema di sicurezza.

Clara: Ma diciamo che abbiamo fatto anche con le foto trappole. Abbiamo visto che gli orsi in Italia, qui in Trentino così come nel resto d'Europa in zone antropizzate hanno. Sono attivi all'alba, al tramonto e di notte ,cioè cercano di essere attivi quando sanno che non ci sono le persone. Poi ovviamente, sono dati statistici, perciò non è impossibile trovare un orso che di giorno va in giro. Però siccome tendono a evitarci, in genere si sono adattati a utilizzare questi momenti della giornata per cui è difficile incontrarli in pieno giorno.

Nicola: Non mi faccio illusioni .

Io vado spesso in Alto Adige o in Val di Rabbi. Si sentieri c´`e tanta gente, siamo rimasti bloccati. lo scorso anno su sentiero in agosto. Non è che ci siamo ritrovati a ferragosto...

Clara: a Ferragosto gli orsi secondo me si sono tutti infrattati

Nicola: Durante il giorno, sui sentieri battuti antropizzate, trovate una persona, una bici poi.

Non vedo un grossissimo problema. Poi se uno va di notte o va. Non so.

Clara: Magari c'è qualcuno di voi che va a funghi. Il sente minacciato dalla presenza del.

Claudio: Io vado in compagnia. . In realtà considero il rischio fondamentale praticamente zero o quasi. Da quello che sappiamo io ritengo questa una cavolata pazzesca. Questa è una colpa dell'uomo per l'appunto che lo ha favorito, dunque io personalmente non ho alcuna va al di là di un ponte tibetano eh un sentiero molto frequentato però voglio dire mi vengono sentieri se va se cerco se cerco i funghi sempre non lontanissimo dal sentiero insomma. E e cerco di avere compagnia e comunque faccio sempre rumore. cioè il discorso del fischietto non so quanto sia efficace però io e mia moglie sentiamo proprio il fischietto ogni tanto..

Lucia: Ma io non ho capito. Ma che vantaggio ci sarebbe ad avere l'orso col collare? Che vantaggio c'è che avere chi c'è? Chi controlla o verifica come stanno? Si sa dove stanno ?

Claudio: Dico per dire, se c'è un criterio, se si sa che c'è una densità maggiore di una certa zona e quindi le persone stanno in guardia, casomai in quel momento evitano di andare di fare cose. Un lavoratore che lo sa, allora oggi adegua il suo programma di lavoro perché sappiamo che ci stanno in questa zona ma in un'altra zona.

Lucia: Ma in quanto tempo si fanno quei dieci venti 30 chilometri gli orsi? No, no mi fido che sta lì l'orso. Cioè io il sabato sera quando devo programmare l'escursione vado a vedere dove stanno gli orsi il sabato sera. Ok, no, allora non andiamo in questa zona, vado nell'altra, faccio così

Claudio: Adesso non pesco più che tanto non si piglia niente. Ma io quando pescavo andavo a vedere qual era il livello dell'Adige, perché l'Adige, sto dicendo, non parliamo del Noce, se tu ti metti a pescare lì senza sapere il livello di diciamo di quell'acqua e di quel periodo rischi di trovarti in acqua. perché lì arriva una città con la pirna. Una volta che stavo pescando, ma mi ero concentrato su lla mosca mi sono trovato con i piedi in acqua. . Sto dicendo una cosa apparentemente priva di relaizione con l'orso, ma secondo me queste informazioni sul rischio ci sono e chiedendole si possono di sfruttarle.

Comunque il fatto che questi qua non abbiano fatto i sentieri che consentono agli orsi di passare le barriere. Cioè non so come si chiamino però questi ,corridoi ecologici, cioè quelli quei passaggi che ti consentono di superare le barriere umane peraltro no voglio dire per cui le autostrade queste cose qua. E e l'altra cosa il fatto di non seguirli cioè di non avere. Cioè quando uno sente dire sì sta troppo in tre però quello si è scaricato a batterie allora quindi fare. Cioè ma non credo che siano le persone che lo fanno penso che sia una decisione cioè investire risorse in questa cosa

Clara: sicuramente. Il monitoraggio, con collare o con altri sistemi permette di di conoscere meglio dove stanno. poi come dicevi tu l'orso può fare anche 30 chilometri in una notte. però diciamo le femmine coi piccoli che sono quelle più più pericolose non si muovono tantissimo perché appunto i piccoli che non riescono a camminare 30 chilometri in una notte. Qualcuno di voi va a correre in montagna? O fa mountain bike ?

Studente: Io vado in bici in Val di Sole perché ho la famiglia di là .Quello che sento che dicono le persone, soratutti i vecchi che hanno un odio irrefrenabile nei confronti dell'orso. . Ammazzarli tutti non serve. E poi c'è anche la gente un po più razionale. Mi verrebbe da dire che comunque la gente ha paura di andare lì.

Sono appunto dietro casa. Nonostante la situazione meno male rispetto a un anno fa è la stessa, perché il numero di orsi più o meno è quello,. Hanno molta meno sicurezza, vanno in giro quindi molto impauriti.

Sara: Sperimentiamo prima e dopo.

Nel senso che io andavo sempre in montagna in valle d'Aosta e mi dicevano di fare rumore. Fin da piccola sono stata educata così. Questa sì. Però la prima volta che fai camminata qui ne vedo i simboli, Già, i cartelli è un attimo. però allora c'è una nuova forma di vita e quindi non non ero, cioè non sono educata, non sono informata. nel senso che da bambina e con questa educazione sapevo cosa fare e non fare. Poi uno cresce poi anchee c'è altro tipo di di relazione. però c'è un prima e dopo cioè se già prima era un po che siamo una zona di attenzioneorso facciamo rumore eccetera . per me adesso che

sono arrivata a camminare oppure vado in bici sempre per escursionismo sempre in due con magari tanti di più comunque però c'è un'alternativa di movimento insomma è cambiato da allora

Clara: Vero. adesso entriamo un po più nel vivo di che impatto ha l'orso sull'ecosistema ci sono molti studi che sostengono l'idea che dove ci sono appunto predatori, tra cui lupo e orso, l'ecosistema sia più in equilibrio e sia più sano. E in questo questionario vorremmo andare a esplorare se la gente percepisce questo ecosistema più sano nelle sue varie componenti. Una di queste sono le le foreste che sono state nominate anche per il cambiamento climatico. Se vi faccio vedere queste tre immagini di foresta voi che cosa ci vedete. Lo chiedo a Giulia che.

Giulia: A me personalmente piacciono tutte, pero se devo dare un giudizio.

Clara: Un giudizio estetico è benvenuto. Ma come sono queste foreste? Non sono tutte uguali.

Giulia: No, ovviamente. E bisognerebbe sapere più o meno a che quota siamo, perché l'abete rosso può essere una specie che ci sta bene e che ci arriva da sola, come pure a quote più basse è stato introdotto. Per cui io dico la verità, non demonizzo così tanto l'abete rosso. Sarà che ci ho lavorato talmente tanti anni dentro e l'ho visto così potente e gagliardo che proprio non lo puoi contrastare quando è nel suo optimum di vegetazione. Che metto sempre un po. Cioè, prendo un po con le pinze. Io adesso son d'accordo se siamo in Primiero e il faggio naturalmente lì ci sta bene, per carità eh, ma va assolutamente incentivata la presenza di faggio. Però quando sento demonizzare i boschi di abete rosso della Val di Fiemme mi dico ma li conoscono veramente poi i gli equilibri di questi di questi boschi?

Clara: Una delle cose in cui ci serve il vostro aiuto è capire se il modo in cui vogliamo chiedere a una persona Ma qual è la. Il bosco più biodiverso? Cioè, cos'è la biodiversità forestale? Che ci vuole un corso di studio per spiegarla... Abbiamo provato a riassumerla con le immagini, però non sappiamo quale funziona meglio

Giulia: Ma si potrebbe provare a cambiare il voto. Per esempio io darei un interno di bosco dove vedi molto, ma non prenderei neanche l'abete rosso. Io prenderei un popolamento di Pino Nero per esempio. No piantato che quello è proprio chiaro chiaro quello che stona no. Vedi che è estremamente.

Clara: Diciamo che noi vorremmo chiedere alle persone un'opinione sulla biodiversità della foresta e abbiamo scelto questa immagine. e volevo chiedere a voi se vedendo queste foto vi viene in mente la biodiversità di un ambiente forestale oppure no.

Claudio: Quindi dovrebbero essere parte di stagioni diverse, cioè di quelle che sono esseri comuni, per esempio legati alla stagione. Quella di destra vorrebbe quella di destra estrema ma anche se a distanza non non riesco a vedere bene però alcuni di quegli alberi potrebbero essere anche malati potrebbero avere molti problemi. Cioè sinceramente mi cioè mi preoccupa più il bostrico che ti possono cadere gli alberi in testa oppure perché insomma la foresta ne soffre tanto piuttosto che che.

Sara: . Non so se voi volevate invece dire prima ecco uno secondo son due terzo son tre perché son tre colori diversi in questo senso non so questo era la.

Clara: La nostra idea era di provare a spiegare la biodiversità forestale abbiamo provato con questa immagine e poi abbiamo pensato anche questa più schematica in cui si vedono alberi mono specie di una sola specie di due specie diverse ma tutti della stessa altezza, oppure un bosco più.

Giulia: lo rende forse d quasi più comprensibile

Sara: non è tanto per le foto .

Claudio: Ecco secondo me queste immagini fanno pensare più a quello che dici tu.

Clara: Tra l'altro, visto che prima. più di una persona ha nominato i cambiamenti climatici, un bosco che ha maggiore biodiversità è un bosco che resiste meglio agli eventi estremi e quindi comunque porta un beneficio avere un bosco più biodiverso rispetto avere un bosco mono specifico, senza nulla togliere ai boschi gagliardi, abete rosso però. Solo che.

Secondo me con delle semplici immagini. Un tocco così è.

Nicola: Un bosco diverso avrebbe avuto una prestazione migliore rispetto alla tempesta Vaia o invece sarebbe stato tutto uguale?

Clara: Faccio rispondere a Marco Ciolli che è proprio il suo argomento

Marco: SDipende. Nel senso che la situazione non è stata uguale dappertutto. Il vento è stato fortissimo, per cui in alcune zone penso niente avrebbe retto. Però effettivamente la cosa che colpiva anche in alcune zone del Primiero altre aree dello Stato dove è stata colpita abbastanza pesantemente

era il fatto che in mezzo laddove c'era qualche qualche faggio, dove c'era un po di c'erano un po di faggi e non era una situazione solo di abete rosso, eh, Effettivamente alcuni di quei faggi sono rimasti in piedi e alcuni son riusciti a ripartire. Ora diciamo è una grande semplificazione naturalmente perché e poi c'erano delle aree che erano completamente mono specifiche però di piantagioni recenti quelle soprattutto, alcune piantagioni recenti che erano state fatte di abete rosso in altopiano. lì proprio è venuto giù tutto ma lì è stato proprio lì è stata una questione sia meccanica cioè erano tanti soldatini messi in piedi che arrivava il vento e buttati giù come un domino. Ecco quindi quel in quella situazione lì se tu avessi avuto un bosco misto sicuramente qualcosa di diverso l'avresti avuto. anche a livello.

Giulia: Anche a livello di percezione. Per esempio quel faggio in Primiero si è salvato perché era comunque più giovane, a livello quasi di sottobosco. Anche più elastico. E però, nel momento in cui è rimasto scoperto il terreno. Invece hai dei boschi molto artificiali con quegli investimenti forse.

Clara: Poi per quanto riguarda il bosco che era stato nominato un bosco mono specifico sicuramente in caso di arrivo di un parassita è più attaccabile ma questo in generale vale sempre perché quel parassita lì è specifico per quella pianta lì, quindi se ne trova 1000 tutte insieme. È la festa del parassita. Se trova alberi diversi si prolifica però sulla pianta accanto, magari non riesce a crescere e non si hanno proprio questi. Diffusione a macchia d'olio del bosco.

Marco: Dopodiché però ci sono delle situazioni, soprattutto qui in Trentino, ma non solo, dove il bosco di abete rosso è la situazione ottimale, o meglio lo era fino adesso. Poi adesso vediamo che cosa succederà. Però fino adesso era la situazione ottimale. Ci sono dei boschi che in cui proprio il bosco puro di abete rosso con occasionalmente qualche altra specie, era la situazione naturale dove le piante si auto rinnovavano in modo assolutamente normale tranquillo. Però cioè adesso è una fase di cambiamento non puoi sapere in che direzione stiamo andando.

Giulia: Specie a scavo micro termo, specie che si sono adattate a basse temperature, sopportano -60 in Siberia e perché hanno tutta una serie, però non sopportano la più elevate, non riescono a entrare in dormienza d'inverno e rimangono in uno stato per cui sono particolarmente suscettibili.

Claudio: Comunque io l'esperienza io. Cioè io frequento alcune zone del Trentino dove vado spesso per funghi per correre. e ho notato questa stessa cosa. Per esempio sulla strada sulla strada che sale verso questo verso Vicenza è abbastanza evidente che sono rimasti in piedi dopo Vaia e le latifoglie in modo prevalente cioè i boschi. Lì ci stavano dei boschetti di castagno, delle querce. Anche gli alberi sono pochi, isolati a pinete dove praticamente dominava la vite. A Pinè invece è una cosa drammatica, non c'è più nulla perché sopra dove sono andato un sacco di volte prima di arrivare, uno rimane così perché non c'è un albero a vista d'occhio. Ecco, qualcuno lo stanno diventando. Spero che non piange però perché io onestamente in quella zona e d'altra parte come dici tu ci sono anche i casi opposti. Per quanto riguarda invece il discorso bostrico. io ecco due mesi fa sono capitato su delle serre in Calabria

dove c'era un'invasione di rischio e tutti i castagni che ci stavano erano tutti malati che una cosa incredibile ma vischio ragazzi.

Sembrava sembrava un albero di vischio. Cioè, voglio dire, di cui mi rendo conto, è che lì il castagno è prevalente,

Marco: Il vischio è portato dagli animali, cioè nel senso il rischio è portato praticamente dagli animali. Sono stato in Germania proprio per questo progetto Transwild. Qua sono andato sul confine con la Polonia, c'erano delle zone che io sono rimasto colpito perché c'era degli alberi. Sembravano vischio, sembravano alberi di vischio erano. Era completamente pieno e lì però è una questione anche legata proprio l'avifauna per questo gli uccelli vanno a portare la cosa sostanzialmente quindi diciamo lì è un po una un aspetto un po diverso perché non è propriamente una malattia tra virgolette no nel senso che si.

Claudio: Vi riporto agli orsi perché, scusate cioè possiamo stare qui quanto volete però io voglio cercare di avere il vostro parere.

Sara: Quindi questo d è un consiglio cioè la grafica e avendo una un pubblico più variegato è quello che mi aspettavo dicevate la cosa più efficace diretta semplificativa in qualche modo sistematica perché eh magari. Cioè nel senso le immagini di prima magari non erano quelle più azzeccate però come noi cerchiamo di capire aspetta ma i colori sono le stagioni.

Anche altre cose però forse nelle nelle immagini più descrittive si cercano più cose ognuno ha anche degli immaginari diversi quasi per esempio sono tutti uguali due tre due tre due tre quattro diversi quindi forse al fine di far capire questa cosa. Certamente meriterebbe che ci fosse più chiaro soprattutto sarete varie persone diverse ecco.

Clara: grazie perché è proprio questo genere di cose che ci serve sapere, cioè quando vi ho fatto vedere l'altra immagine e mi avete detto le stagioni e nessuno ha detto biodiversità. ho capito che questo non funziona però finché non la provo non lo so. sì dimmi.

Paolo: A parte l'effetto fastidiosissimo che i rettangoli non sono uguali.

Secondo me l'altra immagine, se tu conosci le specie, capisci che hanno colori diversi perché sono specie diverse, quindi sarà immagino abete, sempre verde verde , gli altri erano faggi e faggio larice.

Magari una persona non sa distinguere le specie e vede l' autunno.

Marco: Sì, questo è un bosco misti ambiente larice l'altro un bosco ancora più misto ma sono anche a quote diverse

Sara: sono anche inquadrature diverse.

Clara: Perché noi pensavamo anche così al valore estetico della biodiversità. Però quelle immagini lì non funzionano. Abbiamo scoperto

Vi proponiamo questa grafica

Sara: questa è diciamo, sistematica e quella più realistica insomma.

Clara: Beh guarda tutte le idee sono utilissime. Noi siamo particolarmente interessati a indagare gli effetti che l'orso ha sull'ambiente e abbiamo trovato un sacco di studi in cui l'orso Bruno in Europa, che è una specie tecnicamente classificata come un carnivoro, ma di fatto qui si comporta come un onnivoro e la maggior parte delle proteine animali che consuma sono dovute agli insetti e il resto della dieta è una dieta vegetariana. E questo fa sì che l'orso svolga un ruolo molto importante nell'ecosistema di dispersione dei semi, non di vischio, ma soprattutto dei piccoli frutti di cui si nutre prugne selvatiche, frutti di bosco, mirtilli, fragole, eccetera. Sicuramente in un bosco dove ci sono gli orsi c'è maggiore diffusione di frutti di bosco. E questo "servizio ecosistemico" avevamo pensato di rappresentarlo così cioè col fatto di poter raccogliere un maggior numero o un minor numero di frutti di bosco. Sicuramente l'orso ha questo effetto anche sui funghi perché è un animale che aumenta la circolazione della della materia organica perché scava negli alberi marci e quindi poi favorisce la diffusione dei funghi però questo era certamente più difficile da spiegare.

Per un pubblico generico quindi abbiamo scelto i frutti di bosco. Aqui vi faccio vedere due due possibilità una è questa e un'altra era questa.

Cioè se vedete l'orologio cosa vi viene in mente?

Sara: Eh, che fai più veloce?

Lucia Bisogna arrivare prima che vi mangino. Sì, però.

Clara: Prima raccogli qua, cioè che li raccogli in 1 ora, che li raccogli in 3 ore.

Paolo: se ci metto 3 ore non ci vado proprio. E poi dove ci sono più frutti ci sono più orsi, non è pericoloso?

Lucia: So per chi va all'alba

Giulia: queste cose però vanno spiegate prima di dare il questionario.

Clara : Fine tra qualche minuto farete una prova del questionario. Ve lo darò tra un attimo per vedere, per farvi fare da cavia anche su questo. Una volta spiegati queste cose dovranno fare delle scelte, però.

abbiamo pensato di mettere delle immagini, a volte dei numeri, a volte delle cose e vogliamo capire se poi nei 3 minuti che passano da quando gli spieghiamo le cose, quando devono rispondere poi se lo ricordano e capiscono.

Lucia Perché abbiamo lo stesso i mirtilli?

Sara: E poi parlerà spiegare quello che ci ha detto a voce ci sarà scritto qualcosa. Cioè nel senso questo che ci ha detto a voce lo dice a voce.

Clara Allora sarà scritto. Cioè perché pensiamo di farlo online in questionario? Quindi ci sarà una spiegazione introduttiva che ti dice la presenza dell'orso è legata a una maggiore. Cioè ci sarà una spiegazione però in questo momento ci sembra più semplice fare un questionario online.

Non ci sarà nessuna comunicazione.

Sara: Dicevi prima, prima spieghiamo 3 minuti e poi no ho capito

Clara: la spiegazione di 3 minuti la farò a voi Un altro dei temi che tratteremo è questo cioè la biodiversità animale. Un ambiente dove ci sono i predatori è un ambiente ad alta biodiversità. Mentre un ambiente dove non ci sono predatori è un ambiente a più bassa biodiversità, perché le popolazioni possono crescere in modo incontrollato e quindi poi sono anche più difficili da osservare in natura. Qui non abbiamo volutamente messo l'orso. Però se secondo voi è una bella idea metterlo. o un lupo.

Claudio: Secondo me sì, perché non so quanti sanno che che il rapace è. Vabbè. Sì, il rapace predare un piccolo anche di cervo no. Ci metterei un lupo, secondo me. Chiaro? Anche se probabilmente i lupi non mangiano gli insetti.

Sara: Come? Nel senso che non so se mettere dentro il lupo , dai altri generi di indicazioni?

Clara: Sì sì, le indicazioni ci sono, però a me interessava a voi rendervi il compito più difficile per capire se le immagini comunque funzionavano, funzionano anche senza scritte. Non siete le mie cavie oggi. Sì. Ci sarà scritto biodiversità alta, media.

Giulia: E quindi la domanda che si fa un intervistato è quale delle tre situazioni preferisci ? La biodiversità? Perché Mi sembra un po ovvio.

Clara: La domanda vera la vedrete. Abbiate pazienza, la vedrete.

Nicola: Domande per una persona che vive in città. Insomma, che senso ha l'orso? Cioè, tanto nel bosco chi se ne frega? Nel senso, poi non è un predatore perché mangia insetti. Che cos'è che gli da il valore aggiunto che hanno addosso? Effettivamente una persona cioè nel senso che io la guardo un po in faccia. Nel senso che anche se c'è chi se ne frega.

Clara: Ma infatti uno dei motivi per cui mi sono imbarcata in questo eh in questo tipo di lavoro e questo tipo di ricerche perché mi è stato chiesto delle persone ma perché studi l'orso ma perché li hanno rimessi Ma a cosa serve l'orso? La presenza dell'orso è legata a una serie di servizi ecosistemici. Il fatto che l'orso consumi tantissimi insetti, soprattutto imenotteri, cioè formiche, api, vespe e calabroni, tiene sotto controllo queste popolazioni. E in una ricerca che abbiamo fatto insieme a Paolo, insieme a un suo studente, siamo andate a chiedere tutti i dati dei ricoveri in pronto soccorso, per puntura di insetto e abbiamo visto che nelle zone del Trentino orientale dove l'orso non c'è, il numero di ricoveri per punture imenotteri, ogni 1000 accessi al pronto soccorso è più basso di quello della zona. del Trentino occidentale dove l'orso c'è e quindi abbiamo pensato di proporre un'altra immagine no. Cioè ci sono meno meno punti dove c'è l'orso è più punti più interessante quindi contrario ho detto il contrario e quindi.

Tra l'altro questi sono i numeri veri che sono usciti da da questa ricerca. Cioè nelle zone ad alto impatto ci sono 280 accessi medie all'anno per punture di insetto. Nelle zone dove non c'è l'orso e 120 accessi ogni 10.000. In realtà, perché non è una. Una delle patologie più per cui si ricorre di più al pronto soccorso. Ogni 10.000 pazienti. Ehm. E niente, abbiamo rappresentato il controllo della popolazione di insetti in questo modo.

Critiche.

Apprezzamenti. È tutto benvenuto.

Non si deve capire per forza che l'orso controlla le popolazioni di insetti, quindi ci sono meno vespe in giro e uno dei vantaggi che puoi avere è minor rischio di essere punto quando vai in giro.

Giulia: Ma la domanda che poi viene fatta all'intervistato è. Perché tu gli dici.

Clara: Adesso abbiate attrezzi che ci sia questo servizio da parte offerto dall'orso è questa la domanda la domanda è. Ve lo farò vedere tra un attimo vi farò vedere tutti i servizi mescolati insieme. Situazione attuale e possibili cambiamenti rispetto alla situazione attuale. E l'idea di capire che cosa valutano veramente le persone. Cioè se per uno è importantissimo non essere punto, che ne so, perché allergico sceglierà sempre lo scenario dove ha meno punture, anche se la biodiversità fa schifo e non raccoglie i mirtilli, per dire.

Claudio: Domanda riguardo avete provato per caso a fare la stessa valutazione anche per quanto riguarda gli accessi? Specificamente per la questione delle zecche che da noi abbastanza ingrandita?

Clara: No no non l'abbiamo fatta per relazione.

Claudio: Avete sentito che addirittura la psicologia il vaccino quindi le.

Clara: Zecche non sono tantissimo le legate agli orsi sono più legate ai micro mammiferi e e agli ungulati sia domestici che selvatici cioè ciclo molto complesso sì. Per cui no le zecche non le abbiamo considerato.

Sicuramente un tema ambientale importante. Tornando alle domande dell'inizio,

Marco: Non si Riesce a legarle all'orso

Claudio: dice ma se poi riesce a legare perché?

Clara: . Il lupo tiene sotto controllo la popolazione di capriolo di cervo il cinghiale, perché sono le sue prede principali. l'Orso tiene sotto controllo gli insetti formiche, api e vespe che sono lessate anche il 50% della della massa fecale che si trovano. Dei colleghi che fanno questo di lavoro analizzano le cacche di orso metà della cacca, in peso sono formiche api e il resto vegetali.

Claudio: zecche le zecche no.

Quindi non vivono solamente di api del resto proprio. Ma scusa è una domanda che una minoranza ma quindi l'orso diciamo è un super predatore per questo anche perché approfitta dell'animale piccolo perché in realtà l'orso sbrana certi tipi di animale superiore no cioè voglio dire è uno è un.

Clara: Opportunista.

È un opportunista in questo senso quindi potrebbe anche andare a mangiare animali domestici e anche selvatici, però in nel nostro contesto ambientale non la sue principali prede cioè non sono i mammiferi fa troppa fatica a cacciare un capriolo si mangia le api e le formiche e quindi si impegna. No è un predatore comunque prova.

Giulia: Questo era l'orso marsicano dell'epoca. Adesso da quello che mi dicono sia un po imbastardito pure lui. Per esempio una volta l'orso Marsicano non si faceva vedere. Non c'era proprio. Veramente un animale molto, molto schivo. Adesso pare abbiano deciso di prendere confidenza

Lucia: ma perché una una Vespa, una Vespa e tanti cerotti e non tante vespe?

Clara: Eh, è un'ottima domanda. Perché ti piacerebbe di più con tante vespe?

Lucia: . Cioè è più immediato

Clara: Dici questo? Due vespe? Una vespa?

Lucia: Sì, nel senso qua dici eh. E posto l'evidenza sulla puntura sì, no sul dolore, su quello.

Sara: Però io mentre parlavamo ho capito che. Sì. Sono anche meno. Diciamo.

Lucia: Perché non ho voluto mettere la marca così ma cioè se vedi tante vespe io ho paura. Ma so che mi pungono, quindi se ne metti tanti capisco.

Clara: volevamo più che altro legarlo a un dato che avevamo mentre non abbiamo i dati sulla popolazione di insetti. Sse è più efficace possiamo cambiarlo di sicuro

Giulia però se uno lo spiega che quelli sul palco

Clara: si può scegliere un'altra icona per il cerotto.

Lucia: controllo popolazione di insetti però il titolo non è prevenzione da punture di mitigazione punture da insetti no. E controllo di popolazione di uccelli no.

Clara: Ma a me serve tantissimo parlare con voi perché noi sono mesi che parliamo di queste cose ormai cioè siamo fossilizzati sui nostri discorsi cioè.

Lucia: Eh, è fondamentale distinguere la Vespa dalla api . Nel senso che se tu mi dici dove stai, meglio è dove ho meno vespe. Se mi metti le api dico dove stai meglio? Dove ci sono più api? Sono golosa di miele anch'io. Certo, poi l'impollinazione. Diversità. E quindi?

Clara: E quindi vabbè, la patata bollente rimane a noi. Su, su cosa fare. Una cosa che siamo indecisi se chiedere o no è se chiedere alla gente dove vuole gli orsi. se li vuole solo in Trentino, un po in giro o dappertutto.

Giulia: Forse li metterei lo stesso numero di orsi. Sparpagliato o concentrato. Perché allora.

Sara: Saranno fatti solo in Trentino.

Clara: No saranno fatte in Italia saranno fatte agli agli italiani.

Italia perché quello che ci interessa è capire quello che. Siccome lavoriamo anche con degli economisti quello che per loro è il valore totale dell'orso quindi anche il valore di esistenza dell'orso quello per capirci che un animalista di Reggio Calabria che non verrà mai in Trentino a vedere l'orso però sarebbe disposto a pagare perché gli orsi continuino a esistere , e perché nelle Alpi ci sia un livello di di biodiversità . Però anche vogliamo valutare l'effetto non nel mio nel giardino di casa mia perché distribuendola tutta a un campione italiano cioè se si vede che più avvicini qua più le risposte sono negative più ti allontani più cambiano. è comunque un dato cioè a noi interessa capire.

Cosa succede? Non quello che vorremmo che succedesse

Paolo: Ci sono i confini amministrativi? E allora diventa un problema politico.

se la Lombardia non vuole gli orsi li caccia. No, il Veneto sì eccetera diventa nel senso che loro sono si ferma ovviamente il confine però la gestione potrebbe essere diverso se regionali.

Sara: Perché sono un pezzo d'Italia cioè se vanno in tutte le valli che si percorrono c'è il progetto l'arco alpino perché?

Clara: la nostra area di studio sono le Alpi non consideriamo l'orso marsicano.

Giulia: Ma ritorno su quell'idea dello stesso numero concentrando perché l'idea quando è stato all'inizio diciamo prodotto l'uso era che poi. Bloccato in Trentino ma che fosse una zona da cui poi si poteva espandere andare distribuiti diciamo che.

Claudio: nell'immagine in effetti il Trentino rimane il posto dove ce ne sono più di tutti alla fine se ci fai caso. Ma nella terza immagine per tutto però ce ne stanno cinque in Trentino e uno in Piemonte e cioè voglio dire non lo so se riesce a capire.

Meglio una mappa fisica e non amministrativa ma fisica cioè modo fai vedere più le montagne no quindi evidenzi l'habitat sì evidenziare più l'arte allora.

Clara: ci serve a capire quanto la gente percepisca il fatto che la popolazione di orsi si può espandere rispetto a dove adesso oppure va contenuta. Se uno pensa no, vabbè, gli orsi introdotti in Trentino devono stare solo in Trentino, Io in Veneto non li voglio. Oppure. Mi piacciono così tanto gli orsi che li vorrei dappertutto. Ci interesserebbe anche capire se qualcuno ci dice no, nessuno di questi scenari perché io vorrei zero orsi dappertutto. E quindi se mi trovo una cosa così che non ha lo zero non mi piace.

Giulia: Però bisogna stare attenti a come si gioca con i numeri perché se no si rischia di non non avere le risposte che uno si aspetta insomma.

Paolo: Un trentino che vede nella prima immagine e poi diventano due. Così rimaniamo in Lombardia in Veneto eccetera., è questione di fortuna o di maggiore o minore densità.

Clara: Cioè gli orsi arrivano a una densità fino a quella che l'ecosistema è in grado di reggere e poi si spostano e crescono fino alla densità in cui l'ecosistema è in grado di reggere. La politica può decidere che questa che non li lascia arrivare a questa massima possibilità di di crescita e li tiene più bassi però questo è oltre quello che andremo a chiedere noi.

Paolo: Il risultato dell'ambiente influenza anche si muovano in città, vadano a pulire i cassonetti dei rifiuti, eccetera.

Clara: Quello non ha tanto a che fare con la densità che l'orso ha. All'orso piace non far fatica, quindi se trova un cassonetto, cioè i cassonetti li aprivano anche quando c'erano nove orsi. Primi rilasciati perché cibo facile.

All'inizio erano solo nove orsi, per cui vabbè, hanno chiuso, hanno messo i cassonetti anti orso solo proprio vicino alle zone del rilascio. Però chiaramente più aumentano gli orsi più certe problematiche aumentano. Però il cassonetto, anche se fosse uno solo, lo va a prendere. Se è pieno di cibo

se aumenta il numero di individui, immagino.

E poi vabbè, la probabilità di incontrarne uno aumenta, la probabilità che facciano dei danni aumenta perché comunque appunto vanno nei pollai, vanno nei recinti. Sto sforando il tempo, voi avete ancora 10 minuti o volete che si chiuda?

Sara: Che poi non è l'area ma è più quello che dici tu. L'espansione. Cioè nel senso perché se vedo l'area e dico dove li voglio mi viene naturale.   Invece mi sembrava di capire che se anche son tre però potrebbero fare tutto insieme considerato il tema. Cioè.

Nicola: No è titolo è area geolocalizzazione mentre forse quello più.

Claudio: mmaginario di problematiche del tipo ma allora diciamo che lì in quella immagine comunque il Trentino rimane la zona più attrattiva per qualche motivo che non è chiaro che ce ne stanno cinque devo centrare il Trentino. Ripeto è cioè a meno che tu non voglia rappresentare la dinamica di questa espansione molto no ma piuttosto mi chiedo ma quindi la nostra zona questi sono stati mesi di qua ne ne in realtà reggere molti di più. No perché in realtà per quale motivo.

Clara: Allora dello studio di fattibilità che era stato fatto dall'Ispra negli anni 2000 avevano fatto uno studio in cui 50 era il numero della minima popolazione vitale cioè che vuol dire che una popolazione di animali in grado di sopravvivere nel tempo anche a quelle che sono eh casualità che possono arrivare l'influenza degli orsi piuttosto che una moria per qualche tipo di qualche tipo perché se voi pensate a

una popolazione di 50 orsi metà più o meno sono cuccioli quindi sono 25 adulti quindi vuol dire che ci sono. Boh. Dodici 13 femmine riproduttive che si riproducono ogni due anni, quindi vuol dire che con un 50 orse hai ogni anno forse cinque sei cucciolate. Quindi sembrano tanti, ma in realtà per mantenere una popolazione a lungo termine sono pochi. E secondo sempre questo studio, che aveva considerato l'area idonea all'orso e una densità di orsi di due tre orsi per 100 chilometri quadrati, la popolazione potrebbe arrivare tranquillamente a 150 orsi in equilibrio con l'ambiente nel Trentino occidentale.

Claudio: Cioè, faccio una domanda per quale motivo era stato. scritto su questo studio.

dell'Ispra una significativa della per questo meccanismo che dice loro sono cioè ci vogliono molti anni perché in realtà la reale si espanda questo sì.

Clara: Questo è un discorso molto complesso perché poi i maschi in realtà in dispersione ci sono andati cioè ci sono maschi di orsi in Piemonte maschi in Slovenia maschi sono andati in Svizzera.

Claudio: Questo non viene. Mai detto dai cioè dalle istituzioni

Clara: Se ti spulci i rapporti Orso circa 50 orsi hanno lasciato il Trentino però solo maschi le femmine per biologia della specie sono molto legate al territorio dove sono nate. E questo succede anche in Abruzzo cioè le femmine son tutte lì nel parco, i maschi vanno in giro, non trovano altre femmine, poi tornano lì perché.

Claudio: Però ti posso dire sta cosa qua guarda è un'informazione secondo me importantissima che secondo me io non l'ho mai vista scritta tant'è vero che mi hanno chiesto ma basta bastano le le difficoltà diciamo imposte dalla strutture umane a spiegare questo non avevo capito che c'era questo sottinteso meccanismo molto interessante che ci ha raccontato no non lo sapevo proprio.

Clara: Cioè comunque problemi ecologici sono problemi complessi, è difficile che ci sia una sola ragione che spiega tutto.

Claudio: Comunque poi anche noi facciamo delle ipotesi su chi informare anche semplicemente informare i trentini. Guardate che i trentini non è vero che stanno zitti qua viaggiano nelle Alpi, arrivano pure in Val d'Aosta. Secondo me è quello più importante

Clara: Qualcuni torna, qualcuno no, qualcuno rimane lì. C'è un orso in Val d'Ossola ormai da cinque anni, che sverna lì. Maschio maschio. Però quest'anno hanno visto due cucciolate nel bresciano. Quindi questo è un bellissimo segno.

Claudio Cioè stanno scavalcando anche le Femmine.

Anziché ci si va verso verso la riduzione parco in realtà probabilmente il territorio più meno antropizzato.

Clara: Cerco di stringere perché sto veramente abusando del vostro tempo un altro tema è sentitissimo è sicuramente la sicurezza al momento non ci sono diciamo informazioni su come muoversi in un'area dell'orso. Quello che fanno in in Abruzzo è questo: chiusura temporanea dei sentieri con avviso su come comportarsi. Quello che fanno solo all'interno del Parco Adamello Brenta è quello avvisarti che sei in un'area di presenza dell'orso però al di fuori del parco non c'è nessuna informazione certe zone che non sono parco la presenza dell'orso non è segnalata.

E voi, sareste disposti a non andare a fare un'escursione perché c'è l'orso? Cioè sareste contenti di avere un cartello così? Oppure che può andare davvero? Vi sentireste privati della libertà di andare dove volete, quando volete?

Giulia: Beh, non è mica. Che ti obbligano a non andare. Però, ti dico, c'è proprio un divieto di accesso. Potrebbe non essere un divieto, potrebbe essere un invito.

Sara: Se c'è un divieto vuol dire che ci sarà una particolare ragione per cui esiste questo divieto, per cui magari c'è un particolare monitoraggio e si capirà che magari c'è qualche questione per cui venga. Sì cioè nel senso anche delle indicazioni poi dal fatto che

Giulia: un visitatore che viene da fuori questo è il segnale che il territorio monitorato che chi lo gestisce il fatto suo e che ti dà delle abbandona.

Clara: Una me l'avete me l'avete demolita no ma son contenta perché così stavo meglio.

Paolo: Anche scusa legale nemica eccetera. Cioè se io ho messo un orso sbrana nemmeno una persona eh.

Clara: Sì è un diciamo sicuramente da parte dell'Amministrazione uno scaricabarile del tipo cioè io t'ho avvisato tu sei andato lo stesso po come se c'è il divieto per una frana e tu vai lo stesso nella strada e ti fai del male. Non è che puoi far causa al Comune perché c'era le buche nella strada non ci dovevi proprio andare. Sì.

Lucia: Ma e come vengono messi questi limiti? sulla base di cosa?   Temporanei cioè in base a un sito

Clara:per esempio questo è un cartello vero, non è non è una mia grafica l'anno scorso in Abruzzo c'era un'orsa con quattro cuccioli in realtà lì c'era la situazione opposta della gente che voleva farsi i selfie con l'orsa con quattro cuccioli.

E no. Cioè c'erano delle foto tipo c'è gente con 50 macchine fotografiche cavalletti così e l'orsa lì nel prato perché a un certo punto l'Ente Parco ha detto basta. Più per proteggere l'orsa che la gente in quel caso lì. Però anche la gente, perché ci sarebbe arrivato prima o poi quello che veramente voleva farsi il selfie così col cellulare l'orsa dietro e rischiava la vita stupidamente e quindi hanno hanno messo questo cartello sulla base di questo in particolare.

Claudio: Graduando diciamo la la durezza del divieto, divieto assoluto divieto di accesso in certi momenti in certe zone e semplicemente avviso guarda cioè ci stai invitando a valutare cosa preferiremmo di queste cose ma.

Clara: Eh più o meno sì del tipo cioè per voi è questo aspetto importante se e adesso arrivo al dunque cioè se vi chiedessi ok vorreste un ambiente dove è mantenuta questa cartellonistica, Sareste disposti a pagare per avere solo dei cartelli tipo questi, che non richiedono manutenzione, quindi sono meno costosi o dei cartelli come questi altri che sì eh sono più informativi però chiaramente vuol dire avere una squadra, avere un monitoraggio avere qualcuno che una squadra di monitoraggio una squadra di operai che mette toglie i cartelli perché ci.

Claudio: Saranno anche quelli che vedono dove stanno. Come dicevo prima il monitoraggio.

Clara: E quindi c'è poi la la domanda è sareste disposti a pagare per questo o no questa è un'altra versione di di questo.

Paolo: Della grafica di prima però la prima di sinistra la croce. Sì è ovvio no

Sara: infatti. Hai detto che era nessuna informazione.

Clara: Sì infatti.

Sara: Non interpretavo nessuna. informazione quindi in caso di avvistamento poi sono informati poi chiusura quindi.

Clara: Esatto.

Sara: Non cambiare l'ordine quello centrale adesso.

Clara: Ma in realtà adesso cioè l'ordine non sarà così importante perché alle persone verranno proposte. Farò vedere le schede. Degli scenari dove sono mescolate queste cose, quindi non devono scegliere per forza uno in ordine.

L'ultima cosa: tra. i vantaggi che sembra ci possano essere dall'avere una popolazione di orsi cioè la pubblicità possibilità di sviluppare un turismo legato all'orso quindi la possibilità di avere dei tour di bear watching che ti portano a vedere gli orsi. E al momento non si vede cioè non c'è niente di questo tipo ci possono essere dei tour dove non vedi l'orso ma vedi solo le tracce dei tour dove vedi le tracce.

Magari un orso, oppure dei tour dove vedi tutto. Tanti orsi, tante tracce.

Come quelli che ci sono in Canada, che se non vedi l'orso ti offrono un altro tour perché sono così sicuri che lo vedi che se quel giorno lì non lo vedi, il giorno dopo te ne regalano un altro.

Sara: La prima sarebbe che.

Clara: Non vedi niente, non c'è niente, non vedi niente.

Sara: Non c'è il tour

Paolo: Non c'è Il tour non può essere la stessa, secondo me. La stessa icona che non vedi, ovvio, ma c'è.

Sara: Cioè, c'è questa ambiguità. Sono d'accordo con te, c'è un'ambiguità in entrambi invece. Vedi tu.

Clara: Se volete si sono un po' di penne. Invece in questo questionario abbiamo preparato invece delle immagini dell'orso c'è la probabilità di vedere l'orso e praticamente questa sarà una delle cose dei questionari che eh che distribuiremo e in realtà daremo più versioni faremo cinque sei versioni di questo in cui ci sono tutti gli attributi eh mescolati cioè c'è una situazione attuale e un ipotetico programma di gestione che ha un costo. E qui e praticamente questo tipo di questionario si chiama discrete Choice modeling cioè C'è una situazione di partenza che è la situazione attuale. Le altre possibilità le abbiamo chiamato qui Progetto A. Progetto B. Con molta fantasia, ci sono questi livelli di questi variabili ambientali che vengono mescolati in modo pseudo casuale. E la gente deve scegliere quello che preferisce, incluso il prezzo che sarebbe disposto a pagare per avere. É uno scenario piuttosto che un altro e la cosa per cui siamo piú abbiamo avuto molte le discussioni È proprio come come imporre un prezzo, perché.

Sara: Non è chiaro. Poi c'è chi va a fare il tour, tutti i cittadini o i turisti.

Clara:E allora questa è la domanda che faccio a voi, perché secondo il mio collega economista bisognerebbe mettere un prezzo di accesso al parco che però in Italia non ha senso. Il mio collega non è italiano.

Giuilia: È per un territorio di Parco dell'Adamello, Brenta per intendersi, o in generale per una visita in Trentino.

Clara: In questo caso questo costo chiediamo a voi. Cioè, secondo voi cosa sarebbe più logico mettere una tassa, un costo di un tour o il costo di accesso al Parco Adamello Brenta?

Giulia: Quindi stiamo parlando comunque del Parco Adamello Brenta o del territorio trentino o di un altro parco?

Clara: Potrebbe essere un Parco X o del Parco dello Stelvio? Se ci fossero gli orsi, cioè tu saresti disposto a pagare per questo set di di cose? e quanto?

Claudio: È correlato effettivamente perché? Cioè perché dovresti pagare di più se vuoi l'orso? Anche se poi non lo Vedi? Eh, è vero, c'è il deconcentrato da una parte significativa probabilità di essere tecnica. L'unico vantaggio sarebbe che fare più più frutti di bosco.

Clara: In questo caso sì. Questa è una delle 5 o 6 schede come questa che vengono distribuite in cui poi i vari livelli sono mescolati, per cui tu potresti averne una dove hai 0€ ma anche zero frutti di bosco perché vengono rimescolate e in questo modo in teoria si dovrebbe riuscire a tirar fuori quello che veramente la gente valuta di più.

Claudio: Più importante i soldi o il più importante o più un'altr cosa.

Clara: Importante, il frutto di bosco è più importante non essere punto. È più importante che gli orsi non siano in Veneto.Sì, però secondo me la tassa di ingresso al parco è una cosa che non è realistica. In Italia per.

Giulia: O è più importante non avere una tartaruga? Ecco qua.

Parco della Maremma ti fa pagare ti fa pagare la visita guidata quindi tu puoi percorrere un posto stare fuori 5 ore. E la guida ti spiega che tipo di ambienti attraversi. Poi arrivi sulla spiaggia anche il bagno. Cioè quindi per.

Clara: Voi potrebbe essere il costo di una visita guidata però così no.

Sara: Se diventa l'ingresso al parco cambia la scala p

Giulia: però siamo in una realtà completamente diversa. Intanto nella Marche da solo non ci vai e non capisci assolutamente. Anche cioè è proprio un'altra cosa.

Clara: Sì, io adesso qua ho messo dei numeri che non hanno senso perché non non so ancora se sarà una tassa una tantum se sarà. Cioè io avevo proposto un aumento della tassa di soggiorno perché adesso la tassa di soggiorno in Trentino e va da 1€ se va in campeggio a 3€ se vai nell'hotel cinque stelle al giorno per persona. Quindi se tu la aumenti di 1€. Il Trentino ha 1.000.000 di turisti all'anno, cioè hai tirato su 1.000.000 di euro per la gestione dell'orso. Però la critica che mi fa il mio economista preferito è se tu metti che paghi 1€ vuol dire che è una cosa che non ha valore alla fine.

Claudio: All'Università di Trento no, ma devi ricordare che se no gli stranieri dicono pensano che non ricordiamo niente vi ricordate però va.

Giulia: Beh c'è anche il rischio che però se tu mi metti una carta troppo alta dice vabbè vado in Alto Adige, è bello uguale magari non c'è l'orso però non paghi.

Clara: Va beh ma a noi interessa sapere anche questo.

Claudio: Ci sono dei meccanismi indiretti. per esempio io ti faccio un esempio di meccanismo indiretto che secondo me efficacissimo. se tu andare a vedere Tovel, eh tu praticamente devi fare c'è una strada che ti porta a casa c'è un controllo da questo punto di vista cioè quella che ti porta a dover. Ci sono dei blocchi e tu devi pagare per il parcheggio e paghi tanto più quanto più arrivi vicino a Tovel.

Poi ci sarà il pulmino che ti porta gratis giù giù però diciamo controllo indiretto che fondamentalmente questo tipo di cose. Alla fine il pagamento è fissato. Tu paghi il parcheggio se vuoi essere più comodo andare là sul lago. Eh, Devi prenotare tanto prima e paghi di più. No, per cui ci son tanti meccanismi, non solamente questo qua dell'ingresso e basta. Cioè, si potrebbe anche immaginare un meccanismo un po più indiretto legato a questi servizi di supporto che comunque ti obbligano a dover paghi il parcheggio.

Lucia: C'è l'alternativa della navetta a pagamento, ovviamente, perché i parcheggi a pagamento per limitare il numero di veicoli? No, perché?

Giulia: Cioè su che cosa chiedere come costo perché se fuori. Sì, ma 50€ è una cosa che proprio. sul discorso famiglia di Quattro persone che diventano 200.

Clara: sui prezzi stiamo ancora ragionando sul discorso.

Clara: Sì ma se uno ti dice per gestire gli orsi ti chiedo una tassa una tantum di 40€ su tutte le tasse che paghi. Però per avere gli orsi cartelli e le cose sei disposto a darmeli tu, no? Magari un altro si.

Tu no anche.

Paolo: A livello nazionale o provinciale?

Taccagno. Un po nel senso che.

Qualcuno è una ragione diversa e devo dare dei soldi per gli allenamenti.

Ma io tipo per l'orso marsicano, li darei anche per la balenottera del Mar Ligure. Però.

Però c'è un sacco di gente che paga, non lo so. Il WWF per adottare una balena e paga 50€.

Giulia: Però qui tu in cambio offri qualcosa. Cioè va indietro di tanto in tanto per dire oppure vai lì, ti fai una bella camminata tutto il giorno, non ti punge nessun insetto, quindi presuppone che tu comunque pagheresti questa cifra se andassi a visitare questa non in generale

Clara: dipende. Cioè se è un ingresso al parco ovviamente questi numeri non vanno bene come ingresso al parco. Se una famiglia spende 200€ per entrare al parco coi bambini, quindi queste cifre non vanno bene. Se invece è una tassa o una una tantum o qualcos'altro cioè su questo stiamo ancora discutendo un sacco e non abbiamo le idee chiare.

Giulia: Cioè di qualcuno che vive in Sicilia non sa che tanto non andrà mai in Trentino se è disposto a pagare 50€ all'anno.

Clara: No, 50€ una tantum come per dire io non voglio che si estingua i lleopardo delle Nevi. Quando il WWF mi chiede i soldi glieli do, ma non gli do solo io, gli dà un sacco di gente.

Come un sacco di gente dai soldi per dire alla LAV per fare il processo contro l'orso.

Giulia: Non so se mi torna sta cosa, perché io lo vedo bene legato a uno che va e non si fa pungere, che va e che sta, si fa il suo percorso in sicurezza, che va in un viene e trova i piccoli frutti. Mi sembrano due piani un po diversi, questo lo dico, ma.

Clara: Questo tipo di feedback perché se poi facciamo un questionario e la gente lo pianta a metà perché non.

Giulia: capisce dove uno? Allora forse, forse.

A parte, alla fine potrebbe essere la domanda ma se tu ritieni importante questa specie come simbolo tutto quello che vuoi, però sai che non ci sono soldi per fare una gestione adeguata. Saresti disposto a pagare una tantum questo, questo o quest'altro. Però non lo farei legato al servizio che può erogare direttamente a te. Quel territorio è perché secondo me sono due piani un po' diversi.

Sara: Questo così di chiedere no? Saresti interessata una tantum a un biglietto di imbarco o una tassa locale della Regione perché alla fine effettivamente vero cioè se con questo poi gestisci la ma la cartellonistica le informazioni sono molto locale del territorio della regione del luogo.

Clara: Però visto che tutta Italia si è divisa per questo povero Andrea Papi cioè alla fine magari uno anche che vive lontano è sereno se i ragazzi possono andare nei boschi trentini in sicurezza, anche se lui o lei non ci va. Però questa vicenda ha colpit, .come quando diamo i soldi per una causa umanitaria o qualsiasi altra cosa. Cioè questo è un tema che ti sta a cuore. E poi, secondo l'economista, io qua mi alzo le mani perché nel mio mestiere, bisogna mettere comunque dentro anche un prezzo molto alto per

capire qual è poi la soglia cioè se ci deve essere un prezzo che non scegli mai nessuno perché poi i conti tornino questo è quello che mi ha detto l'economista.

Sara: Non italiano.

Claudio:

Cioè il concetto che sia un bene comune che il pubblico sia disposto a pagare o sia una merce. Questo è il concetto perché tu anche anche se tu vai paghi per entrare al parco. Quando vai al museo tu paghi e hai un servizio no o hai diciamo la merce e l'alternativa tra questa visione delle cose che quella a cui siamo abituati. Noi paghiamo ci siamo abituati ad avere delle cose come merci come cose che si comprano. E invece l'altro punto di vista che è un punto di vista di bene comune, in cui c'è un bene comune che il territorio fatto bene l'orso che sopravvive eccetera tu sei disposto a sopportare questa cosa anche se non è una cosa che tu hai direttamente. Non necessariamente hai direttamente il tuo centro il bene comune contrapposto alla merce. Però secondo me la domanda deve essere perché non è una cosa banalissima, qual era cioè il bene comune è il punto perché che poi cioè per esempio no la gente ha votato per avere l'acqua. Però poi non è capace di difendersi dal fatto che i Comuni impongono le municipalizzate e vendono il servizio a un privato, di fatto cioè cedendo questo noi abbiamo abbiamo detto no siamo per l'acqua bene comune , nulla vi posso dire poi dopo però non siamo capaci di difenderci la parte nel nostro Comune ci sta un Comune che impone che che che dà il servizio il Comune che già affitta il servizio da un privato perché queste cose qua sono un po complicate da.

Nicola: Dire che io sarei disposto a pagare tanto se faccio qualcosa di particolarmente forte cioè una cosa straordinaria ,non so quando vogliono fare un'opera oppure so che vado a vedere una cosa particolare. Se invece devo pagare per la manutenzione do qualcosina insomma cioè nel senso che dipende che cosa ho più dal mio punto di vista per esempio.

Per esempio c osì pure in Islanda che vai col gommone devi e devi paghi tanto però è qualcosa che non vedo tutti i giorni e allora vado lì apposta. Se vado in quel parco lì e pago tanto, voglio vedere qualcosa di particolare, non per andare nel bosco.

Claudio: Certo, però è sempre una visione di servizio ed è una cosa, Ma lei sta proponendo due alternative uno paga. Cioè l'alternativa che ci sta proponendo in questo momento che fa questa misura e che io ho cominciato questo questa visione è una visione più generale in cui tu dici okay per la t sopravvivenza o se vuoi per la più questa è una sofferenza per la corretta gestione di una cosa comune che comunque migliora l'ecologia complessiva del Paese.

Clara: Eh, se una parte. Delle mie tasse va in questo, piuttosto che al finanziamento pubblico ai partiti all'acquedotto o a un'altra cosa.

Lucia: L'otto per 1000 non lo so.

Clara: E questa è una cosa che io ho proposto. Ma non possiamo dire diamo il cinque per 1000 l'otto per 1000. E secondo l'economista l'economista è una cosa che non funziona perché tu a quel punto entri in competizione con qualcun altro cui di solito dai l'otto per 1000 quindi ti trovi a scegliere non so tra la chiesa valdese e l'orso o tra la società del calcetto e l'orso non so se dare l'otto per 1000 all'ospedale della tua città e l'orso quindi a quel punto per ogni persona diventa una scelta che non è su quella cosa lì ma su un'altra. Abbiamo orrendamente sforato io vi chiedo scusa è stato interessantissimo cioè se volete rimanere per me va bene ma vi avevo promesso 1 ora e io sto abusando.

Sara: Sono certo che sarà così perché mi devo scegliere il.

Clara: Questionario saranno tipo cinque schede come quella fatte così però con tutti i livelli che si mescolano in maniera pseudo casuale tra i vari scenari.

Sara: Quindi devo scegliere solo A o B?

Esatto, oppure le cose come sono.

Cioè alla fine. Lo stato attuale rimane. Eccetera. E invece prima mi hanno spiegato cosa vogliono dire questo esatto.

Claudio: Di nazioni ceduto ai livelli orizzontali e decidere.

Clara: Se fosse forse più facile pensare se fosse un prodotto. Che ne so, tu hai un vasetto di yogurt che può avere un 100 grammi di yogurt o 200, avere la confezione riciclabile o no? Essere sparo.

Claudio: Biologico, non.

Clara: Biologico, No. E il prezzo? E tu magari sei interessato agli imballaggi, quindi sei disposto a spendere di più se l'imballaggio riciclabile è un altro invece più interessato al biologico e ti scambiandosi queste cose poi trovano la la quadra in quel caso che funziona per il mercato dello yogurt.

Marco: diciamo che. Qui pendiamo un po dalle labbra del degli economisti nel senso che ci raccontano quali sono le metodologie da usare rispetto a questo perché anche anche per me alcune cose sono contro intuitive cioè non invece in realtà di fatto io vado se.

Clara: Vado a prendere il vino per fare l'aperitivo.

Lucia: Mi ascolta ma in Slovenia costa tenere l'orso è un costo che si sta sobbarcandosi il Governo sloveno sì.

Clara: La gestione dell'orso in Slovenia è completamente diversa da qua e ci sono dei costi che si sobbarca in parte il governo sloveno, in parte l'associazione cacciatori slovena.

Claudio: Di cui ammazzare vai la paghi lo ammazzi.

Clara: l'associazione Cacciatori slovena è qualcosa di molto diverso dalle associazioni che ci sono qua. Per esempio l'associazione Cacciatori è partner del proggetto dell'introduzione della lince che stanno facendo. Cioè i cacciatori stanno investendo i loro soldi e il loro tempo per la reintroduzione della Lince una cosa che qua cioè sembra perché non sia possibile e tra l'altro i cacciatori mantengono tutta una serie di siti di alimentazione artificiale per gli orsi per tenere la popolazione molto alta ad una densità più alto d'Europa in modo da poterla cacciare quindi è una gestione che non è assolutamente paragonabile a quella che c'è qua. No

Lucia: Ma se anche lì ci sono gli orsi, non ci posso credere che in Friuli non ci siano orsi .

Clara: certo che ci sono

Lucia: non si sono mai avuto problemi

Clara: ma sai, sono anche a densità molto basse

Lucia: perché sono liberi che ne so perché adesso di naturalmente non lo so portate cioè creiamo allora i corridoi ecologici in modo che quelli stanno. Arrivando in Friuli sono entrati.

Marco: È lo stesso meccanismo che si verifica di cui parlava Clara prima del discorso dello spostamento degli orsi dal Trentino verso l'esterno allora gli orsi che si muovono dalla Slovenia verso.

E adesso hanno trovato tutti convinti no no è i lupi sono stati portati cioè qui adesso

Paolo: perché ora e non dieci anni fa vent'anni fa?

Marco: l'aumento delle foreste. Cioè il fatto che la foresta si è richiusa non c'è più.

Giulia: Guarda che è l'Appennino al 1000 volte più selvaggio dell'Italia.

Marco: Allora il discorso della riforestazione naturale non c'è stata in tutta Italia ha portato un cambiamento drammatico della popolazione ma c'è, per dire, in Toscana.

Lucia: Anche più controllo forse c'è meno bracconaggio meno bracconaggio.

Marco: Sì ci sono. Cacciatori. Insomma, anche sì, un po meno bracconieri perché un po meno bracconieri ci sono di sicuro. Ma perché diminuito il numero dei cacciatori? Sul numero dei cacciatori di totale c'è sempre un certo numero di. Mi diceva un mio collega che ha lavorato per anni alla come direttore associazione attrattori eh che una volta per esempio avevano trovato un bracconiere e in Val di non, mi sembra e avevano trovato dentro alla casa di questo bracconiere un numero spropositato di trofei, Ma una cosa impressionante lo diceva anche prendendo le statistiche sulle popolazioni degli animali che tutti gli anni venivano fatte, non ci si capacitava di come questo fosse questa quantità di prede .

Allora avete un'idea esatta. I bracconieri sono un'importantissima fonte di informazione. Per esempio, in Africa i migliori eh aiutanti dei ricercatori sono quelli che poi appunto passano diciamo dal dal lato oscuro al eh perché in effetti quando poi vanno in giro sono quelli che sanno tutto loro sanno dove trovarli animali vedono le tracce riconoscono tutto quanto quelli son quelli che dicono tutto di tutto bracconieri sono una fonte eh ma in generale parlare con i cacciatori è fondamentale cioè l'atteggiamento negativo nei confronti dei cacciatori è pessimo perché tu non riesci a tirare fuori informazioni di nessun tipo. In realtà loro sono proprio una grande fonte di informazione con qualche lato pittoresco questa storia del del dei lupi anche le vipere era convinta di essere vipere buttate col paracadute.

Giù eh era un classico proprio. Però comunque in realtà questa di questa situazione eh è abbastanza si è ripetuta più volte no cioè si ripete dappertutto poi i meccanismi sono meccanismi che si ripetono anche ehm lui prima citava l'Abruzzo ma in Abruzzo, io la prima volta ci sono andato avevo a 17 anni, era l' 82 mi sembra ero andato a fare la guardia LIPU in con la LIPU dentro come da ragazzino insomma ero andato con amici perché lì c'era sono andati. lì c'era un'atmosfera pesantissima c'era Franco Grassi. Il direttore del del parco girava la scorta cioè c'era il direttore girava

C'erano i Pastori incavolatissimi, Eh già, Situazione molto molto pesante laggiù, sia per il lupo che per.

L'orso.

Adesso tutto sommato giù al parco la situazione è completamente diversa. C'è un'accettazione generale molto significativa. Si sono resi conto che loro si porta un sacco di quattrini. Poi è chiaro che c'è sempre qualcuno che magari non è contento della situazione. Però anche lì che cosa è successo? Che in

parte è cambiata anche l'economia locale, no? nel senso di quella che poteva essere la gestione dell'epoca veniva fatta in alcune aree del parco ora magari viene fatta in modo diverso. E lì c'è anche stato sono state fatte anche delle scelte importanti, per esempio delle valli esistono delle vallate nella Val di Rose uno dei posti più belli che abbia mai visto in vita mia, , in Abruzzo bellissima montagna, strepitosa eh? È una zona chiusa, C'è un sentiero in cui da qui entri ed esci, cioè entri, esci solo da quel sentiero. All'ingresso c'è una persona che ti fa entrare o no? C'è un numero chiuso di 50 persone che devono aver prenotato, non c'è niente quindi non allora è una scelta però essendo molto molto chiara se tu in quel posto non ci vai. E così facendo questo però è servito.

Bene adesso per ringraziarvi vi offriamo un aperitivo.

Spegniamo, stacchiamo. Grazie a tutti

C.4 Choice cards

Efficient design of choice cards showing all combinations used in the survey and example of the look of a single choice card.

D-Efficient design for ESV of Bears in the Alps

Model A 3 sets 8 scenarios

Model B 3 sets 8 scenarios

Model C 3 sets 8 scenarios

Model A1

1	Option A	Option B
FOREST DIVERSITY	LOW	MEDIUM
BEE STINGS	MEDIUM	LOW
SAFETY	HIGH	LOW
AREA	HIGH	MEDIUM
WILD BERRIES	HIGH	HIGH
Cost	30 €	10 €

2	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	MEDIUM	HIGH
SAFETY	LOW	HIGH
AREA	HIGH	LOW
WILD BERRIES	MEDIUM	LOW
Cost	20 €	10 €

3	Option A	Option B
FOREST DIVERSITY	MEDIUM	HIGH
BEE STINGS	LOW	LOW
SAFETY	MEDIUM	LOW
AREA	MEDIUM	LOW
WILD BERRIES	LOW	MEDIUM
Cost	20 €	15 €

4	Option A	Option B
FOREST DIVERSITY	MEDIUM	HIGH
BEE STINGS	MEDIUM	HIGH
SAFETY	LOW	HIGH
AREA	LOW	HIGH
WILD BERRIES	HIGH	LOW
Cost	10 €	30 €

5	Option A	Option B
FOREST DIVERSITY	MEDIUM	MEDIUM
BEE STINGS	MEDIUM	LOW
SAFETY	HIGH	LOW
AREA	HIGH	MEDIUM
WILD BERRIES	HIGH	LOW
Cost	20 €	15 €

6	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	LOW	HIGH
SAFETY	MEDIUM	MEDIUM
AREA	MEDIUM	MEDIUM
WILD BERRIES	LOW	LOW
Cost	20 €	20 €

7	Option A	Option B
FOREST DIVERSITY	MEDIUM	MEDIUM
BEE STINGS	HIGH	MEDIUM
SAFETY	LOW	HIGH
AREA	MEDIUM	MEDIUM
WILD BERRIES	MEDIUM	HIGH
Cost	10 €	30 €

8	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	LOW	MEDIUM
SAFETY	MEDIUM	HIGH
AREA	MEDIUM	MEDIUM
WILD BERRIES	HIGH	LOW
Cost	15 €	15 €

Model A2

1	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	MEDIUM	LOW
SAFETY	HIGH	MEDIUM
AREA	LOW	HIGH
WILD BERRIES	MEDIUM	LOW
Cost	15 €	15 €

2	Option A	Option B
FOREST DIVERSITY	MEDIUM	MEDIUM
BEE STINGS	HIGH	LOW
SAFETY	LOW	MEDIUM
AREA	LOW	MEDIUM
WILD BERRIES	HIGH	LOW
Cost	30 €	15 €

3	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	LOW	HIGH
SAFETY	HIGH	MEDIUM
AREA	LOW	HIGH
WILD BERRIES	MEDIUM	HIGH
Cost	15 €	20 €

4	Option A	Option B
FOREST DIVERSITY	MEDIUM	MEDIUM
BEE STINGS	HIGH	LOW
SAFETY	MEDIUM	MEDIUM
AREA	LOW	HIGH
WILD BERRIES	LOW	LOW
Cost	10 €	20 €

5	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	MEDIUM	HIGH
SAFETY	MEDIUM	HIGH
AREA	HIGH	LOW
WILD BERRIES	LOW	HIGH
Cost	15 €	30 €

6	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	LOW	HIGH
SAFETY	HIGH	LOW
AREA	HIGH	LOW
WILD BERRIES	MEDIUM	HIGH
Cost	15 €	30 €

7	Option A	Option B
FOREST DIVERSITY	HIGH	MEDIUM
BEE STINGS	LOW	MEDIUM
SAFETY	MEDIUM	MEDIUM
AREA	MEDIUM	MEDIUM
WILD BERRIES	MEDIUM	LOW
Cost	30 €	15 €

8	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	HIGH	LOW
SAFETY	LOW	HIGH
AREA	HIGH	LOW
WILD BERRIES	LOW	MEDIUM
Cost	30 €	10 €

Model A3

1	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	LOW	MEDIUM
SAFETY	HIGH	LOW
AREA	MEDIUM	HIGH
WILD BERRIES	MEDIUM	HIGH
Cost	30 €	10 €

2	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	HIGH	MEDIUM
SAFETY	HIGH	LOW
AREA	LOW	HIGH
WILD BERRIES	LOW	MEDIUM
Cost	10 €	30 €

3	Option A	Option B
FOREST DIVERSITY	MEDIUM	MEDIUM
BEE STINGS	MEDIUM	HIGH
SAFETY	LOW	HIGH
AREA	LOW	HIGH
WILD BERRIES	LOW	MEDIUM
Cost	20 €	30 €

4	Option A	Option B
FOREST DIVERSITY	LOW	MEDIUM
BEE STINGS	HIGH	MEDIUM
SAFETY	LOW	HIGH
AREA	HIGH	LOW
WILD BERRIES	MEDIUM	LOW
Cost	10 €	30 €

5	Option A	Option B
FOREST DIVERSITY	MEDIUM	LOW
BEE STINGS	LOW	MEDIUM
SAFETY	MEDIUM	MEDIUM
AREA	HIGH	LOW
WILD BERRIES	MEDIUM	MEDIUM
Cost	20 €	10 €

6	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	HIGH	MEDIUM
SAFETY	LOW	MEDIUM
AREA	MEDIUM	MEDIUM
WILD BERRIES	MEDIUM	HIGH
Cost	30 €	10 €

7	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	MEDIUM	High
SAFETY	MEDIUM	MEDIUM
AREA	LOW	HIGH
WILD BERRIES	MEDIUM	LOW
Cost	10 €	20 €

8	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	HIGH	LOW
SAFETY	HIGH	LOW
AREA	MEDIUM	LOW
WILD BERRIES	LOW	HIGH
Cost	15 €	20 €

Model B1

1	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	MEDIUM	HIGH
SAFETY	LOW	HIGH
SIZE	HIGH	LOW
WILD BERRIES	HIGH	LOW
Cost	10	30

2	Option A	Option B
FOREST DIVERSITY	MEDIUM	MEDIUM
BEE STINGS	HIGH	MEDIUM
SAFETY	LOW	HIGH
SIZE	MEDIUM	HIGH
WILD BERRIES	HIGH	MEDIUM
Cost	15	20

3	Option A	Option B
FOREST DIVERSITY	MEDIUM	MEDIUM
BEE STINGS	MEDIUM	LOW
SAFETY	MEDIUM	MEDIUM
SIZE	LOW	MEDIUM
WILD BERRIES	HIGH	MEDIUM
Cost	20	10

4	Option A	Option B
FOREST DIVERSITY	LOW	MEDIUM
BEE STINGS	LOW	LOW
SAFETY	HIGH	MEDIUM
SIZE	HIGH	MEDIUM
WILD BERRIES	MEDIUM	HIGH
Cost	15	15

5	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	HIGH	LOW
SAFETY	MEDIUM	MEDIUM
SIZE	LOW	HIGH
WILD BERRIES	MEDIUM	HIGH
Cost	10	30

6	Option A	Option B
FOREST DIVERSITY	MEDIUM	HIGH
BEE STINGS	HIGH	MEDIUM
SAFETY	HIGH	LOW
SIZE	LOW	MEDIUM
WILD BERRIES	LOW	HIGH
Cost	15	15

7	Option A	Option B
FOREST DIVERSITY	MEDIUM	HIGH
BEE STINGS	LOW	HIGH
SAFETY	MEDIUM	LOW
SIZE	LOW	HIGH
WILD BERRIES	LOW	HIGH
Cost	10	30

8	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	HIGH	MEDIUM
SAFETY	MEDIUM	HIGH
SIZE	MEDIUM	HIGH
WILD BERRIES	MEDIUM	LOW
Cost	10	20

Model B2

1	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	LOW	MEDIUM
SAFETY	LOW	HIGH
SIZE	HIGH	MEDIUM
WILD BERRIES	HIGH	MEDIUM
Cost	10	30

2	Option A	Option B
FOREST DIVERSITY	LOW	MEDIUM
BEE STINGS	HIGH	LOW
SAFETY	HIGH	LOW
SIZE	MEDIUM	HIGH
WILD BERRIES	LOW	MEDIUM
Cost	15	20

3	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	MEDIUM	LOW
SAFETY	MEDIUM	MEDIUM
SIZE	MEDIUM	LOW
WILD BERRIES	LOW	HIGH
Cost	10	30

4	Option A	Option B
FOREST DIVERSITY	HIGH	MEDIUM
BEE STINGS	MEDIUM	HIGH
SAFETY	LOW	HIGH
SIZE	LOW	MEDIUM
WILD BERRIES	MEDIUM	LOW
Cost	20	15

5	Option A	Option B
FOREST DIVERSITY	MEDIUM	MEDIUM
BEE STINGS	HIGH	LOW
SAFETY	MEDIUM	MEDIUM
SIZE	LOW	MEDIUM
WILD BERRIES	HIGH	LOW
Cost	30	15

6	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	LOW	HIGH
SAFETY	LOW	HIGH
SIZE	HIGH	MEDIUM
WILD BERRIES	LOW	MEDIUM
Cost	15	20

7	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	MEDIUM	LOW
SAFETY	MEDIUM	MEDIUM
SIZE	MEDIUM	HIGH
WILD BERRIES	HIGH	LOW
Cost	30	10

8	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	MEDIUM	HIGH
SAFETY	MEDIUM	LOW
SIZE	MEDIUM	LOW
WILD BERRIES	LOW	MEDIUM
Cost	30	15

Model B3

1	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	MEDIUM	MEDIUM
SAFETY	HIGH	LOW
SIZE	HIGH	LOW
WILD BERRIES	HIGH	LOW
Cost	30	10

2	Option A	Option B
FOREST DIVERSITY	MEDIUM	MEDIUM
BEE STINGS	HIGH	MEDIUM
SAFETY	LOW	HIGH
SIZE	HIGH	LOW
WILD BERRIES	LOW	HIGH
Cost	20	10

3	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	LOW	MEDIUM
SAFETY	HIGH	MEDIUM
SIZE	MEDIUM	HIGH
WILD BERRIES	HIGH	MEDIUM
Cost	30	10

4	Option A	Option B
FOREST DIVERSITY	HIGH	MEDIUM
BEE STINGS	HIGH	LOW
SAFETY	LOW	HIGH
SIZE	MEDIUM	LOW
WILD BERRIES	MEDIUM	HIGH
Cost	20	20

5	Option A	Option B
FOREST DIVERSITY	MEDIUM	LOW
BEE STINGS	LOW	MEDIUM
SAFETY	LOW	LOW
SIZE	LOW	LOW
WILD BERRIES	MEDIUM	LOW
Cost	20	20

6	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	LOW	HIGH
SAFETY	MEDIUM	MEDIUM
SIZE	HIGH	LOW
WILD BERRIES	MEDIUM	HIGH
Cost	20	15

7	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	LOW	HIGH
SAFETY	HIGH	LOW
SIZE	LOW	HIGH
WILD BERRIES	MEDIUM	LOW
Cost	15	30

8	Option A	Option B
FOREST DIVERSITY	MEDIUM	LOW
BEE STINGS	HIGH	HIGH
SAFETY	HIGH	LOW
SIZE	HIGH	MEDIUM
WILD BERRIES	LOW	HIGH
Cost	30	10

Model C1

1	Option A	Option B
FOREST DIVERSITY	MEDIUM	MEDIUM
BEE STINGS	MEDIUM	LOW
SAFETY	MEDIUM	MEDIUM
SIZE	MEDIUM	LOW
WILD BERRIES	LOW	MEDIUM
Cost	15	15

2	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	LOW	HIGH
SAFETY	MEDIUM	HIGH
SIZE	HIGH	MEDIUM
WILD BERRIES	HIGH	LOW
Cost	15	15

3	Option A	Option B
FOREST DIVERSITY	MEDIUM	LOW
BEE STINGS	MEDIUM	LOW
SAFETY	LOW	MEDIUM
SIZE	HIGH	MEDIUM
WILD BERRIES	MEDIUM	HIGH
Cost	15	20

4	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	HIGH	MEDIUM
SAFETY	MEDIUM	MEDIUM
SIZE	HIGH	LOW
WILD BERRIES	MEDIUM	HIGH
Cost	30	15

5	Option A	Option B
FOREST DIVERSITY	HIGH	MEDIUM
BEE STINGS	HIGH	MEDIUM
SAFETY	LOW	HIGH
SIZE	HIGH	LOW
WILD BERRIES	LOW	MEDIUM
Cost	30	15

6	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	HIGH	MEDIUM
SAFETY	MEDIUM	LOW
SIZE	HIGH	LOW
WILD BERRIES	LOW	HIGH
Cost	10	30

7	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	HIGH	MEDIUM
SAFETY	MEDIUM	LOW
SIZE	MEDIUM	MEDIUM
WILD BERRIES	MEDIUM	LOW
Cost	15	20

8	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	MEDIUM	HIGH
SAFETY	HIGH	LOW
SIZE	MEDIUM	LOW
WILD BERRIES	HIGH	MEDIUM
Cost	20	10

Model C2

1	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	HIGH	LOW
SAFETY	LOW	HIGH
SIZE	MEDIUM	HIGH
WILD BERRIES	HIGH	LOW
Cost	10	30

2	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	LOW	HIGH
SAFETY	HIGH	LOW
SIZE	HIGH	MEDIUM
WILD BERRIES	MEDIUM	HIGH
Cost	20	15

3	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	LOW	LOW
SAFETY	MEDIUM	MEDIUM
SIZE	MEDIUM	LOW
WILD BERRIES	MEDIUM	LOW
Cost	10	20

4	Option A	Option B
FOREST DIVERSITY	MEDIUM	LOW
BEE STINGS	MEDIUM	HIGH
SAFETY	LOW	HIGH
SIZE	MEDIUM	HIGH
WILD BERRIES	MEDIUM	LOW
Cost	30	10

5	Option A	Option B
FOREST DIVERSITY	MEDIUM	MEDIUM
BEE STINGS	MEDIUM	LOW
SAFETY	HIGH	LOW
SIZE	LOW	HIGH
WILD BERRIES	LOW	HIGH
Cost	10	20

6	Option A	Option B
FOREST DIVERSITY	MEDIUM	MEDIUM
BEE STINGS	HIGH	LOW
SAFETY	HIGH	MEDIUM
SIZE	LOW	MEDIUM
WILD BERRIES	HIGH	LOW
Cost	30	15

7	Option A	Option B
FOREST DIVERSITY	LOW	MEDIUM
BEE STINGS	MEDIUM	HIGH
SAFETY	HIGH	LOW
SIZE	HIGH	LOW
WILD BERRIES	HIGH	MEDIUM
Cost	30	10

8	Option A	Option B
FOREST DIVERSITY	MEDIUM	MEDIUM
BEE STINGS	LOW	HIGH
SAFETY	HIGH	MEDIUM
SIZE	MEDIUM	HIGH
WILD BERRIES	LOW	MEDIUM
Cost	15	20

Model C3

1	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	LOW	MEDIUM
SAFETY	LOW	HIGH
SIZE	LOW	MEDIUM
WILD BERRIES	MEDIUM	LOW
Cost	20	10

2	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	HIGH	MEDIUM
SAFETY	MEDIUM	MEDIUM
SIZE	LOW	HIGH
WILD BERRIES	LOW	MEDIUM
Cost	20	10

3	Option A	Option B
FOREST DIVERSITY	MEDIUM	HIGH
BEE STINGS	LOW	HIGH
SAFETY	LOW	HIGH
SIZE	HIGH	LOW
WILD BERRIES	HIGH	MEDIUM
Cost	15	30

4	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	MEDIUM	MEDIUM
SAFETY	MEDIUM	HIGH
SIZE	LOW	MEDIUM
WILD BERRIES	LOW	HIGH
Cost	20	15

5	Option A	Option B
FOREST DIVERSITY	HIGH	MEDIUM
BEE STINGS	LOW	MEDIUM
SAFETY	LOW	HIGH
SIZE	MEDIUM	HIGH
WILD BERRIES	HIGH	HIGH
Cost	20	20

6	Option A	Option B
FOREST DIVERSITY	MEDIUM	MEDIUM
BEE STINGS	LOW	HIGH
SAFETY	HIGH	LOW
SIZE	LOW	HIGH
WILD BERRIES	MEDIUM	LOW
Cost	10	30

7	Option A	Option B
FOREST DIVERSITY	HIGH	LOW
BEE STINGS	MEDIUM	LOW
SAFETY	LOW	MEDIUM
SIZE	LOW	MEDIUM
WILD BERRIES	LOW	MEDIUM
Cost	10	30

8	Option A	Option B
FOREST DIVERSITY	LOW	HIGH
BEE STINGS	HIGH	MEDIUM
SAFETY	HIGH	LOW
SIZE	LOW	HIGH
WILD BERRIES	HIGH	MEDIUM
Cost	30	10

C.5   Survey form

Dear Sir – Madam,

the Department of Tourism and Sustainable development of the University of Las Palmas de Gran Canaria, Spain, in collaboration with the University of Insubria, Italy, are researching several topics including sustainability, climate change, nature conservation and their impact on society and people's wellbeing.
The opinion of citizens like you is very important for us and for proposing policies and management solutions that are scientifically sound and , at the same time, include people's preferences.
Your participation is anonymous, and the information shall be used exclusively for the purposes of the research undertaken. Please take your time and read the questions carefully. Thank you very much for your time and cooperation.

Clara Tattoni

1.- Have you ever been asked your opinion about public policy?

	1. Yes		2. No

2.- In your opinion, what are the 5 most important challenges we are facing as a society? Please, mark with 1 to the most important one for you, 2 for the second most important, — and 5 to the least important issue. If you consider the list is missing relevant problems, just include them at the end.

Challenges	Rank
Unemployment	
Immigration	
Health system	
Climate Change	
Transportation. Traffic jams	
Environmental quality	
Air quality	
Personal Security	
Global economic problems (high prices, high interest rates)	
OTHERS (please specify)	

3.- In particular, let's talk about the environment. Listed below are statements about the relationship between humans and the environment. Which is your opinion about them?
Please, consider the following answers: 1=Strongly disagree; 2=Mildly disagree; 3=Unsure; 4=Mildly agree; 5=Strongly agree.

Statements	Strongly disagree	Mildly disagree	Unsure	Mildly agree	Strongly agree
Humans have the right to modify the natural environment to suit their needs.	1	2	3	4	5
Humans are severely abusing the environment.	1	2	3	4	5
Plants and animals have as much right as humans to exist.	1	2	3	4	5
Nature is strong enough to cope with the impacts of modern industrial nations.	1	2	3	4	5
Humans were meant to rule over the rest of nature.	1	2	3	4	5
The balance of nature is very delicate and easily upset.	1	2	3	4	5
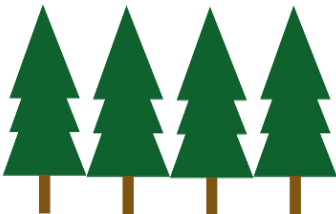
Bear management in the Alps

As you may already be aware, Trentino is home to a brown bear population, a species protected by European and national legislation and a State asset. Brown bears need to be conserved because they are critical to maintaining the ecosystem's equilibrium, which provides numerous benefits to society. Large carnivores, such as the brown bear, increase plant and animal diversity, reduce wasp populations, and contribute to maintaining beautiful and healthy forests. They are also a component of alpine culture: bears appear in numerous coats of arms and place names. Bears can pose a threat to some human activities because they can damage livestock, agricultural activities and, on rare occasions, accidents involving people may occur. Bears can be managed in a variety of ways: as a society, we must select between several conservation schemes with varying costs and benefits. This survey aims to learn your thoughts on various management programs in order to assist the government in making the best decisions based on the welfare of citizens.
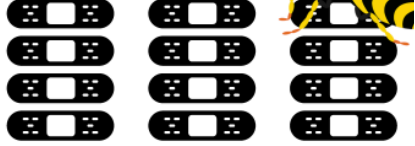
Ecosystem services
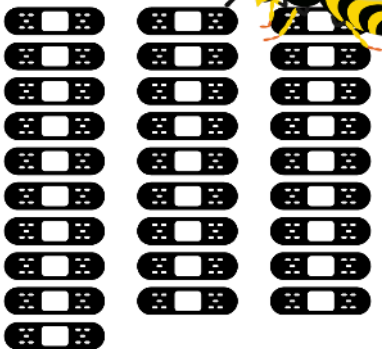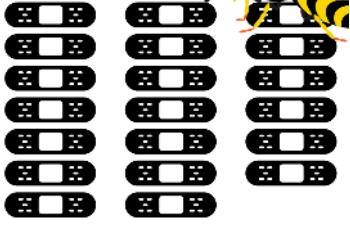
Here you will find a description of some ecosystem services, *that is the direct and indirect contributions that Nature provides for human well-being and quality of life.* ***The following services are those provided by a healthy population of brown bears.*** ***<u>Please, read carefully the description of the benefits provided to the society when bears are present in the ecosystem.</u>***

Forest diversity: Bears contribute to maintaining forest diversity in various ways for instance by transporting seeds, eating insects into decaying woods and fertilising the forest soil. A forest made of a single kind of tree of the same age is less resistant to climate change, extreme weather events and parasite outbreaks. Currently the most common type of forest has low diversity, trees belonging to one species of one age class. Other scenarios include more diverse forests. In the highest diversity forest there are also dead trees, very important for birds like the woodpeckers.

| Low | Medium | High | high | Very |

Bee stings: No other species eats so many bees, wasps and hornets as the bears.
Brown bears keep the population of these insects under control, without affecting their role as pollinators. Insects can
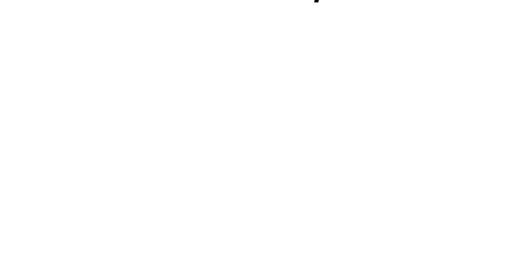
inflict painful stings that can lead to hospitalisation and even death for allergic people. In the current situation about 280 persons need to go to ER every year because of stings. Please, consider two other scenarios with 200 and 120 persons needing ER after being stung.
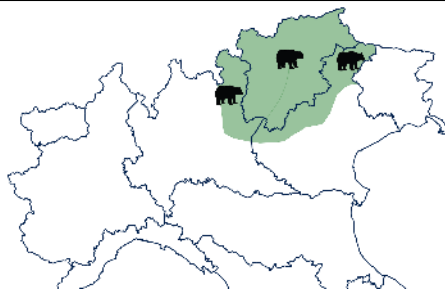
280 persons need ER every year High sting risk	200 person need ER every year Medium sting risk	120 persons need ER every year Low sting risk

Forest production of wild berries: Many studies showed that bears eat berries and then drop the seeds in their scats around in the forest. They spread around and fertilise the seeds that are then available for other animals and for us to pick. The bag size of forest fruits you can collect is regulated by the law and it is 2 kg per day. However, the availability of wild berries can vary, so it can be easier or more difficult to find them. Now you need about 3 hours to collect berries to fill a ¼ of a 2 kg basket. Please, consider two other scenarios where, in the same amount of time you can fill half of the basket or the whole basket..

¼ basket	½ basket	Full basket

Size of bear area: *Bears in Italy are isolated from other populations and in the long term this will cause genetic problems and eventually extinction. The long term existence of bears in Italy will be guaranteed if the current population is able to move towards Slovenia, where there is a healthy and big population of bears. In the current situation bear core area is only in Trentino. The different programmes aim to increase the bear distribution, through the building of ecological corridors and overpassess.*

West Trentino	Central Alps	All Alps

Safety: At the moment there is free access to all the areas where the bears are present and bear presence is not advertised. In order to reduce the risk of encounter for people and also avoid disturbing bears, the programme will increase monitoring in order to provide information about how to behave in bear areas along trails or temporary restrictions about bear areas and some restrictions to hiking trails.

No information	Warning	Trail closure

In this study we are interested in knowing how you would choose between two different conservation programmes for the brown bears with different level of the benefits provided by the environment

Consider you are asked to support one of the programmes of bear management. You are asked to choose between two alternative programmes, or maintain the current management . Please, choose as if these were the only options available.

For each option there is a fee to pay as **una tantum tax** to support the increased cost of bear management: monitoring, updating trail signs and so on.

All the options include the reimbursement for damages to property agriculture and livestock.

From the following alternatives, which one would you choose?

Example: You have to choose between the following options**.**
- **Current situation:**   Low forest diversity, high risk of stings, bear area only in Trentino, free access to trails and no information on trails, 1/4 basket of berries, no costs

- **Programme A:** medium forest diversity ,averager risk of stings, bear area in central Alps , free access to all trails with bear warnings, ½ basket of berries, cost   30 €
- **Programme :** high forest diversity, low risk of stings , bears in all the the Alps, temporary closure of on trails with bears,   full basket of berries,   cost   40 €

CHOICE CARDS HERE

IF chosen status QUO many times ASK

Why do you prefer the current situation?

	1. I really like it		4. I do not trust that my money will be used to implement any of the programmes
	2. I already pay enough taxes		5. I do not like the alternatives
	3. The questionnaire is too complicated		6. OTHER: _____

4.- Do you expect or plan to visit the Alps in the next year?

	1. Yes		2. No

5. Are you a member of some ONG for environmental protection (WWF, LIPU, Legambiente, Greenpeace or similar)?

	1. Yes		2. No

6.- Are you a member of some ONG for animal rights? (LAV, OIPA, or similar,)

	1. Yes		2. No

7.- Are you a hunter?

	1. Yes		2. No

8.- Listed below are statements about the bear management. Please, consider the following answers: 1=<u>Strongly disagree; 2=Mildly disagree; 3=Unsure; 4=Mildly agree; 5=Strongly agree</u>.

Statements	Strongly disagree	Mildly disagree	Unsure	Mildly agree	Strongly agree
Bears should live in their natural habitat, even outside National Parks.	1	2	3	4	5
Bear management should be done locally (Province).	1	2	3	4	5
Bear management should be done at national level.	1	2	3	4	5
Actual bear management can be improved.	1	2	3	4	5
Problem bears should be removed from the environment.	1	2	3	4	5

Bears and people can co-exist.	1	2	3	4	5
Bearwatching is a great experience	1	2	3	4	5
Bear can promote eco-tourism	1	2	3	4	5

BOX would you like to motivate your choices?

9- Country of Residence: _____ **Province:** _____

Town _____

10.- Where do you live?

	1. Metropolitan city		4. Village
	2. Big city		5. Countryside
	3. Small city		6. Other:

11.- Gender: 1. ☐ Male   2. ☐ Female   3. ☐ Other

12.- Age: _____

13.- Education level:

	1. No schooling completed		4. Technical/vocational training
	2. Primary school		5. Bachelor's degree
	3. Secondary school		6. Master or Doctorate degree

14.- Employment status:

	1. Unemployed		4. Employee
	2. Student		5. Retired
	3. Self-employed		6. Other: _____

15.- How many people live in the household (also count yourself)? _____

16.- Net monthly income:

Individual					Household (total)			
1	<500€	4	2001-2800 €		1	<500€	4	2201-3000 €
2	500-1200€	4	2801-3500 €		2	500-1500€	5	3001-3400 €
3	1201-2000€	6	>3501€		3	1501-2200 €	6	>4001€

17.- Would you like to add any comments?

THANK YOU very much for your participation!

Figure C.5: Focus group flyer in italian.

	UK	Germany	France	Italy
Valid	542	515	572	484
Protest	91	117	63	153
Total	633	632	635	637

Table C.1: Collected questionnaire per country and relative number of valid and protest votes

C.6 Exploratory data analysis of DCE

Here is reported an exploratory data analysis of the preliminary questions of the DCE survey. The introductory questions were designed to understand if people were familiar with the Alpine environment and their attitude towards the environment and the present management of the bears.

Most of the respondents have never been to the Alps, especially people from the UK and do not plan to go there. Only a minority belongs to an environmental or an animal right association and around 2% are hunters, Table C.3.

The answers provided in the socio-demographic section aimed at defining the age, education level, and income are summarised below:

- **Gender**: The gender balance was 50% 1324 women and 1213 men.

- **Age**: the age of the ranged between 18 and 89 year old, mean 46.1 Figure C.6.

- **Education**: 0.9% of the respondents had no education, 2.8% had Primary; 24.1% High school ; 27.7% Technical 27.1% Bachelor and 17.2% had a Master degree.

- **Employment**: 6.7% of the respondents were Unemployed; 6.1% Students; 6.9% Self employed 6.9% Employees; 17.4% Retired and 1.7% Other .

- **Household size**: was on average 2.7 ranging from 1 to 12 with some possible mistakes (like 34 or 55) that were excluded.

- **Income**: 6% of the people refused (128 individuals) to declare their income, see Figure C.7

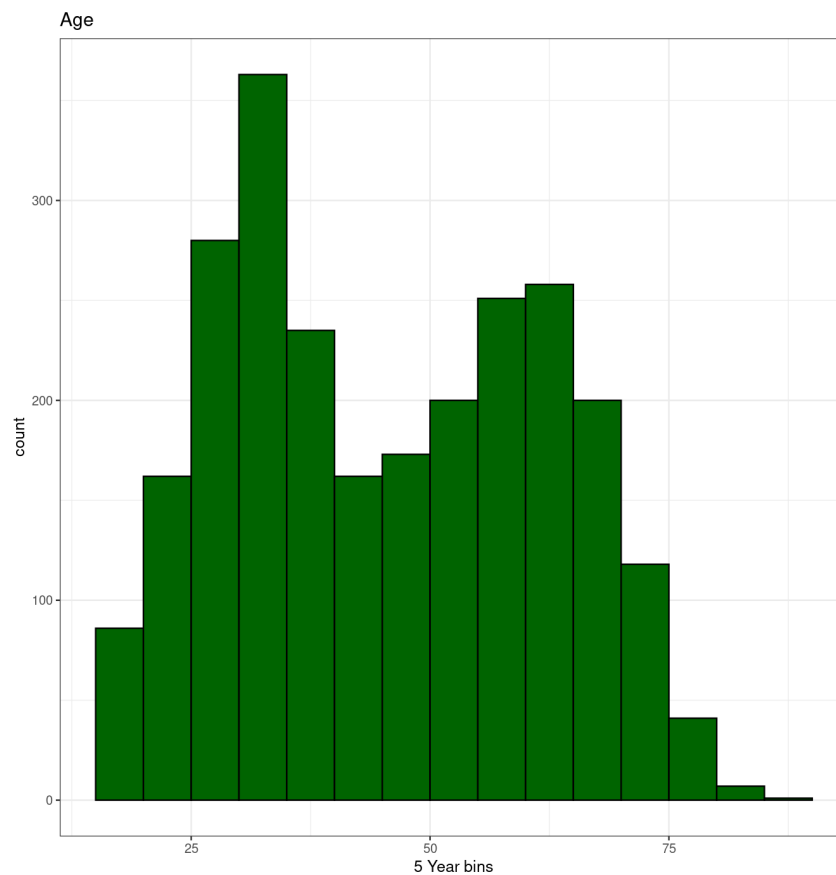- **Total Income**: 10.3% of the interviewed refused to declare their family income (217 persons) , Table C.2

Figure C.6: Age of the respondents

Income class	N	Percent
<500	43	2.0
500-1500	198	9.4
1501-2200	337	15.9
2201-3000	484	22.9
3001-4000	614	29.1
>4000	644	30.5
NA's	217	10.3

Table C.2: Total income of the household

Question	No	Yes
Has been to the Alps	0.78	0.22
Plans to go to the Alps	0.87	0.13
Hunter	0.98	0.02
Member of Envirnmental ONG.	0.83	0.17
Member of Animal rights ONG.	0.82	0.18

Table C.3: Summary of socio-demographic answers with a binary response, figures are proportions of answers in the whole dataset
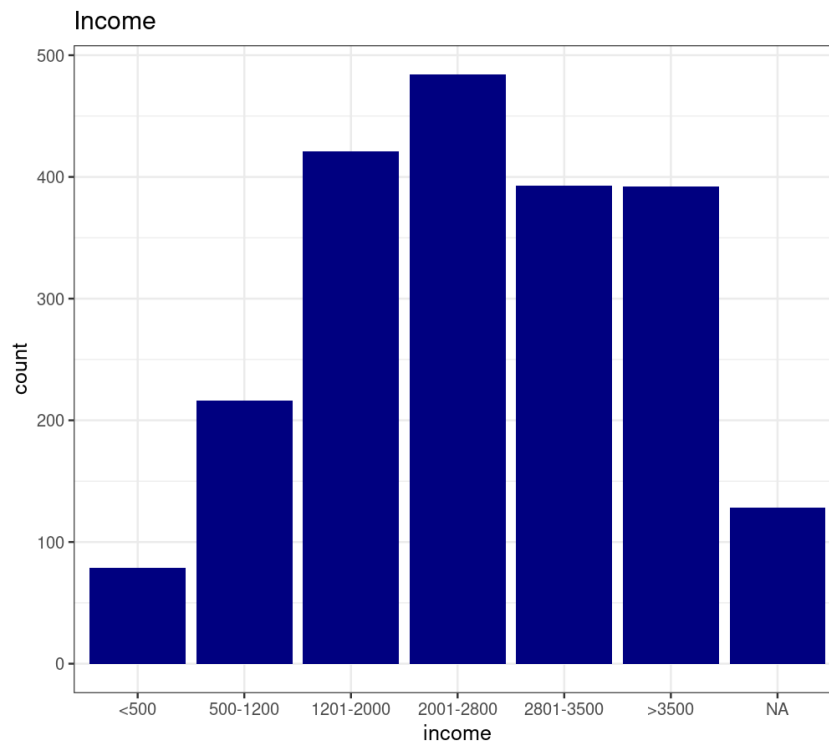
Figure C.7: Distribution of the income among the respondents

Table C.4 reports the responses to the set of questions that aim to understand the environmental attitude of the respondents according to a Likert scale, Figure C.8.

Question	St. disagree	Disagree	Unsure	Agree	Str. agree
Humans have the right to modify the nature	0.25	0.26	0.16	0.23	0.10
Humans are severely abusing the environment	0.03	0.05	0.08	0.28	0.56
Humans are severely abusing the environment	0.02	0.06	0.08	0.24	0.60
Plants and animals have as much right as humans to exist	0.28	0.26	0.17	0.19	0.11
Nature is strong enough	0.30	0.22	0.18	0.19	0.11
Humans were meant to rule over the rest of nature	0.02	0.05	0.10	0.30	0.52

Table C.4: Proportion of the answers dealing with the environmental attitude expressed in a Likert scale
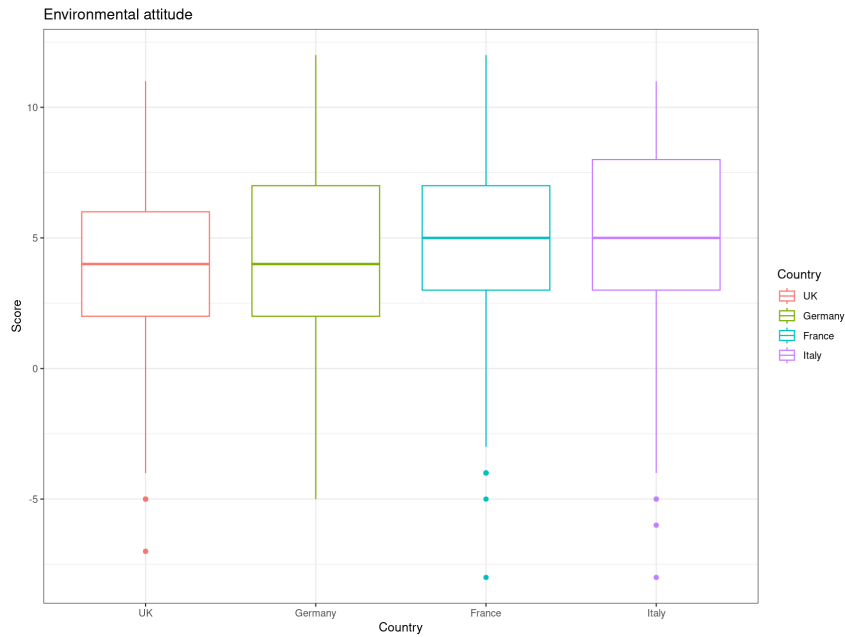

Figure C.8: The environmental attitude of the respondents leaned towards Ecocentrism in all countries. Tukey multiple comparisons of means showed significant differences (p<0.05) among all counties except between Italy-France and UK-Germany
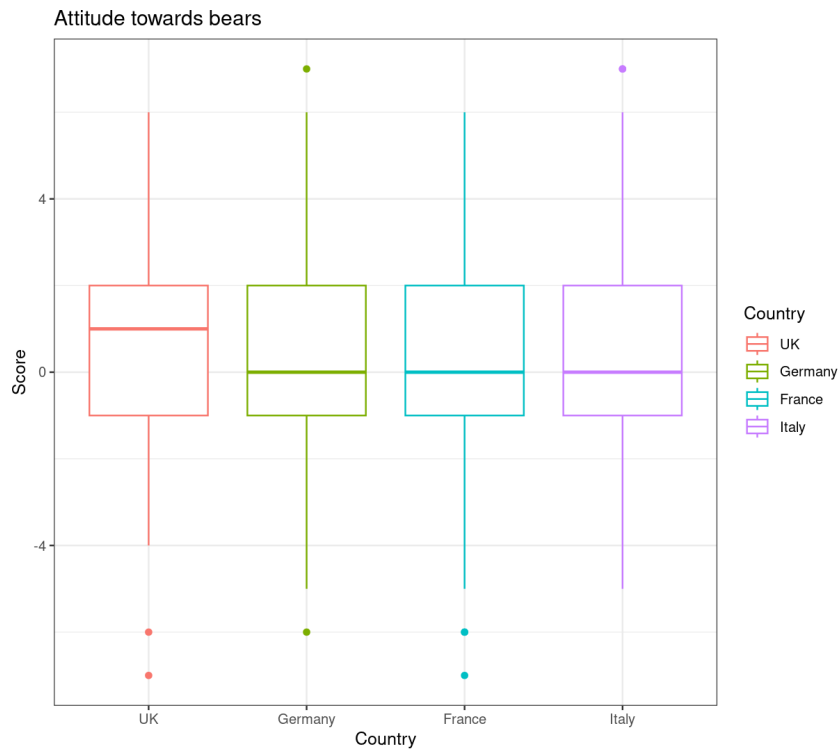
Figure C.9: In all countries the respondents had on average a neutral attitude towards the brown bear, except in UK where is more positive. Tukey post hoc test had p>0.05, thus there was no significant difference among Countries.
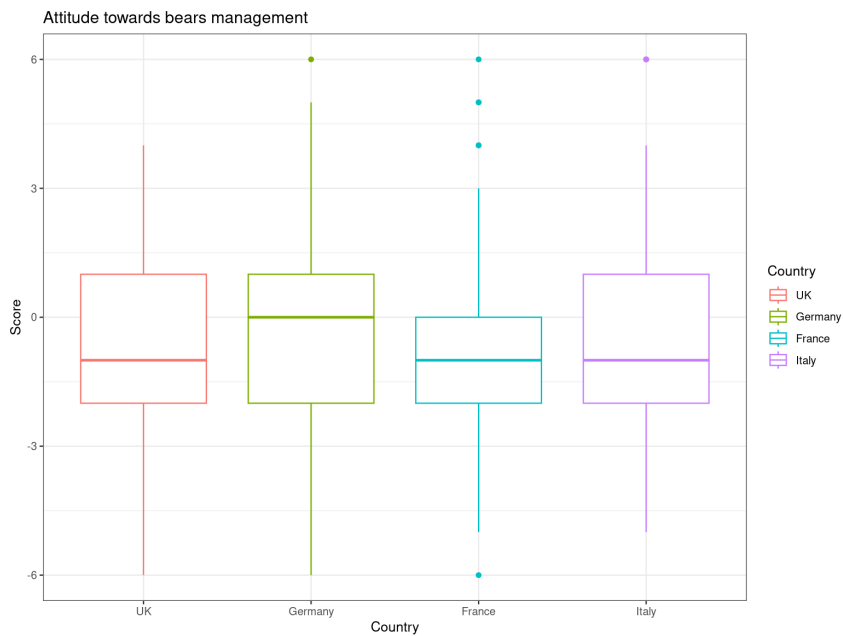

Figure C.10: In UK, France and Italy , the respondents had a slightly negative attitude towards the institutions appointed for wildlife management. In Germany they were neutral, Tukey multiple comparisons of means p<0.05 with the other countries

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Bibliography

A'Bear, A. D., Johnson, S. N., & Jones, T. H. (2014). Putting the 'upstairs-downstairs' into ecosystem service: What can aboveground-belowground ecology tell us? *Biological Control*, *75*, 97–107. https://doi.org/10.1016/j.biocontrol.2013.10.004

Adams, M. S. (2019). *Cultural and ecological relationships among consumers, food, and landscapes; implications for stewarding bear-human-salmon systems* [Doctoral dissertation, University of Victoria]. https://dspace.library.uvic.ca/handle/1828/10836

Aguilera-Alcalá, N., Morales-Reyes, Z., Martín-López, B., Moleón, M., & Sánchez-Zapata, J. A. (2020). Role of scavengers in providing non-material contributions to people. *Ecological Indicators*, *117*. https://doi.org/10.1016/j.ecolind.2020.106643

Akaike, H. (1973). Information theory and an extension of the maximum likelihood principle. In B. N. Petran & F. Csaki (Eds.), *International symposium on information theory* (pp. 267–281). Akademiai Kiadi.

Albrecht, J., Bartoń, K. A., Selva, N., Sommer, R. S., Swenson, J. E., & Bischof, R. (2017). Humans and climate change drove the Holocene decline of the brown bear. *Scientific Reports*, *7*(1), 10399. https://doi.org/10.1038/s41598-017-10772-6

Angeli, F., & Brignoli, A. (1994). Status della popolazione di gallo cedrone in Provincia di Trento, Dendronatura. *Dendronatura: semestrale dell'Associazione forestale del Trentino*, *94*(1), 17–31.

Arbieu, U., Helsper, K., Dadvar, M., Mueller, T., & Niamir, A. (2021). Natural Language Processing as a tool to evaluate emotions in conservation conflicts. *Biological Conservation*, *256*, 109030. https://doi.org/10.1016/j.biocon.2021.109030

Arreola, D., & Burkhart, N. (2010). Photographic postcards and visual urban landscape. *Urban Geography*, *31*(7), 885–904. https://doi.org/10.2747/0272-3638.31.7.885

Attenborough, D. (2020). *A Life on Our Planet: My Witness Statement and a Vision for the Future* (Ebury Publ). Random House. https://books.google.com/books?hl=en&lr=&id=DRjcDwAAQBAJ&oi=fnd&pg=PT3&dq=hotspot+fire+blockchain&ots=4xIvh3gAKn&sig=7m1biH3EqfHoR7aqcdp1hyGIZbA

Auger, J., Meyer, S. E., & Black, H. L. (2002). Are American black bears (Ursus americanus) legitimate seed dispersers for fleshy-fruited shrubs? *American Midland Naturalist*, *147*(2), 352–367. https://doi.org/10.1674/0003-0031(2002)147[0352:AABBUA]2.0.CO;2

Bateman, I. J., & Mace, G. M. (2020). The natural capital framework for sustainably efficient and equitable decision making. *Nature Sustainability*, *3*(10), 776–783. https://doi.org/10.1038/s41893-020-0552-3

Bateman, P. W., & Fleming, P. A. (2017, July). Are negative effects of tourist activities on wildlife over-reported? A review of assessment methods and empirical results. https://doi.org/10.1016/j.biocon.2017.05.003

Becker, N., Inbar, M., Bahat, O., Choresh, Y., Ben-Noon, G., & Yaffe, O. (2005). Estimating the economic value of viewing griffon vultures Gyps fulvus: A Travel Cost Model study at Gamla Nature Reserve, Israel. *ORYX*, *39*(4), 429–434. https://doi.org/10.1017/S0030605305001122

Benazzo, A., Trucchi, E., Cahill, J. A., Delser, P. M., Mona, S., Fumagalli, M., Bunnefeld, L., Cornetti, L., Ghirotto, S., Girardi, M., Ometto, L., Panziera, A., Rota-Stabelli, O., Zanetti, E., Karamanlidis, A., Groff, C., Paule, L., Gentile, L., Vilà, C., . . . Bertorelle, G. (2017). Survival and divergence in a small group: The extraordinary genomic history of the endangered Apennine brown bear stragglers. *Proceedings of the National Academy of Sciences of the United States of America*, *114*(45), E9589–E9597. https://doi.org/10.1073/pnas.1707279114

Bennett, N. J., Roth, R., Klain, S. C., Chan, K., Christie, P., Clark, D. A., Cullman, G., Curran, D., Durbin, T. J., Epstein, G., Greenberg, A., Nelson, M. P., Sandlos, J., Stedman, R., Teel, T. L., Thomas, R., Veríssimo, D., & Wyborn, C. (2017). Conservation social science: Understanding and integrating human dimensions to improve conservation. *Biological Conservation*, *205*, 93–108. https://doi.org/10.1016/j.biocon.2016.10.006

Berger, J., Stacey, P. B., Bellis, L., & Johnson, M. P. (2001). A Mammalian Predator-Prey Imbalance: Grizzly Bear and Wolf Extinction Affect Avian Neotropical Migrants. *Ecological Applications*, *11*(4), 947. https://doi.org/10.2307/3061004

Bianchi, A., & Biffignandi, S. (2017). Representativeness in panel surveys. *Mathematical Population Studies*, *24*(2), 126–143. https://doi.org/10.1080/08898480.2016.1271650

Bishop, R. C., Boyle, K. J., Carson, R. T., Chapman, D., Hanemann, W. M., Kanninen, B., Kopp, R. J., Krosnick, J. A., List, J., Meade, N., Paterson, R., Presser, S., Smith, V. K., Tourangeau, R., Welsh, M., Wooldridge, J. M., DeBell, M., Donovan, C., Konopka, M., & Scherer, N. (2017). Putting a value on injuries to natural assets: The BP oil spill. *Science*, *356*(6335), 253–254. https://doi.org/10.1126/science.aam8124

Black, L. T. (1988). Bear in Human Imagination and in Ritual. *Ursus*, *10*, 343–347.

Bombieri, G., Naves, J., Penteriani, V., Selva, N., Fernández-Gil, A., López-Bao, J. V., Ambarli, H., Bautista, C., Bespalova, T., Bobrov, V., Bolshakov, V., Bondarchuk, S., Camarra, J. J., Chiriac, S., Ciucci, P., Dutsov, A., Dykyy, I., Fedriani, J. M., García-Rodríguez, A., . . . Delgado, M. M. (2019). Brown bear attacks on humans: a worldwide perspective. *Scientific Reports*, *9*(1), 8573. https://doi.org/10.1038/s41598-019-44341-w

Bonner, S. (2022). *Social Cost Benefit Analysis and Economic Evaluation* (epub). The University of Queensland. https://uq.pressbooks.pub/socialcba/

Bostedt, G., & Grahn, P. (2008). Estimating cost functions for the four large carnivores in Sweden. *Ecological Economics*, *68*(1-2), 517–524. https://doi.org/10.1016/j.ecolecon.2008.05.008

Brambilla, M. (2019). Six (or nearly so) big challenges for farmland bird conservation in Italy. *Avocetta*, *43*(2), 101–113. https://doi.org/10.30456/AVO.2019201

Brambilla, M., Bergero, V., Bassi, E., & Falco, R. (2015). Current and future effectiveness of Natura 2000 network in the central Alps for the conservation

of mountain forest owl species in a warming climate. *European Journal of Wildlife Research*, *61*(1), 35–44. https://doi.org/10.1007/s10344-014-0864-6

Brambilla, M., & Pedrini, P. (2013). The introduction of subsidies for grassland conservation in the Italian Alps coincided with population decline in a threatened grassland species, the Corncrake Crex crex. *Bird Study*, *60*(3), 404–408. https://doi.org/10.1080/00063657.2013.811464

Brookshire, D. S., Eubanks, L. S., & Randall, A. (1983). Estimating Option Prices and Existence Values for Wildlife Resources. *Source: Land Economics*, *59*(1), 1–15. http://www.jstor.org/stable/3145871%5Cnhttp://about.jstor.org/terms

Burkhard, B., & Maes, J. (2017). *Mapping ecosystem services on different scales* (B. Burkhard, Ed.; First). Pensoft Publishers, 374.

Campbell, M., & Lancaster, B.-L. (2010). Public Attitudes toward Black Bears (Ursus americanus) and Cougars (Puma concolor) on Vancouver Island. *Society and Animals*, *18*(1), 40–57. https://doi.org/10.1163/156853010790799839

Cantiani, M. G., Geitner, C., Haida, C., Maino, F., Tattoni, C., Vettorato, D., & Ciolli, M. (2016). Balancing economic development and environmental conservation for a new governance of Alpine areas. *Sustainability (Switzerland)*, *8*(8), 802. https://doi.org/10.3390/su8080802

Center for Responsible Travel. (2014). Economic Impact of Bear Viewing and Bear Hunting in The Great Bear Rainforest of British Columbia. (January), 130.

Cerri, J., Mori, E., Ancillotto, L., Russo, D., & Bertolino, S. (2020). COVID-19 has led to a global increase in web searches for bats: a risk for conservation ? https://doi.org/10.32942/osf.io/4pa2q

Chamberlain, D. E., Pedrini, P., Brambilla, M., Rolando, A., & Girardello, M. (2016). Identifying key conservation threats to Alpine birds through expert knowledge. *PeerJ*, *4*(February), e1723. https://doi.org/10.7717/peerj.1723

Chapron, G., & López-Bao, J. V. (2016). Coexistence with Large Carnivores Informed by Community Ecology. *Trends in Ecology and Evolution*, *31*(8), 578–580. https://doi.org/10.1016/j.tree.2016.06.003

Ciolli, M., Tattoni, C., & Ferretti, F. (2012). Understanding forest changes to support planning: A fine-scale Markov chain approach. *Developments in Environmental Modelling*, *25*, 355–373. https://doi.org/10.1016/B978-0-444-59396-2.00021-3

Clayton, C., & Mendelsohn, R. (1993). The Value of Watchable Wildlife: a Case Study of McNeil River. *Journal of Environmental Management*, *39*(2), 101–106. https://doi.org/10.1006/jema.1993.1057

Clucas, B., McHugh, K., & Caro, T. (2008). Flagship species on covers of US conservation and nature magazines. *Biodiversity and Conservation*, *17*(6), 1517–1528. https://doi.org/DOI10.1007/s10531-008-9361-0

Costanza, R., d'Arge, R., de Groot, R., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R. V., Paruelo, J., Raskin, R. G., Sutton, P., & van den Belt, M. (1997). The value of the world's ecosystem services and natural capital. *Nature*, *387*(6630), 253–260. https://doi.org/10.1038/387253a0

Costello, C., Gaines, S. D., & Lynham, J. (2008). Can Catch Shares Prevent Fisheries Collapse? *Science*, *321*(5896), 1678–1681. https://doi.org/10.1126/science.1159478

Crête, M. (1999). The distribution of deer biomass in North America supports the hypothesis of exploitation ecosystems. *Ecology Letters*, *2*(4), 223–227. https://doi.org/10.1046/j.1461-0248.1999.00076.x

DeBruyn, T. D., Smith, T. S., Proffitt, K., Partridge, S., & Drummer, T. D. (2004). Brown bear response to elevated viewing structures at Brooks River, Alaska. *Wildlife Society Bulletin*, *32*(4), 1132–1140. https://doi.org/10.2193/0091-7648(2004)032[1132:bbrtev]2.0.co;2

Della Giacoma, F. (1992). Le foreste demaniali di Cavalese e Primiero. *Dendronatura: semestrale dell'Associazione forestale del Trentino*, *2*(35-42).

Deroy, B. C., Darimont, C. T., & Service, C. N. (2019). Biocultural indicators to support locally led environmental management and monitoring. *Ecology and Society*, *24*(4). https://doi.org/10.5751/ES-11120-240421

DeShazo, J., & Fermo, G. (2002). Designing Choice Sets for Stated Preference Methods: The Effects of Complexity on Choice Consistency. *Journal of Environmental Economics and Management*, *44*(1), 123–143. https://doi.org/10.1006/jeem.2001.1199

Di Cristofaro, M., Sallustio, L., Sitzia, T., Marchetti, M., & Lasserre, B. (2020). Landscape preference for trees outside forests along an urban–rural–natural gradient. *Forests*, *11*(7), 1–16. https://doi.org/10.3390/f11070728

Di Minin, E., Slotow, R., Hunter, L. T., Montesino Pouzols, F., Toivonen, T., Verburg, P. H., Leader-Williams, N., Petracca, L., & Moilanen, A. (2016). Global priorities for national carnivore conservation under land use change. *Scientific Reports*, *6*(April), 23814. https://doi.org/10.1038/srep23814

Di Nicola, U., Scacchia, M., & Marruchella, G. (2015). Pathological and serological findings in wild boars (Sus scrofa) from Gran Sasso and Monti della Laga National Park (Central Italy). *Large Animal Review*, *21*(4), 167–171.

Dickman, A. J. (2010). Complexities of conflict: The importance of considering social factors for effectively resolving human-wildlife conflict. *Animal Conservation*, *13*(13), 458–466. https://doi.org/10.1111/j.1469-1795.2010.00368.x

Dietsch, A. M., Teel, T. L., & Manfredo, M. J. (2016). Social values and biodiversity conservation in a dynamic world. *Conservation Biology*, *30*(6), 1212–1221. https://doi.org/10.1111/cobi.12742

Donahue, S. W., Vaughan, M. R., Demers, L. M., & Donahue, H. J. (2003). Bone formation is not impaired by hibernation (disuse) in black bears ¡i¿Ursus americanus¡/i¿. *Journal of Experimental Biology*, *206*(23), 4233–4239. https://doi.org/10.1242/jeb.00671

Dupré, E., Pedrotti, L., & Genovesi, P. (2000). Studio di fattibilità per la reintroduzione dell'Orso bruno (Ursus arctos) sulle Alpi Centrali. *Biol. Cons. Fauna*, *105*, 1–96. https://www.isprambiente.gov.it/public_files/studio-fatt-reintr-orso-bruno.pdf

Egarter Vigl, L., Tasser, E., Schirpke, U., & Tappeiner, U. (2017). Using land use/land cover trajectories to uncover ecosystem service patterns across the Alps. *Regional Environmental Change*. https://doi.org/10.1007/s10113-017-1132-6

Ehrlich, P. R., & Ehrlich, A. H. (1981). *Extinction: The Causes and Consequences of the Disappearance of Species*. Random House.

Estifanos, T., Polyakov, M., Pandit, R., Hailu, A., & Burton, M. (2021). What are tourists willing to pay for securing the survival of a flagship species? The case of protection of the Ethiopian wolf. *Tourism Economics*, *27*(1), 45–69. https://doi.org/10.1177/1354816619880430

Estifanos, T. K., Polyakov, M., Pandit, R., Hailu, A., & Burton, M. (2020). Managing conflicts between local land use and the protection of the Ethiopian wolf: Residents' preferences for conservation program design features. *Eco-*

logical Economics, *169*(December 2018), 106511. https://doi.org/10.1016/j.ecolecon.2019.106511

Fagarazzi, C., Sergiacomi, C., Stefanini, F. M., & Marone, E. (2021). A model for the economic evaluation of cultural ecosystem services: The recreational hunting function in the agroforestry territories of Tuscany (Italy). *Sustainability (Switzerland)*, *13*(20), 11229. https://doi.org/10.3390/su132011229

Fauna, S. F. e., & Ufficio Foreste e Fauna. (1988). *Relazione annuale del servizio foreste e fauna* (tech. rep.). Provincia Autonoma di Trento.

Fernández-Gil, A., Naves, J., Ordiz, A., Quevedo, M., Revilla, E., Delibes, M., Fernández-Gil, A., Naves, J., Ordiz, A., Quevedo, M., Revilla, E., & Delibes, M. (2016). Conflict misleads large carnivore management and conservation: Brown bears and wolves in Spain. *PLoS ONE*, *11*(3). https://doi.org/10.1371/journal.pone.0151541

Fink, C., Hausmann, A., & Di Minin, E. (2020). Online sentiment towards iconic species. *Biological Conservation*, *241*, 108289. https://doi.org/10.1016/j.biocon.2019.108289

Fisher, B., Turner, R. K., & Morling, P. (2009). Defining and classifying ecosystem services for decision making. *Ecological Economics*, *68*(3), 643–653. https://doi.org/10.1016/j.ecolecon.2008.09.014

Folmer, A., Haartsen, T., & Huigen, P. P. (2013). The role of wildlife in emotional attachment to a nature-based tourism destination. *Journal of Ecotourism*, *12*(3), 131–145. https://doi.org/10.1080/14724049.2013.864297

Foltête, J. C., & Litot, J. B. (2015). Scenic postcards as objects for spatial analysis of tourist regions. *Tourism Management*, *49*, 17–28. https://doi.org/10.1016/j.tourman.2015.02.007

Frank, S., Fürst, C., Koschke, L., Witt, A., & Makeschin, F. (2013). Assessment of landscape aesthetics—Validation of a landscape metrics-based assessment by visual estimation of the scenic beauty. *Ecological Indicators*, *32*, 222–231. https://doi.org/10.1016/j.ecolind.2013.03.026

García-Nieto, A. P., García-Llorente, M., Iniesta-Arandia, I., & Martín-López, B. (2013). Mapping forest ecosystem services: From providing units to beneficiaries. *Ecosystem Services*, *4*, 126–138. https://doi.org/10.1016/j.ecoser.2013.03.003

García-Rodríguez, A., Albrecht, J., Szczutkowska, S., Valido, A., Farwig, N., & Selva, N. (2021). The role of the brown bear Ursus arctos as a legitimate megafaunal seed disperser. *Scientific Reports*, *11*(1). https://doi.org/10.1038/s41598-020-80440-9

Garrod, G., & Willis, K. (1992). Valuing goods' characteristics: An application of the hedonic price method to environmental attributes. *Journal of Environmental Management*, *34*(1), 59–76. https://doi.org/10.1016/S0301-4797(05)80110-0

Gervasi, V., Ciucci, P., Boulanger, J., Randi, E., & Boitani, L. (2012). A multiple data source approach to improve abundance estimates of small populations: The brown bear in the Apennines, Italy. *Biological Conservation*, *152*(0), 10–20. https://doi.org/10.1016/j.biocon.2012.04.005

Gervasi, V., Nilsen, E. B., Sand, H., Panzacchi, M., Rauset, G. R., Pedersen, H. C., Kindberg, J., Wabakken, P., Zimmermann, B., Odden, J., Liberg, O., Swenson, J. E., & Linnell, J. D. C. (2011). Predicting the potential demographic impact of predators on their prey: a comparative analysis of two carnivoreungulate systems in Scandinavia. *Journal of Animal Ecology*, *81*(2), 443–454. https://doi.org/10.1111/j.1365-2656.2011.01928.x

Giovannini, G. (2017). *Paesaggi agro-forestali in Trentino: tutela, ripristino e miglioramento degli ambienti tradizionali. Provincia Autonoma di Trento, Servizio Foreste e fauna.* (tech. rep.). Provincia Autonoma di Trento, Servizio Foreste e fauna.

Glikman, J. A., Vaske, J. J., Bath, A. J., Ciucci, P., & Boitani, L. (2012). Residents' support for wolf and bear conservation: The moderating influence of knowledge. *European Journal of Wildlife Research, 58*(1), 295–302. https://doi.org/10.1007/s10344-011-0579-x

Gómez-Baggethun, E., de Groot, R., Lomas, P. L., & Montes, C. (2010). The history of ecosystem services in economic theory and practice: From early notions to markets and payment schemes. *Ecological Economics, 69*(6), 1209–1218. https://doi.org/10.1016/j.ecolecon.2009.11.007

Gordon, H. S. (1954). *The Economic Theory of a Common-Property Resource: The Fishery Author(s)* (tech. rep. No. 2). http://www.jstor.org/stable/1825571

Gottardo, I. (2015). *Le dinamiche del bosco negli ultimi 50 anni nel distretto forestale di primiero l'assetto forestale di un territorio di montagna* (tech. rep.). Servizio Foreste e fauna PAT. https://www.parcopan.org/download/1686_1.html

GRASS Development Team. (2022). Geographic Resources Analysis Support System (GRASS GIS) Software. http://grass.osgeo.org

Green, A. J., & Elmberg, J. (2014). Ecosystem services provided by waterbirds. *Biological Reviews, 89*(1), 105–122. https://doi.org/10.1111/brv.12045

Grêt-Regamey, A., & Kytzia, S. (2007). Integrating the valuation of ecosystem services into the Input-Output economics of an Alpine region. *Ecological Economics, 63*(4), 786–798. https://doi.org/10.1016/j.ecolecon.2007.02.026

Groff, C., Bragalanti, N., Rizzoli, R., & Zanghellini, P. (2015). *Bear report- Rapporto Orso 2014* (tech. rep.). Servizio Foreste e fauna della Provincia Autonoma di Trento. http://www.orso.provincia.tn.it/binary/pat_orso/rapporto_orso/rapportoORSO_2014.1426152499.pdf

Haines-Young, R., & Potschin, M. (2010, March). The links between biodiversity, ecosystem services and human well-being. In *Ecosystem ecology* (pp. 110–139). Cambridge University Press. https://doi.org/10.1017/CBO9780511750458.007

Haines-Young, R., & Potschin, M. (2018). *Common International Classification of Ecosystem Services CICES V5. 1. Guidance on the Application of the Revised Structure* (tech. rep. No. January). Available from www.cices.eu. www.cices.eu

Han, S.-Y., & Lee, C.-K. (2008). Estimating the value of preserving the Manchurian black bear using the contingent valuation method. *Scandinavian Journal of Forest Research, 23*(5), 458–465. https://doi.org/10.1080/02827580802400562

Hanemann, W. M. (1989). Welfare Evaluations in Contingent Valuation Experiments with Discrete Response Data: Reply. *American Journal of Agricultural Economics, 71*(4), 1057–1061. https://doi.org/10.2307/1242685

Haroldson, M. A., Gunther, K. A., Reinhart, D. P., Podruzny, S. R., Cegelski, C., Waits, L., Wyman, T., & Smith, J. (2005). Changing numbers of spawning cutthroat trout in tributary streams of Yellowstone Lake and estimates of grizzly bears visiting streams from DNA. *Ursus, 16*(2), 167–180. https://doi.org/10.2192/1537-6176(2005)016[0167:CNOSCT]2.0.CO;2

Harrer, L. E., & Levi, T. (2018). The primacy of bears as seed dispersers in salmon-bearing ecosystems. *Ecosphere*, *9*(1), e02076. https://doi.org/10.1002/ecs2.2076

Haynes, G. (2017). Postcards on the edge as Britain's oldest publishers signs off — Art and design — The Guardian. https://www.theguardian.com/artanddesign/shortcuts/2017/sep/25/postcards-demise-britains-oldest-publisher-industry-death

Hemati, T., Pourebrahim, S., Monavari, M., & Baghvand, A. (2020). Species-specific nature conservation prioritization (a combination of MaxEnt, Co$ting Nature and DINAMICA EGO modeling approaches). *Ecological Modelling*, *429*. https://doi.org/10.1016/j.ecolmodel.2020.109093

Heneghan, M. D., & Morse, W. (2018). Finding our bearings: Understanding public attitudes toward growing black bear populations in Alabama. *Human Dimensions of Wildlife*, *23*(1), 54–70. https://doi.org/10.1080/10871209.2017.1386248

Herrero, S., Smith, T., DeBruyn, T. D., Gunther, K., & Matt, C. A. (2005). Brown bear habituation to people—safety, risks, and benefits. *Wildlife Society Bulletin*, *33*(1), 362–373. https://doi.org/10.2193/0091-7648(2005)33[362:ftfbbh]2.0.co;2

Hess, S., & Palma, D. (2019). Apollo: A flexible, powerful and customisable freeware package for choice model estimation and application. *Journal of Choice Modelling*, *32*, 100170. https://doi.org/10.1016/j.jocm.2019.100170

Hess, S., & Rose, J. (2009). Some lessons in stated choice survey design. *Association for European Transport and contributors*, 1–29. https://trid.trb.org/view.aspx?id=1106400

Hess, S., & Train, K. (2017). Correlation and scale in mixed logit models. *Journal of Choice Modelling*, *23*, 1–8. https://doi.org/10.1016/j.jocm.2017.03.001

Hilderbrand, G. V., Hanley, T. A., Robbins, C. T., & Schwartz, C. C. (1999). Role of brown bears (Ursus arctos) in the flow of marine nitrogen into a terrestrial ecosystem. *Oecologia*, *121*(4), 546–550. https://doi.org/10.1007/s004420050961

Holtgrieve, G. W., Schindler, D. E., & Jewett, P. K. (2009). Large predators and biogeochemical hotspots: brown bear (Ursus arctos) predation on salmon alters nitrogen cycling in riparian soils. *Ecological Research*, *24*(5), 1125–1135. https://doi.org/10.1007/s11284-009-0591-8

Honey, M., Johnson, J., Menke, C., Cruz, A. R., Karwacki, J., & Durham, W. H. (2016). The comparative economic value of bear viewing and bear hunting in the Great Bear Rainforest. *Journal of Ecotourism*, *15*(3), 199–240. https://doi.org/10.1080/14724049.2016.1142554

Inagaki, A., Allen, M. L., Maruyama, T., Yamazaki, K., Tochigi, K., Naganuma, T., & Koike, S. (2020). Vertebrate scavenger guild composition and utilization of carrion in an East Asian temperate forest. *Ecology and Evolution*, *10*(3), 1223–1232. https://doi.org/10.1002/ece3.5976

Jeffrey, A. (2005). Research Yields Best Metric for Measuring Media Against Outcomes; Sophisticated New Measure now Available to PR Pros of all Budget Levels. In *New releas.* https://www.prweb.com/releases/2005/02/prweb206426.htm

Jonker, S. A., Parkhurst, J. A., Field, R., & Fuller, T. K. (1998). Black bear depredation on agricultural commodities in Massachusetts. *Wildlife Society Bulletin*,

26(2), 318–324. https://www.scopus.com/inward/record.uri?eid=2-s2.0-0031730399&partnerID=40&md5=aea4783607578d2f132b5a1ce753e5ac

Karimi, S., Hemami, M.-R., Esfahani, M. T., & Baltzinger, C. (2020). Endozoochorous dispersal by herbivores and omnivores is mediated by germination conditions. *BMC Ecology*, 20(1). https://doi.org/10.1186/s12898-020-00317-3

Keating, J. M., & Krannich, R. S. (2020). An assessment of factors influencing bear viewing experiences on the Kodiak National Wildlife Refuge: implications for management. *Human Dimensions of Wildlife*, 25(3), 268–280. https://doi.org/10.1080/10871209.2019.1705438

Kee, C. P. C., & Hassan, M. A. M. (2006). THE ADVERTISING-VALUE-EQUIVALENT (AVE) METHOD IN QUANTIFYING ECONOMIC VALUES OF PUBLIC RELATIONS ACTIVITIES: EXPERIENCE OF A PUBLIC-LISTED COMPANY IN MALAYSIA. *Kajian Malaysia*, 24(24), 33–54. http://web.usm.my/km/24-06/KM%20ART%203.pdf

Knight, C. (2008). The Moon Bear as a Symbol of Yama. *Asian Ethnology*, 67, 79–102.

Kohlmann, S. G., Green, R. L., Trainer, C. E., & Popu, F. (n.d.). *Effects of Collection Method on Sex and Age Composition of Black Bear (Ursus americanus) Harvest in Oregon* (tech. rep.).

Kojola, I., & Heikkinen, S. (2012). Problem brown bears Ursus arctos in Finland in relation to bear feeding for tourism purposes and the density of bears and humans. *Wildlife Biology*, 18(3), 258–263. https://doi.org/10.2981/11-052

Kolosova, V., Svanberg, I., Kalle, R., Strecker, L., Özkan, A. M. G., Pieroni, A., Cianfaglione, K., Molnár, Z., Papp, N., Łuczaj, Ł., Dimitrova, D., Šeškauskaite, D., Roper, J., Hajdari, A., & Sõukand, R. (2017). The bear in Eurasian plant names: Motivations and models. *Journal of Ethnobiology and Ethnomedicine*, 13(1). https://doi.org/10.1186/s13002-016-0132-9

Koshino, Y., Kudo, H., & Kaeriyama, M. (2013). Stable isotope evidence indicates the incorporation into Japanese catchments of marine-derived nutrients transported by spawning Pacific Salmon. *Freshwater Biology*, 58(9), 1864–1877. https://doi.org/10.1111/fwb.12175

Krofel, M., Jonozovič, M., & Jerina, K. (2012). Demography and mortality patterns of removed brown bears in a heavily exploited population. *Ursus*, 23(1), 91–103. https://doi.org/10.2192/ursus-d-10-00013.1

Kubo, T., & Shoji, Y. (2014a). Spatial tradeoffs between residents' preferences for brown bear conservation and the mitigation of human-bear conflicts. *Biological Conservation*, 176(August 2014), 126–132. https://doi.org/10.1016/j.biocon.2014.05.019

Kubo, T., & Shoji, Y. (2014b). Trade-off between human-wildlife conflict risk and recreation conditions. *European Journal of Wildlife Research*, 60(3), 501–510. https://doi.org/10.1007/s10344-014-0812-5

Kubo, T., & Shoji, Y. (2016). Demand for bear viewing hikes: Implications for balancing visitor satisfaction with safety in protected areas. *Journal of Outdoor Recreation and Tourism*, 16, 44–49. https://doi.org/10.1016/j.jort.2016.09.004

La Notte, A., D'Amato, D., Mäkinen, H., Paracchini, M. L., Liquete, C., Egoh, B., Geneletti, D., & Crossman, N. D. (2017). Ecosystem services classification: A systems ecology perspective of the cascade framework. *Ecological Indicators*, 74, 392–402. https://doi.org/10.1016/j.ecolind.2016.11.030

Lajeunesse, M. J. (2016). Facilitating systematic reviews, data extraction and meta-analysis with the metagear package for R. *Methods in Ecology and Evolution*, *7*(3), 323–330. https://doi.org/10.1111/2041-210X.12472

Lalleroni, A., Quenette, P. Y., Daufresne, T., Pellerin, M., & Baltzinger, C. (2017). Exploring the potential of brown bear (Ursus arctos arctos) as a long-distance seed disperser: A pilot study in South-Western Europe. *Mammalia*, *81*(1), 1–9. https://doi.org/10.1515/mammalia-2015-0092

Lancaster, K. J. (1966). *A New Approach to Consumer Theory* (tech. rep. No. 2). https://www.jstor.org/stable/1828835

Laurila-Pant, M., Lehikoinen, A., Uusitalo, L., & Venesjärvi, R. (2015). How to value biodiversity in environmental management? *Ecological Indicators*, *55*, 1–11. https://doi.org/10.1016/j.ecolind.2015.02.034

Linnell, J. D., Swenson, J. E., & Andersen, R. (2000). Conservation of biodiversity in Scandinavian boreal forests: Large carnivores as flagships, umbrellas, indicators, or keystones? *Biodiversity and Conservation*, *9*(7), 857–868. https://doi.org/10.1023/A:1008969104618

Liu, H. L. H.-L., & Sharp, R. L. (2018). Influence of attitudes toward wildlife on preferences for management of American black bears. *Ursus*, *29*(1), 32–42. https://doi.org/10.2192/URSU-D-17-00016.2

Loke, V. P. W., Lim, T., & Campos-Arceiz, A. (2020). Hunting practices of the Jahai indigenous community in northern peninsular Malaysia. *Global Ecology and Conservation*, *21*, e00815. https://doi.org/10.1016/j.gecco.2019.e00815

Loomis, J., Richardson, L., Huber, C., Skibins, J., & Sharp, R. (2018). A method to value nature-related webcam viewing: the value of virtual use with application to brown bear webcam viewing. *Journal of Environmental Economics and Policy*, *7*(4), 452–462. https://doi.org/10.1080/21606544.2018.1483842

López Hurtado, M. (2013). La tarjeta postal en España: Usos y tendencias. *Revista General de Informacion y Documentacion*, *23*(2), 437–453. https://doi.org/10.5209/rev{_}RGID.2013.v23.n2.43136

Louviere, J. J., Hensher, D. A., & Swait, J. D. (2000). *Stated choice methods: Analysis and applications*. Cambridge University Press.

Lozano, J., Olszańska, A., Morales-Reyes, Z., Castro, A. A., Malo, A. F., Moleón, M., Sánchez-Zapata, J. A., Cortés-Avizanda, A., von Wehrden, H., Dorresteijn, I., Kansky, R., Fischer, J., & Martín-López, B. (2019). Human-carnivore relations: A systematic review. *Biological Conservation*, *237*, 480–492. https://doi.org/10.1016/j.biocon.2019.07.002

MacDonald, D., Crabtree, J. R., Wiesinger, G., Dax, T., Stamou, N., Fleury, P., Lazpita, J. G., & Gibon, A. (2000). Agricultural abandonment in mountain areas of Europe: environmental consequences and policy response. *Journal of Environmental Management*, *59*, 47–69.

Macdonald, D. (2001). Carnivore conservation: Science, compromise, and tough choices. In D. Funk, D. Macdonald, & R. Wayne (Eds.), *Carnivore conservation* (pp. 524–538). Cambridge University Press.

Macnamara, J. (2006). Advertising values to measure PR: Why they are invalid. . . . *NSW,, Australia: Archipelago Press. Retrieved January*, (1968), 1–10. http://www.pria.com.au/sitebuilder/resources/knowledge/files/1868/advaluestomeasureprpaper.pdf%20https://www.researchgate.net/publication/265660059_Advertising_Values_to_Measure_PR_Why_They_Are_Invalid

Manfredo, M. J., Berl, R. E., Teel, T. L., & Bruskotter, J. T. (2021). Bringing social values to wildlife conservation decisions. *Frontiers in Ecology and the Environment*, *19*(6), 355–362. https://doi.org/10.1002/fee.2356

Marino, F., Kansky, R., Shivji, I., Di Croce, A., Ciucci, P., & Knight, A. T. (2021). Understanding drivers of human tolerance to gray wolves and brown bears as a strategy to improve landholder–carnivore coexistence. *Conservation Science and Practice*, *3*(3). https://doi.org/10.1111/csp2.265

Markwick, M. (2001). Postcards from Malta image, consumption, context. *Annals of Tourism Research*, *28*(2), 417–438. https://doi.org/10.1016/S0160-7383(00)00049-9

Marques, B., Freeman, C., Carter, L., & Pedersen Zari, M. (2020). Sense of Place and Belonging in Developing Culturally Appropriate Therapeutic Environments: A Review. *Societies*, *10*(4), 83. https://doi.org/10.3390/soc10040083

Martin-López, B., Montes, C., & Benayas, J. (2008). Economic Valuation of Biodiversity Conservation: the Meaning of Numbers. *Conservation Biology*, *22*(3), 624–635. https://doi.org/10.1111/j.1523-1739.2008.00921.x

Martino, S., & Kenter, J. O. (2023). Economic valuation of wildlife conservation. *European Journal of Wildlife Research*, *69*(2), 32. https://doi.org/10.1007/s10344-023-01658-2

Mascia, M. B., Brosius, J. P., Dobson, T. A., Forbes, B. C., Horowitz, L., McKean, M. A., & Turner, N. J. (2003). Conservation and the social sciences. *Conservation Biology*, *17*(3), 649–650. https://doi.org/10.1046/j.1523-1739.2003.01738.x

McFadden, D. (1974). Conditional logit analysis of qualitative choice behavior. In P. Zarembka (Ed.), *Frontiers in econometrics.* (pp. 105–142). Academic Press.

McGrath, K., Rowsell, K., Gates St-Pierre, C., Tedder, A., Foody, G., Roberts, C., Speller, C., & Collins, M. (2019). Identifying Archaeological Bone via Non-Destructive ZooMS and the Materiality of Symbolic Expression: Examples from Iroquoian Bone Points. *Scientific Reports*, *9*(1), 11027. https://doi.org/10.1038/s41598-019-47299-x

Miller, S. M., Miller, S. D., & McCollum, D. W. (1998). Attitudes toward and relative value of alaskan brown and black bears to resident voters, resident hunters, and nonresident hunters. *Ursus*, *10*, 357–376. https://doi.org/10.2307/3873147

Milne, E. (2012). *Letters, postcards, email: Technologies of presence.* https://doi.org/10.4324/9780203862155

Motte, E., & McInnes, R. (2019). Using Artistic Imagery to Improve Understanding of Coastal Landscape Changes on the Rance Estuary (French Channel Coast). *Geoheritage*, *11*(3), 961–972. https://doi.org/10.1007/s12371-018-00341-2

Nanni, V., Caprio, E., Bombieri, G., Schiaparelli, S., Chiorri, C., Mammola, S., Pedrini, P., & Penteriani, V. (2020). Social Media and Large Carnivores: Sharing Biased News on Attacks on Humans. *Frontiers in Ecology and Evolution*, *8*, 71. https://doi.org/10.3389/fevo.2020.00071

Nardin, D. (1994). Storia dei cervi di Paneveggio. *Dendronatura: semestrale dell'Associazione forestale del Trentino*, *94*(1), 41–46.

Nelson, F. (2009). Developing payments for ecosystem services approaches to carnivore conservation. *Human Dimensions of Wildlife*, *14*(6), 381–392. https://doi.org/10.1080/10871200903045228

Norden, A., & Tansey, J. (2011). *Great bear markets : the interface of finance, forestry and conservation in BC's Great Bear Rainforest* (tech. rep.). University of British Columbia, Sauder School of Business. Vancouver, BC, Canada, https://doi.org/10.14288/1.0078386

Notarangelo, G., Paletto, A., Sacchelli, S., Casini, L., De Meo, I., & Cocciardi, D. (2013). *Biomasse legnose di origine forestale per impieghi energetici in Trentino* (tech. rep.). Consiglio per la Ricerca e la sperimentazione in Agricoltura, CREA Villazzano. https://www.legnotrentino.it/documenti/Pubblicazioni/2013/biomasfor.pdf

Notaro, S., & Grilli, G. (2021). Assessing tourists' preferences for conservation of large carnivores in the Italian Alps using a discrete choice experiment. *Journal of Environmental Planning and Management, 65*(7), 1–20. https://doi.org/10.1080/09640568.2021.1924124

O'Bryan, C. J., Braczkowski, A. R., Beyer, H. L., Carter, N. H., Watson, J. E., & McDonald-Madden, E. (2018). The contribution of predators and scavengers to human well-being. *Nature Ecology and Evolution, 2*(2), 229–236. https://doi.org/10.1038/s41559-017-0421-2

Ode, Å., Tveit, M., & Fry, G. (2008). Capturing landscape visual character using indicators: Touching base with landscape aesthetic theory. *Landscape Research, 33*(1), 89–117. https://doi.org/10.1080/01426390701773854

Ordiz, A., Bischof, R., & Swenson, J. E. (2013). Saving large carnivores, but losing the apex predator? *Biological Conservation, 168*, 128–133. https://doi.org/10.1016/j.biocon.2013.09.024

Orlandi, S., Probo, M., Sitzia, T., Trentanovi, G., Garbarino, M., Lombardi, G., & Lonati, M. (2016). Environmental and land use determinants of grassland patch diversity in the western and eastern Alps under agro-pastoral abandonment. *Biodiversity and Conservation, 25*(2), 275–293. https://doi.org/10.1007/s10531-016-1046-5

Osservatorio del Paesaggio. (2014). *Dieci azioni per il paesaggio rurale trentino.* (tech. rep.). Provincia Autonoma di Trento. https://www.paesaggiotrentino.it/documenti/Documentazione/Documenti%20dell%20Osservatorio/D0

Osservatorio del Paesaggio. (2015). *Rapporto sullo stato del paesaggio 04 - Percezioni, rappresentazioni e significati del paesaggio in Trentino.* (tech. rep.). Provincia Autonoma di Trento.

Pascual, U., Balvanera, P., Anderson, C. B., Chaplin-Kramer, R., Christie, M., González-Jiménez, D., Martin, A., Raymond, C. M., Termansen, M., Vatn, A., Athayde, S., Baptiste, B., Barton, D. N., Jacobs, S., Kelemen, E., Kumar, R., Lazos, E., Mwampamba, T. H., Nakangu, B., . . . Zent, E. (2023). Diverse values of nature for sustainability. *Nature, 620*(7975), 813–823. https://doi.org/10.1038/s41586-023-06406-9

Peña, L., Casado-Arzuaga, I., & Onaindia, M. (2015). Mapping recreation supply and demand using an ecological and a social evaluation approach. *Ecosystem Services, 13*, 108–118. https://doi.org/10.1016/j.ecoser.2014.12.008

Penteriani, V., Delgado, M. D. M., Pinchera, F., Naves, J., Fernández-Gil, A., Kojola, I., Härkönen, S., Norberg, H., Frank, J., Fedriani, J. M., Sahlén, V., Støen, O. G., Swenson, J. E., Wabakken, P., Pellegrini, M., Herrero, S., & López-Bao, J. V. (2016). Human behaviour can trigger large carnivore attacks in developed countries. *Scientific Reports, 6*. https://doi.org/10.1038/srep20552

Penteriani, V., López-Bao, J. V., Bettega, C., Dalerum, F., Delgado, M. d. M., Jerina, K., Kojola, I., Krofel, M., & Ordiz, A. (2017). Consequences of brown bear viewing tourism: A review. *Biological Conservation, 206*(January), 169–180. https://doi.org/10.1016/j.biocon.2016.12.035

Perea, R., Girardello, M., & San Miguel, A. (2014). Big game or big loss? High deer densities are threatening woody plant diversity and vegetation dynamics. *Biodiversity and Conservation, 23*(5), 1303–1318. https://doi.org/10.1007/s10531-014-0666-x

Plottu, E., & Plottu, B. (2007). The concept of Total Economic Value of environment: A reconsideration within a hierarchical rationality. *Ecological Economics, 61*(1), 52–61. https://doi.org/10.1016/j.ecolecon.2006.09.027

PNAB, G. .-. G. d. R. e. C. d. B. d. (2013). *Dalle strategie di svernamento ai rapporti con l'uomo: le ultime ricerche del Parco Naturale Adamello Brenta sull'orso. Documenti del Parco, Vol. 20 Strembo, Trento, Italy:* (tech. rep.). Volume 20 Parco Documenti.

PNALM. (2020). *Rapporto orso marsicano 2019* (tech. rep.). PNALM. Sulmona. www.parcoabruzzo.it

Preatoni, D., Mustoni, A., Martinoli, A., Carlini, E., Chiarenzi, B., Chiozzini, S., Van Dongen, S., Wauters, L. A., Tosi, G., Dongen, S. V., Wauters, L. A., & Tosi, G. (2005). Conservation of brown bear in the Alps: Space use and settlement behavior of reintroduced bears. *Acta Oecologica, 28*(3), 189–197. https://doi.org/10.1016/j.actao.2005.04.002

Provincia Autonoma di Trento. (2022). *Rapporto orso e Grandi carnivori della Provincia Autonoma di Trento* (tech. rep.). https://grandicarnivori.provincia.tn.it/Rapporto-Orso-e-grandi-carnivori

QGIS Development Team. (2015). QGIS Geographic Information System. http://qgis.osgeo.org

Quinn, T. P., Carlson, S. M., Gende, S. M., & Harry B. Rich, J. (2009). Transportation of Pacific salmon carcasses from streams to riparian forests by bears. *Canadian Journal of Zoology, 87*(3), 195–203. https://doi.org/10.1139/z09-004

Quinn, T. P., & Kinnison, M. T. (1999). Size-selective and sex-selective predation by brown bears on sockeye salmon. *Oecologia, 121*(2), 273–282. https://doi.org/10.1007/s004420050929

R Studio. (2015). RStudio: Integrated development environment for R. Http://www.rstudio.org/,

Renard, D., Rhemtulla, J. M., & Bennett, E. M. (2015). Historical dynamics in ecosystem service bundles. *Proceedings of the National Academy of Sciences, 112*(43), 13411–13416. https://doi.org/10.1073/pnas.1502565112

Rhemtulla, J. M., & Mladenoff, D. J. (2007). Why history matters in landscape ecology. *Landscape Ecology, 22*(SUPPL. 1), 1–3. https://doi.org/10.1007/s10980-007-9163-x

Riccioli, F., Marone, E., Boncinelli, F., Tattoni, C., Rocchini, D., & Fratini, R. (2018). The recreational value of forests under different management systems. *New Forests, 50*(2), 1–16. https://doi.org/10.1007/s11056-018-9663-3

Ripple, W. J., Estes, J. A., Beschta, R. L., Wilmers, C. C., Ritchie, E. G., Hebblewhite, M., Berger, J., Elmhagen, B., Letnic, M., Nelson, M. P., Schmitz, O. J., Smith, D. W., Wallach, A. D., & Wirsing, A. J. (2014). Status and Ecological Effects of the World's Largest Carnivores. *Science, 343*(6167), 1241484–1241484. https://doi.org/10.1126/science.1241484

Ripple, W. J., & Beschta, R. L. (2012). Large predators limit herbivore densities in northern forest ecosystems. *European Journal of Wildlife Research*, *58*(4), 733–742. https://doi.org/10.1007/s10344-012-0623-5

Ripple, W. J., Beschta, R. L., Fortin, J. K., & Robbins, C. T. (2014). Trophic cascades from wolves to grizzly bears in Yellowstone. *Journal of Animal Ecology*, *83*(1), 223–233. https://doi.org/10.1111/1365-2656.12123

RIVADENEIRA-CANEDO, C. (2008). Estudio del oso andino (Tremarctos ornatus) como dispersor legítimo de semillas y elementos de su dieta en la región de Apolobamba-Bolivia. *Ecología en Bolivia*, *43*(1), 29–40.

Rode, K. D., Fortin-Noreus, J. K., Garshelis, D., Dyck, M., Sahanatien, V., Atwood, T., Belikov, S., Laidre, K. L., Miller, S., Obbard, M. E., Vongraven, D., Ware, J., & Wilder, J. (2018). Survey-based assessment of the frequency and potential impacts of recreation on polar bears. *Biological Conservation*, *227*, 121–132. https://doi.org/10.1016/j.biocon.2018.09.008

Røpke, I. (2004). The early history of modern ecological economics. *Ecological Economics*, *50*(3-4), 293–314. https://doi.org/10.1016/j.ecolecon.2004.02.012

Sawyer, C. F., & Butler, D. R. (2006). The use of historical picture postcards as photographic sources for examining environmental change: Promises and problems. *Geocarto International*, *21*(3), 73–80. https://doi.org/10.1080/10106040608542395

Schirpke, U., Meisch, C., & Tappeiner, U. (2018). Symbolic species as a cultural ecosystem service in the European Alps: insights and open issues. *Landscape Ecology*, *33*(5), 711–730. https://doi.org/10.1007/s10980-018-0628-x

Schirpke, U., Scolozzi, R., De Marco, C., & Tappeiner, U. (2014). Mapping beneficiaries of ecosystem services flows from Natura 2000 sites. *Ecosystem Services*, *9*(September), 170–179. https://doi.org/10.1016/j.ecoser.2014.06.003

Schirpke, U., Timmermann, F., Tappeiner, U., & Tasser, E. (2016). Cultural ecosystem services of mountain regions: Modelling the aesthetic value. *Ecological Indicators*, *69*, 78–90. https://doi.org/10.1016/j.ecolind.2016.04.001

Schleyer, C., Kister, J., Klingler, M., Stegmaier, P., & Aukes, E. (2019). *InnoForESt Smart information, governance and business innovations for sustainable supply and payment mechanisms for forest ecosystem services. Report on stakeholders' interests, visions, and concerns.* (tech. rep.). https://innoforest.eu/wp-content/uploads/innoforest-deliverable-5_2.pdf

Scott, C. (2006). Spirit and practical knowledge in the person of the bear among Wemindji Cree hunters. *Ethnos*, *71*(1), 51–66. https://doi.org/10.1080/00141840600603178

Sèbe, M., Briton, F., & Kinds, A. (2022). Do predation by wolves reduce collisions between ungulates and vehicles in France? *Human Dimensions of Wildlife*, *00*(00), 1–13. https://doi.org/10.1080/10871209.2022.2036391

Senchik, A., Toushkin, A., Igota, H., & Toushkina, A. (2020). Production of ecological wild meat products in the hunting organizations of the Hokkaido island (Japan) and the Amur region (Russia) (A. Muratov & S. Ignatieva, Eds.). *E3S Web of Conferences*, *203*, 4005. https://doi.org/10.1051/e3sconf/202020304005

Shakeri, Y. N., White, K. S., & Levi, T. (2018). Salmon-supported bears, seed dispersal, and extensive resource subsidies to granivores. *Ecosphere*, *9*(6). https://doi.org/10.1002/ecs2.2297

Sitzia, T., Campagnaro, T., Dainese, M., Dallabrida, F., Mattedi, S. M., & Portaccio, A. (2019). Altitudinal shift of tetrao urogallus in an alpine natura 2000 site:

Implications for habitat restoration. *Applied Sciences (Switzerland)*, *9*(6). https://doi.org/10.3390/app9061164

Sitzia, T., Semenzato, P., & Trentanovi, G. (2010, March). Natural reforestation is changing spatial patterns of rural mountain and hill landscapes: A global overview. https://doi.org/10.1016/j.foreco.2010.01.048

Skibins, J. C., & Sharp, R. L. (2019). Binge watching bears: efficacy of real vs. virtual flagship exposure. *Journal of Ecotourism*, *18*(2), 152–164. https://doi.org/10.1080/14724049.2018.1553977

Skibins, J. C., Das, B. M., & Schuler, G. (2023). Digital modalities, nature, and quality of life: mental health and conservation benefits of watching bear cams. *Human Dimensions of Wildlife*, *28*(3), 218–232. https://doi.org/10.1080/10871209.2021.2024629

Skibins, J. C., & Sharp, R. L. (2017). Evaluation of the Brown Bear Viewing Experience at Katmai National Park and Preserve: Implications for Management. *Human Dimensions of Wildlife*, *22*(5), 476–482. https://doi.org/10.1080/10871209.2017.1336584

Slagle, K., Zajac, R., Bruskotter, J., Wilson, R., & Prange, S. (2013). Building tolerance for bears: A communications experiment. *Journal of Wildlife Management*, *77*(4), 863–869. https://doi.org/10.1002/jwmg.515

Soulé, . (1985). What Is Conservation Biology? *BioScience*, *35*(11), 727–734. https://doi.org/10.2307/1310054

Stephens, J. (2020). ExpertChoice: Design of Discrete Choice and Conjoint AnalysisNo Title. https://cran.r-project.org/package=ExpertChoice

Stoddart, M. C. J. (2011). Grizzlies and gondolas: Animals and the meaning of skiing landscapes in British Columbia, Canada. *Nature and Culture*, *6*(1), 41–63. https://doi.org/10.3167/nc.2011.060103

Street, D. J., Burgess, L., & Louviere, J. J. (2005). Quick and easy choice sets: Constructing optimal and nearly optimal stated choice experiments. *International Journal of Research in Marketing*, *22*(4), 459–470. https://doi.org/10.1016/j.ijresmar.2005.09.003

Stylianou-Lambert, T. (2012). Tourists with cameras:. Reproducing or Producing? *Annals of Tourism Research*, *39*(4), 1817–1838. https://doi.org/10.1016/j.annals.2012.05.004

Takeda, J. (1972). *An ecological study of bear-hunting activities of the Ma tagi, Japanese traditional hunters* (tech. rep.).

Tattoni, C., Chianucci, F., Grotti, M., Zorer, R., Cutini, A., & Rocchini, D. (2019). Long-term comparison of in situ and remotely-sensed leaf area index in temperate and mediterranean broadleaved forests. *Trends in Earth Observation*, *1*(1), 81–84. https://doi.org/DOI:10.978.88944687/17

Tattoni, C. (2019). Nomen omen . Toponyms predict recolonization and extinction patterns for large carnivores. *Nature Conservation*, *37*, 1–16. https://doi.org/10.3897/natureconservation.37.38279

Tattoni, C., Ciolli, M., Ferretti, F., & Cantiani, M. G. (2010). Monitoring spatial and temporal pattern of Paneveggio forest (Northern Italy) from 1859 to 2006. *IForest*, *3*(MAY), 72–80. https://doi.org/10.3832/ifor0530-003

Tattoni, C., Galaverni, M., Pollutri, A., Preatoni, D. G., Martinoli, A., & Araña, J. E. (2024). Not only seeds: a cultural ecosystem service provided by the Apennine brown bear. *Human Dimensions of Wildlife*, *29*(1), 14–29. https://doi.org/10.1080/10871209.2023.2176950

Tattoni, C., Grilli, G., & Ciolli, M. (2017). Advertising value of the brown bear in the Italian Alps. *Ursus, 27*(2), 110–121. https://doi.org/10.2192/URSU-D-16-00011.1

Tattoni, C., Ianni, E., Geneletti, D., Zatelli, P., & Ciolli, M. (2017). Landscape changes, traditional ecological knowledge and future scenarios in the Alps: A holistic ecological approach. *Science of the Total Environment, 579*, 27–36. https://doi.org/10.1016/j.scitotenv.2016.11.075

Tedeschi, L., Biancolini, D., Capinha, C., Rondinini, C., & Essl, F. (2021). Introduction, spread, and impacts of invasive alien mammal species in Europe. *Mammal Review.* https://doi.org/10.1111/MAM.12277

Throsby, D., Zednik, A., & Araña, J. E. (2021). Public preferences for heritage conservation strategies: a choice modelling approach. *Journal of Cultural Economics, 45*(3), 333–358. https://doi.org/10.1007/s10824-021-09406-7

Vilá, B., Díaz-de-León, A., Diaw, C., Avdibegovic, M., Marton-Lefevre, J., & Allahverdiyev, R. (2022). Methodological Assessment Report on the Diverse Values and Valuation of Nature of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. *IPBES.* https://doi.org/10.5281/zenodo.6522522

Watson, T. (2013). Advertising value equivalence-PR's orphan metric. *Public Relations Review, 39*(2), 139–146. https://doi.org/10.1016/j.pubrev.2012.11.001

Welsh, M. P., & Bishop, R. C. (1993). Multiple bounded discrete choice contingent valuation: parametric and nonparametric welfare estimation and a comparison to the payment card. *Journal of Environmental Economics and Management, 2*(25), 149–162.

Westman, W. E. (1977). How much are nature's services worth? *Science, 197*(4307), 960–964. https://doi.org/10.1126/science.197.4307.960

Willson, M. F., & Gende, S. M. (2004). Seed Dispersal by Brown Bears, Ursus arctos, in Southeastern Alaska. *The Canadian Field-Naturalist, 118*(4), 499. https://doi.org/10.22621/cfn.v118i4.53

Winiwarter, V. (2016). Nationalized Nature on Picture Postcards: Subtexts of Tourism from an Environmental Perspective. *Global Environment, 1*(1), 192–215. https://doi.org/10.3197/ge.2008.010108

Wolynski, A. (2009). Selvicoltura Naturalistica e Sistemica. Quali analogie e quali differenze. *Sherwood, 149*, 14–16. c:%5CElectronic%20publications%5CSherwood%5CWolynski%202009%20-%20Selvicoltura%20naturalistica%20e%20sistemica.pdf

Yüksel, A., & Akgül, O. (2007). Postcards as affective image makers: An idle agent in destination marketings. *Tourism Management, 28*(3), 714–725. https://doi.org/10.1016/j.tourman.2006.04.026

Zanella, A., Tattoni, C., & Ciolli, M. (2010). Studio della variazione temporale della quantità e qualità del bestiame nel Parco di Paneveggio Pal di S. Martino e influenza sui cambiamenti del paesaggio forestale. *Dendronatura: semestrale dell'Associazione forestale del Trentino, 1*, 24–33.

Zuur, A. F., Ieno, E. N., & Elphick, C. S. (2010). A protocol for data exploration to avoid common statistical problems. *Methods in Ecology and Evolution, 1*(1), 3–14. https://doi.org/10.1111/j.2041-210X.2009.00001.x

Zyśk-Gorczyńska, E., Jakubiec, Z., Wertz, B., & Wuczyński, A. (2016). Long-term study of damage to trees by brown bears Ursus arctos in Poland: Increasing trends with insignificant effects on forest management. *Forest Ecology and Management, 366*, 53–64. https://doi.org/10.1016/j.foreco.2016.02.007