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Using social media to assess cultural ecosystem services generated in protected areas in Patagonia

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Abstract

There is currently a willingness to explore the operationalization of cultural ecosystem services (CES) in order to inform the management and decisions about natural resources. This research aims to provide further insight into the assessment of the cultural benefits generated by ecosystems, i.e. the kind of uses and enjoyment they provide and their relative importance, by using social media data, specifically photo-series analysis. The appraisal of CES values refers to social preferences and perception towards protected areas in the Andean Patagonia mainland. This research uses a specially designed typology for classifying pictures, Openness Classify App and looks into the existent literature on frameworks for valuating intangible appreciation of ecosystems. The results revealed that people are more likely to feel attracted to visit these protected areas due to the aesthetic qualities of the landscapes, and they also appreciate individual species. The results showed also a variety of recreational activities conducted in these areas. In some cases, these activities require infrastructure, but in others, visitors use particular features of the landscape such as water bodies and cliffs. The national park with the most spectacular natural attraction is the one with largest number of pictures uploaded, but there seems to be less variability among the motives of these photos, and in the kind of activities conducted in the area, which to a large extend are related to tourism infrastructure. This framework can serve as a model for future research and it offers the possibility to visualize people's preferences and perception in protected landscapes, especially in large and remote areas.

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"There are three rules for writing the novel. Unfortunately, no one knows what they are."

-W. Somerset Maugham

Table of contents

List of figures

List of tables

Acronyms/Abbreviations

ES-Ecosystem Services

CES-Cultural Ecosystem Services

TEEB- The Economics of Ecosystem and Biodiversity

MEA-Millennium Ecosystem Assessment

CICES-Common International Classification of Ecosystem Services

IPBES-The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services

EEA-European Environment Agency

HWB-Human Well Being

OpenNESS- Operationalization of Natural Capital and Ecosystem Services project.

EU-European Union

Introduction

'*The discipline of the writer is to learn to be still and listen to what his subject has to tell him.'*

Rachel Louise Carson

Ecosystem services represent a fundamental and unquestionable value to humanity. According to Daily et al. (1999) human society would cease to exist in the absence of ecosystem services ". Humans enjoy many benefits from nature, including all their food, clean water, fuel, and fiber, pleasure of being outdoor and spiritual benefits of nature. All these contribute to human well-being.

However, and despite most of these benefits being vital, they are, to a large extent, taken for granted. In response to this behavior, several international initiatives have aimed at an appraisal of the qualities of ecosystems (Hernández-Morcillo et al., 2013). These include bodies such as The Intergovernmental Science Policy Platform on Biodiversity and Ecosystem Services (IPBES) and other initiatives such as: The Economics of Ecosystem and Biodiversity (TEEB), the Millennium Ecosystem Assessment (MEA 2005), and UK National Ecosystem Assessment (UK NEA). Their aim is to "make nature's values visible" to disclose the multiple benefits of nature and to provide recommendations for decision-making (Kelemen et al., 2014).

Ecosystem Services framework

The concept of Ecosystem Services (ES) has a very interpretable form and it has been used to transmit and coordinate thinking between disciplines and uses conceptual frameworks and methodological approaches from multiple disciplines including physical and human geography.

It was perceived as the benefits from nature by Costanza et al. (2007) and seen as contribution to our well-being by (Potschin and Haines-Young, 2011). In essence, the biotic and abiotic structures and functions of ecosystems, which sustain living processes as e.g. different plant and animal species (biotic components) or abiotic component as water, air, and soil, are used and appreciated by humans (Mace et al., 2012).

The concept of ecosystem services (ES) emerged in the mid-1960s and the early 1970s (de Groot et al., 2002) and aimed to integrate ecological, socio-cultural and economic approaches into management and policy development (Gómez-Baggethun et al., 2010, Chan et al., 2012). Since its early conceptualization (Daily et al., 1999), the term ecosystem services has evolved. One of the most used definition of ecosystem services is provided by MEA (2005) which describes it as the benefits people obtain from ecosystems. This definition derives from two other definitions given by Costanza et al. (1997) and Daily (1997).

"Ecosystem services are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life. They maintain biodiversity and the production of ecosystem goods, such as seafood, forage timber, biomass fuels, natural fiber, and many pharmaceuticals, industrial products, and their precursors" (Daily, 1997).

"Ecosystem goods (such as food) and services (such as waste assimilation) represent the benefits human population derive, directly or indirectly, from ecosystem functions" (Costanza et al., 1997).

Ecosystem service is often divided into four typologies proposed by MEA: *provisioning (*supplies of food, drinking water, fiber and timber), services that contribute to the *regulation* of the environment (such as climate regulation, carbon sequestration), *cultural*, *spiritual* needs,(such as benefits which are associated with cultural identity, heritage, sense of place) and *supporting* services (including functions such as photosynthesis, pollination) which underpin the services mentioned before (Haines-Young and Potschin, 2010, MEA, 2003, MEA, 2005). To be able to understand the logics that underlies the ecosystem services framework, Haines-Young and Potschin (2010) have developed what they term the 'cascade model'.

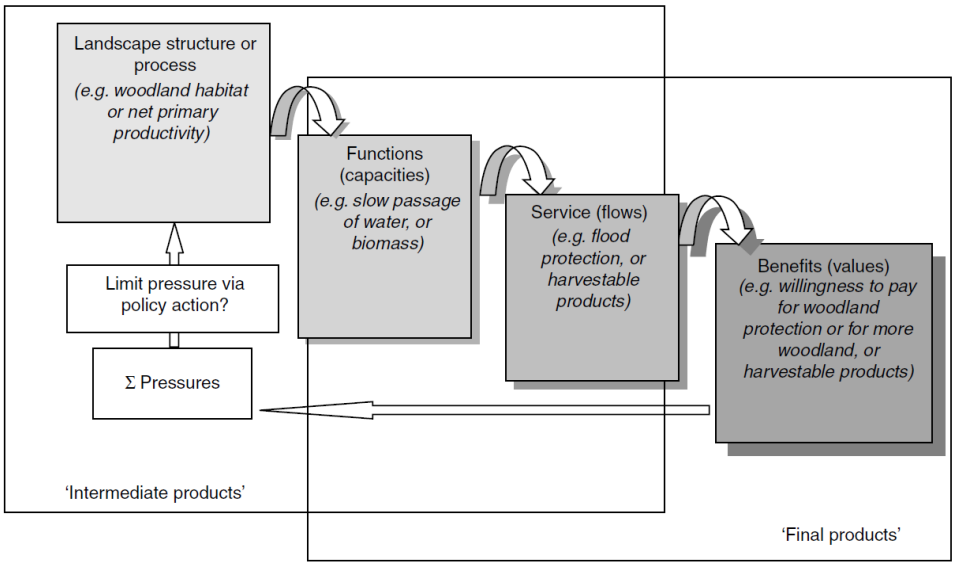

Fig. 1 *Cascade Model-The relationship between biodiversity, ecosystem functions and human well-being (Haines-Young and Potschin, 2010).*

Each step or component of the cascade can enable a systematic analysis of ecosystem services. The first box of the model refers to the actual environment under the label of 'Landscape structure or process'. This box leads to the second one, which is determined by the functions of an ecosystem, and more precisely in this context, defined as functions that are *useful for people*. Ecosystem services lie between ecosystem structures and functions, and the benefits perceived by humans, i.e. it is understood as the ecosystem components that are enjoyed or used by humans. The last component in the cascade is the benefits derived from this flow (Haines-Young and Potschin, 2010, Potschin and Haines-Young, 2011) .

The model sustains the idea of a cascade that links the different components involved in the generation of ecosystem services using a "production chain" as an analogy. This production chain serves as a linkage between biophysical and ecological structures and processes, i.e. the natural capital contributing to our well-being (Haines-Young and Potschin, 2010, Potschin and Haines-Young, 2011).

In addition, the natural capital is considered a stock of natural assets such as soil, air, water and living things. From this stock humans derive different services which are called ecosystem services.

Based on Fig. 1 model, some questions related to this relationship, can be put forward, for instance, whether there are any limits in the supply of ecosystem services, if the natural capital can be restored if it has been damaged, or if and how the benefits provided by ecosystems can be valued (Kumar and Kumar, 2008, Haines-Young and Potschin, 2010). As the framework describes, there is a need to ensure functional ecosystems in order to ensure the provision of benefits. In this context, while aiming at a sustainable use of ecosystem and biodiversity it is important to invest in their protection and determine levels of use that can ensure a continuous flow of services (Turkelboom et al., 2013).

Motivation of study

This research is designed in collaboration with OpenNESS "Operationalization of Natural Capital and Ecosystem Services", a European Union-funded project. The OpenNESS project aims to provide a framework to integrate ecosystem services and natural capital into management and decision-making. Within this framework, ecosystem services are approached by looking at the ways in which they can support and sustain social and environmental initiatives and the project examines potential limitations which may appear along the way.

At the foundation of my research, together with OpenNESS's purpose stands the willingness to explore further the operationalization of Cultural Ecosystem Services (CES). Another factor that sustains this study is the need of providing and developing methodologies to contribute to the management of ecosystems in favor of human well-being. This research aims to provide further insights into the assessment and management of ES sub category, (CES), by specifically trigger developing methodologies that can facilitate the analysis of trade-offs among benefits provided by ecosystems.

Cultural Ecosystem Services

Cultural ecosystem services is a category of ecosystem services that needs more attention towards its assessment to be integrated in decision-making. Until recently, these services had received less scientific attention due to their intangibility (de Groot et al., 2002, Chan et al., 2011).

Cultural Ecosystem Services are defined as the "physical, emotional and mental benefits of humans obtained from the ecosystem" (Kumar and Kumar, 2008). The MEA (2005) describes

cultural services as "the non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflections and aesthetic experiences". In addition according to the MEA and TEEB, cultural ecosystems include: cultural diversity, inspiration, aesthetic values, social relations, sense of place, cultural heritage values, recreation and ecotourism, knowledge system and educational values and last but not least, spiritual and religious values (Potschin and Haines-Young, 2011). Another framework CICES provided by the UK National Ecosystem Assessment (UK NEA) comes later on and shows how other classifications of these values nest into each other (Müller and Burkhard, 2012). Moreover, in this study I refer to the CICES framework. This framework has provided a classification of cultural ecosystem services values that includes: existence value such as spiritual and religious, aesthetic, recreation, intellectual values represented through e.g. ecotourism, cultural heritage and which can evoke benefits for people. These values are driven by interactions such as knowing, perceiving, interacting with and living within nature. The components are affected by physical, mental and spiritual health, as well as inspiration and identity. However, we depend on the integrity of all these elements into the management of ecosystems to be able to fulfill our and the ecosystem's everyday needs.

Furthermore, due to CES's abstract form, in earlier stages, only two of its categories raised attention among researchers, i.e. recreation and culture. Later on, the literature provides information of cultural ecosystem services used in various contexts and filling different functions such as providing life-fulfillment, information, cultural, amenity or socio-cultural fulfillment (Daily et al., 1999, de Groot et al., 2002, Kumar et al., 2010). This cultural category of ecosystem services is considered to have non-consumptive, direct use value. It represents classes of direct benefits of ecosystem services on a direct interaction with the substance e.g. recreational uses as hiking, camping, and enjoying scenic views. Thus, cultural ecosystem services, contribute to the human welfare in a direct or indirect way by providing opportunities of a non-commercial use characterized by aesthetic, artistic, educational, and scientific values (Costanza et al., 1997).

This type of services are represented by different characteristics which highlight the observer's preferences and are influenced by the ecosystems' cultural diversity. This characteristics relate directly to the observer and indirectly to the ecosystem (Kumar et al., 2010, Martín-López et al.,

2012). They come from the social perception of the observer-ecosystem relationship, true experiences and are shaped by belief systems. These experiences can trigger feelings of joy and satisfaction while e.g. recreating or hiking. These emotions will contribute to his/her well-being. One of the factors that drives these emotions is the existence of biological diversity including species that contribute to the ecosystem functions. These species contribute to the way we value an ecosystem and to the reasons that make it valuable to us. Thus, biological diversity is very important as it provides aesthetic, cultural, ecological, scientific, and utilitarian benefits. This concern raises much attention in the nowadays literature (Balvanera et al., 2016, Mace et al., 2012, Muradian et al., 2016). In addition, as mentioned in Hernández-Morcillo et al. (2013), as long as an ecosystem is diversified, it can flourish cultural diversity.

However, it is important to conceptualize the relationship that stands at the root of these cultural diversity outcomes. These outcomes are driven by a set of 'relational values' (see

Fig. **2**)

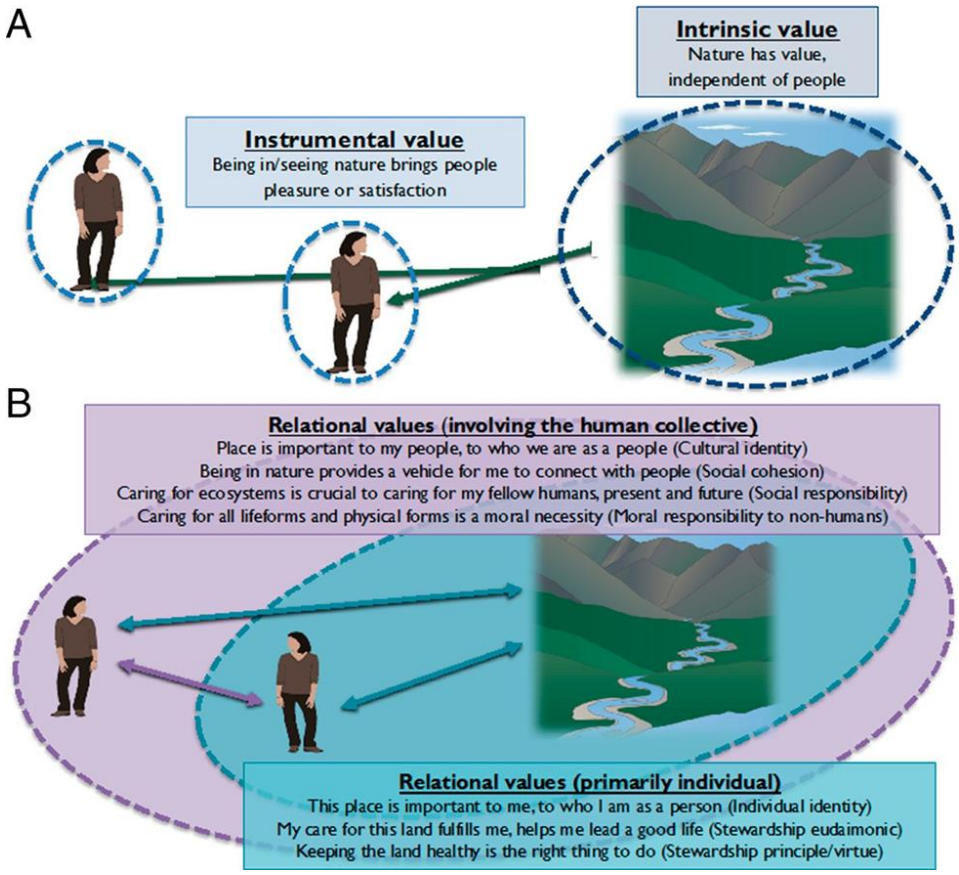

Fig. 2 *Recreational values (Ming and Chan, 2015).*

Fig. **2** shows the two types of values whereas intrinsic values (A) relate only to the value inherent in an object, and instrumental values (A) relate to the value of the object for a person (being in nature, seeing nature). The relational values (B) include all manner of relationships between people and nature, including relationships that are between people, but involve nature which can be deduced from the human-nature relationship. Having this in mind, the relational values framework sustains the human-nature relationship (Chan et al., 2011).

In this research I refer to and use three concepts that contribute to the human-nature relationship and which have a major importance in assessing cultural aspects of ecosystems: value, social preferences/ perception and human well-being. These concepts are bound together by a flow of relational values. Important in this respect, a question arises: What is actually valued in an ecosystem?

Values-Valuation

The appreciation of a landscape view, the acknowledgement of things or the satisfaction that people derive from things can trigger the valuation of such a view. This happens either by admiring a landscape view or just by knowing about its existence. It can also happen when people interact with this landscape through different recreational activities, e.g. Hiking, leisure fishing, and bird watching (Gee and Burkhard, 2010). We give value to things that seem to have a special meaning and importance, and/or supply pleasure for us, as mentioned in several studies (Costanza, 2000, Gómez-Baggethun et al., 2010).

The word ‘value’ comes from the Latin ‘valor’-meaning ‘being strong, having some kind of importance ‘as Dendoncker et al. (2013) describe it. The Oxford dictionary defines ‘value’ as “hold to deserve, the worth, usefulness of something one’s judgment of what is important in life”.

As Costanza et al. (1997) defines ‘value’ as an “estimation of worth, meaning, importance “and mentions the idea that the goals to which people aspire are driven by the values which they attribute to things**.** Moreover, Russell et al. (2013) build upon the idea of human-ecosystem relationship by emphasizing that nature contributes and helps in the decision-making concerning the management of ecosystem by creating benefits for humans as well as for ecosystems.

Furthermore, a model which provides an over view on ecosystems valuation is Maslow's Hierarchy of needs (Fig. 3). This shows interlink ages between ecosystems services categories (cultural, regulating, and provisioning) and human needs (economic, cultural, and ecological).

In this model, Maslow refers to physiological needs, safety and protection, affection and sense of belonging, esteem and identity to connect human needs with ecosystem services categories.

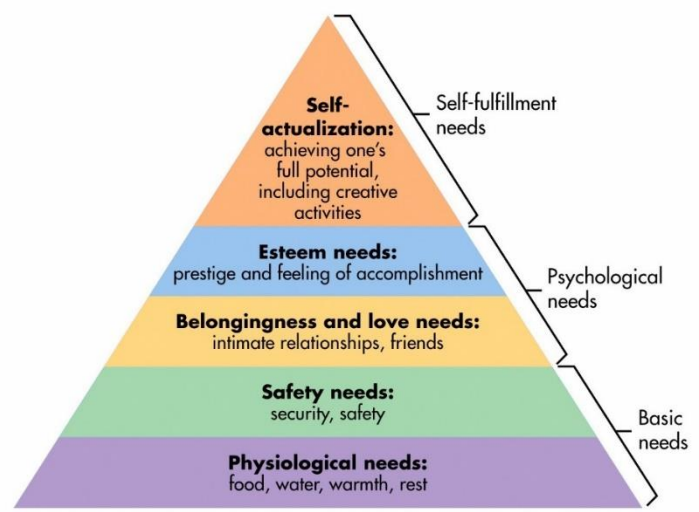

Fig. 3 *Maslow's Hierarchy of needs (Griffin, 1991)*

Non-monetary valuation

Furthermore, to be able to understand the importance of something that can benefit human's needs, a valuation process must be run. Valuation is as Dendoncker et al. (2013) define it, 'an act of assessing, appraising or measuring values', it refers to the understanding of the worth or importance of something. Furthermore, Costanza et al. (2007) refer to the concept of "quality of life" (QQL) as contributing in the valuation process; which combines "measures of human needs with subjective well-being and happiness".

Building on this foundation, there are discussions in the literature about how to incorporate social and cultural benefits into research and practice (Chan et al., 2011, Daniel et al., 2012). These benefits are traditionally included in the non-material, non-tangible category of cultural ecosystem values. These values are difficult to quantify and are represented trough benefits as sense of

heritage, sense of belonging, identity derived from specific places. Another category of benefits include the material, tangible benefits as food, water, fiber, timber. These values are expressed in either monetary or non-monetary terms (Turkelboom et al., 2013).

For a complex valuation of ecosystems it is important to be aware of the fact that no matter what type of methodologies are used (monetary, non-monetary) the individual's relationship plays an important role in the management of the landscape and environment (Chape et al., 2005). This can be deduced through the definition of landscape and the environment itself. A definition given by the Council of Europe (2000:3), describes landscape as "an area perceived by people, whose character is the result of the action and interaction of natural and human factors" (Kumar and Kumar, 2008, López-Santiago et al., 2014). As Gee and Burkhard (2010) indicate, it is of a major importance to include and relate the personal and social driving forces of humans into the assessment of cultural services. Factors related to the observer such as background, belief system, behavior and life-style are directly connected to the observer and indirectly connected to the ecosystem (Kumar and Kumar, 2008, Martín-López et al., 2012). This fact has an important impact on the ecosystem and on the way it is shaped and perceived.

Social preference and perception towards landscape

Moreover, considering the social preferences play an important role in the valuation process of ecosystems. In addition it was mentioned by Kumar and Kumar (2008) that as humans evolve so do their preferences. They are strongly influenced by socio-cultural practices of individuals.

However, there is little empirical evidence for these arguments; only a few studies have looked into the relationship between ecosystem services and the socio-cultural preferences using a non-economic approach. Those studies focus mostly on the preferences of stakeholders such as environmental experts, tourists, and in some cases local people such as farmers (Martín-López et al., 2007b, Lamarque et al., 2011, Martín-López et al., 2012). Referring to the social preferences, they can contribute to identify what are the most meaningful elements of landscape, the biophysical structures that they prefer, what are the factors that mark their needs and, ultimately, contribute to their well-being. In these process together with social preferences it is important to consider their perception toward landscape. The perception of people towards landscape was addressed in

theories referring to landscape management. Both preferences and perception of landscape are main issues to refer to in the assessment of CES services.

Well-being

Another concept that stands at the root of this research refers to the way in which "human well-being" (HWB) manifests itself, i.e. the way in which it is perceived, and how it is used in the management of ecosystems.

The concept of "well-being "is as an "ambiguous and multifaceted concept" as Gasper (2010) describes it. A more specific definition is given by Alexandrova (2009), describing human well-being as "a state that is intrinsically and not just instrumentally valuable or good, for a person".

Moreover, the literature refers to well-being as a link between society and nature. The concept is divided into three categories such as hedonism (well-being as pleasure), desire theories (well-being as preference, desire for fulfillment) and the elements that make a life well lived (Gasper, 2010, Ufz and Ufz, 2015, Aknin et al., 2009, Butler and Oluoch-kosura, 2006, Daw, 2015, Iniesta-Arandia et al., 2014, Martín-López et al., 2014).

Furthermore, HWB dimensions should incorporate the 'objective 'aspect of the concept (basic material needs) as well as the 'subjective' aspect (emotions, satisfactions, and fulfillment). Both aspects are needed in the satisfaction of human needs (Ufz and Ufz, 2015). HWB plays an important role in what humans need from nature and what can be done to fulfill these needs (Butler and Oluoch-kosura, 2006). In addition the literature mentions five components of well-being such as: material for a good life, security, health, good social relations and freedom of choice (MEA, 2003). For example if we take in consideration the biodiversity of an ecosystem, plants and animals can contribute to aesthetic enjoyment, spiritual and mental health. HWB includes positive emotions such as happiness, contentment. Furthermore, it contributes to our satisfaction, fulfilment in life.

Cascade Model

For mapping out these concepts (value, social preferences, and human well-being) I referred to the ecosystem service Cascade Model (Fig. 1). Each of these concepts are important in the assessment

of cultural services. According to the cascade model everything starts by taking into consideration the ecosystem structures and processes. Furthermore, to be able to understand how these ecosystems benefit people I identified those characteristics and properties of the ecosystems which can be useful to people. The existent cascade "flows" between the components of this framework set a light on the functions of ecosystems. These are said to be important as they underpin those characteristics that determine the usefulness of the ecosystem for people. In addition, ecosystems provide functions such as different natural resources (vegetation, animals), sustainable living place for animals, and supports the life of the habitat. The elements in the cascade are represented by the final output of the ecosystem (e.g. possibility of recreation in a national park). Moreover, following the cascade model the benefits obtained from the ecosystems are the ones that have value. Some of the benefits that come with the activity of recreation are enjoying scenic beauty, sense of wilderness, knowledge gained through the perception of nature.

Need of new methodology

Some challenges arise in assessing the cultural values of ecosystem services which relate to the ways in which this type of services are valued and interpreted.

However, as stated in Martín-López et al. (2012), there is a need for new methodological approaches to quantify the social importance of cultural ecosystem services, which can help, among other aspects, to analyze spatial patterns of cultural ecosystem services distribution.

Part of these needs refer to the cultural benefits towards the ecosystem. This relationship needs a good management technique to be able to work. As an example of how important it is to manage the environment - let's consider Easter Island. This island was once very rich in palm trees which were one of the resources that sustained life on the island. They offered the possibility of building homes, making sea-worthy canoes, and sailing out on the sea. The overharvesting of these trees led to their disappearance, which in its turn affected the decrease of different animal's species. This fact slowly affected the disappearance of all the elements that sustained life on the island, which led to the disappearance of an ancient society. This example shows how important it is to manage the environment, as it sustains our own existence.

Conservation

The management of biodiversity and the conservation practices underlie the idea that a landscape or ecosystem has some particular characteristics given by social preferences. Long-term protection of the environment is considered as one of the most valuable things humans can do (Cimon-Morin et al., 2014). A way of using cultural services in management is shown through the concept of 'conservation'. At first, the concept of 'conservation' referred to the conservation of biodiversity. Furthermore, Chape et al. (2005) state that conservation and the act of protecting nature are "the most important strategies available to society" concerning the management of nature. Protected areas are a visible form of the things that humans value and consider important. They play an important role in conserving ecosystems with limited intervention from humans (Durán et al., 2013). Since cultural ecosystem services are the fundamental reasons why ecosystems should be protected (Chan et al., 2011), by promoting conservation, we contribute to our well-being.

Limitations of CES

The concept of ecosystem services in itself looks into how to weigh threatened social and ecological aspects of ecosystems trough different management techniques (Daniel et al., 2012, Sukhdev et al., 2010, Carpenter et al., Chan et al., 2012). The arising problem in research comes with the lack of assessing cultural values of ecosystems which can lead to deficit for ecosystem which will further lead to bad management. More precisely, how the overuse of a protected area a scenic beauty and consequently leads to people's losing interest in that particular place.

Purpose of study

The purpose of this study is to assess cultural ecosystem services generated by nature in protected areas in the Andean Patagonia by using a non-monetary valuation approach to assess the appreciation of cultural services, based on data provided from photographs.

This is done by using photo series analysis to assess social preferences in order to identify what are the important and valuable elements in the landscape. This study uses Flickr, a global internet, online platform containing geo-tagged digital photos to identify cultural ecosystem service

features, in six protected areas in the Andean Patagonia, consisting of the following national parks: Lanín, Nahuel Huapi, Lago Puelo, Los Alerces, Perito Moreno and Los Glaciares. The study assesses cultural ecosystem services with a focus on the level of appreciation within ecosystems. It contributes to the understanding of how people relate to their protected environment and provides an insight into a new non-monetary approach to quantify abstract values of CES.

The objectives of this research are the following:

1. To identify the natural features and their qualities that are appreciated by visitors in the national park

2. To identify the relationship and specific characteristics of this CES values within the six parks.

3. To gain an understanding of how visitors perceive the protected landscape. Determine specific patterns that make this perception visible.

4. To contribute to the improvement of the photo analysis methodology in assessing CES.

Furthermore the following chapter aims to provide a foundation for the study. I refer to existing literature concerning ecosystem services, cultural ecosystem services and I use existing frameworks to describe and understand concepts used in this research.

Literature Review

To be able to assess Cultural Ecosystem Services, we first need to understand how people value different dimensions of nature. A second step is to understand how knowledge about these values can help to protect ecosystems and maintain levels of sustainable use, so that these values and benefits can be secured for the future.

For this research to form new cross-disciplinary connections, it is important to identify concepts, theories and methods used in previous studies, and to identify possible debates about concepts and approaches, as well as the key contributors to the topic.

For the current thesis, the literature review was conducted by searching in scientific journals with good coverage of the field such as Ecological Indicators, Applied Geography, Ecosystem Ecology, Ecological Complexity, Environmental Science and Policy , Ecosystem Services and Landscape Ecology) and other published sources dealing with ecosystem services in general and cultural ecosystem services, in particular. In the search, I used key words such as: 'ecosystem services', 'cultural ecosystem services', 'valuation of cultural services', 'social perception and preferences' and 'human well-being' to retrieve the needed information for conducting this research. In addition, the following sources were accessed to tackle relevant papers: Google scholar, Research Gate, Springer Link Journals, Pilos One Journals, Science Direct, and Bioscience Oxford Journals.

Furthermore, documents produced by global initiatives such as MEA, TEEB, IPBES and UK NEA were examined to help provide with the context and framework of the study.

The literature review addresses three areas of research that contributed to frame the current study. The first section relates to studies that discuss broadly issues related to the valuation and integration of cultural ecosystem services in research. The focus is on papers that describe the theory that lays at the basis of cultural services assessments. The aim of this section is to establish the research territory and its significance for being addressed the research.

The second section discusses studies with commonalities with the current research and it offers a perspective into the existent research niche. This section refers to studies that have assessed cultural ecosystem services (CES) with the aim to contribute in decision making by using non-

monetary valuation techniques. The aim of this section is to help identify gaps in research which triggered the design of the current thesis.

The last section focuses on research methods directly related to the current study. It discusses the use of photo-series methodology to identify CES values, as well as it identifies weaknesses and limitations that need to be addressed. This sections looks into papers that study people's preferences, perceptions about the landscape, and that study how these preferences and perceptions affect the assessment of CES.

The broad issue of Cultural Ecosystem Services concept

There are gaps in the conceptualization of cultural ecosystem services that can enable a consistent framework of analysis that can contribute to include these benefits in decision-making. At the foot of this concept lies human-nature relationships. These relationships have been studied and addressed through various methods and theories (Daniel et al., 2012, Russell et al., 2013, Gould et al., 2013).

Man-nature relationship

Russell et al. (2013) look into the intangible connection that lays at the foundation of man and nature relationship. They refer to several channels through which this happens such as *knowing*, *perceiving*, *interacting* and *living within* nature. Moreover, the paper relates these aspects to different components of human well-being. As one of the aims of this thesis is to provide a framework to contribute to the assessment of cultural service for our well-being, Russell et al. (2013) help to emphasize this fact. The paper mentions that: "*characterizing our intangible connections with nature will help shape decisions that benefit people and ecosystems on which we depend on*". This being said, it emphasizes one of the most important reasons which triggered current research concerning the assessment of CES such its contribution to well-being. Russell et al. (2013) survey some relevant literature to be able to provide an understanding of the non-material connections between nature and human well-being. This aspect provides even more relevance of this study to the focus on CES in the current thesis.

Something that triggered my attention was that I could make a link between the channels of connection between man and nature presented by Russell et al. (2013) and the indicators used in

my study, since the thesis aims to reveal aspects of how people relate and interact with the landscapes and other natural elements in protected areas. My study focuses on how people experience nature seen through pictures. The action of taking pictures in itself provides a channel of interaction between the photographer and the nature in these protected areas. The first channel to which the paper refers is the interaction between man and nature by 'knowing' that the ecosystem components exist, and it provides an idea of an ideal ecosystem that can serve individual basic, physiological as described in Maslow's Hierarchy of needs (Fig. 3).

I can relate the *'knowing'* channel with the CEC fulfilling a function of satisfying *'intellectual'* needs, and represented in indicators considering elements of educational activities, scientific activities, and artistic representations. All these activities contribute to inform the viewer about the nature elements by providing knowledge in this respect. Moreover, the paper mentions '*perceiving nature*' as another channel of interaction with the ecosystem components. This is understood as interactions with visual components of ecosystem (Russell et al., 2013). Having this in mind, it is possible to associate landscape elements included in the *'aesthetic value of landscape'* and different species of plants as representing the *'perceiving 'channel* in Russell et al. (2013). Then the third channel to which the paper refers is the *'interaction'* channel. This channel can be associated with the recreation value in the CEC framework which encompasses activities such hiking, leisure fishing, picking berries, mushrooms. Therefore, Russell et al. (2013) focuses on the directly lived experience within nature and it mentions that "how we think and who we are "influences the management of nature and supports the choice of CEC representations used in my study. Furthermore, it reassures the importance of assessing the cultural value of nature to form decision-making.

Non-use values

In addition, and at the core of the interaction between man and nature and part of people's experiences is the process of assessing non-use values of ecosystem. This aspect raises attention especially concerning CES intangible characteristics. I specifically refer to Chan et al. (2011) as they provide insights into various aspects of the 'valuation 'of nature as the mechanism which contributes to the integration of cultural services in decision making. To be able to integrate an ecosystem service into management processes, first the different values attached to these services

need to be revealed, so that they can be taken into account when management decisions are made. This is a complex process, particularly in the case of cultural services due to its abstract form. Chan et al. (2011) refer to the 'intangible characteristics of CES and that non-use values are difficult to classify and measure' even though the study provides a framework to help in this sense. They refer to the values obtained through the knowledge of something's existence e.g. that a species exists and will exist for future generations. As Chan et al. (2011) refer to these values as the *existence* and *bequest* non-use values of ecosystem. While studying the material in my thesis, I met difficulties in distinguishing between these kinds of values. Especially the ones that are characterized by the 'existence value' as referred by Chan et al. (2011), as values beyond the satisfaction of a human need or interest. Concerning this fact, some of the species elements for e.g. a tree species can be photographed because of its aesthetic value or because the photographer appreciates the mere existence of the species. This problem aroused in the interpretation of pictures, and highlights that the photo-series methodology presents limitations in disentangling these kinds of values. Chan et al. (2011) also refer to the value of sense of place that is generated by recreational experiences in nature. I found this paper useful as it demonstrates the possibility to assess and quantify directly or indirectly several of these values linked to socio-biophysical elements through spatial landscape analysis.

Indicators

An aspect of major importance is related to the indicators of CES. As the category of cultural services consists of indicators that are challenging to value and manage it is mandatory to refer to precisely designated classifications and/or conceptualizations (Hernández-Morcillo et al., 2013). From a scientific point of view, indicators are seen as a measure to weigh or represent a characteristic of interest. For example, species richness can be an indicator of ecological condition (Turnhout et al., 2007).

In the case of CES there is a need of adequate methodologies including a number of indicators that can help gather relevant data for research and practice. For this thesis, I looked up several papers that describe the process of designing indicators for different research purposes as in Müller and Burkhard (2012), Hernández-Morcillo et al. (2013), Turnhout et al. (2007), Chape et al. (2005), Richards and Friess (2015), Heink and Kowarik (2010), as well as papers that describe different

classifications of these indicators to be used in the assessment of ecosystem values such as Maes et al. (2016) (Müller and Burkhard, 2012). The papers provide examples of indicators that have been used in the assessment of cultural values. This being said, I found the paper of Maes et al. (2016) very useful as it provides a classification framework for some of the indicators used in the current study. The study provides a structure around a "conceptual framework that links humans societies and their well-being with the environment" (Maes et al., 2016). The paper describes the analysis of policies and of research results used in the development of a set of indicators to serve in the appraisal of ecosystem services. The paper uses the common international classification of ecosystem services (CICES) together with a typology created especially for this study to estimate ecosystem service values, and tests its applicability in the assessment of ecosystems services. Moreover, it uses different pilot studies to conclude a set of indicators which can be seen as an agreed indicator framework for mapping ecosystems and their services. The paper demonstrates that there is a potential to develop a framework to "assess ecosystem services on the basis of existent data if they are combined in a creative way" (Maes et al., 2016).

The paper by Maes et al. (2016) is relevant for my study because it uses the CICES typology which was framed around human needs and it describes the contribution of ecosystem outputs to human well-being. By doing so, it serves as an example in the evaluation of the six national parks considered in this thesis and it gives a credibility to the indicators used in my research. The indicators used in Maes et al. (2016) can be used as cross references to my thesis as they provide a standard framework that can be used in evaluating CES .The paper introduce some specially designed indicators for terrestrial and fresh water ecosystem as well as indicators for marine ecosystems to help in the mapping methodology. In creating these two groups of indicators it refers to provisioning, regulating and cultural indicators proposed to map ES by EU. In addition, the paper also proves the applicability of non-monetary technique in appraise ecosystems as in Maes et al. (2016), mapping is used as a methodology to assess this kind of services.

How are these examples contributing to my research?

The papers included in this first section of the literature review, frame some of the concepts, characteristics and challenges that take part in the assessment of cultural ecosystem services. Relating to the framework presented in the literature of cultural services helps to set the foundation

of this study. Moreover it is fundamental to have a good knowledge of the state of the art in the topic to be able to integrate and/or include the findings into the current perspectives.

I present some studies that used non-monetary valuation techniques to map CES values. They contribute with useful information to the integration of this concept in decision-making for management of the environment. The following descriptive reviews are conceptual and focused on outcomes of local place-based applications, which stand as a basis for the development and applicability of the CES concept (Milcu et al., 2013).

Indicators, methods used in other studies

All these articles use a newly developed methodology that contribute to the social understanding of preferences and perceptions towards cultural ecosystem services.

Moreover, I found these papers relevant for my research as they present CES indicators and their classification as well as methods used to assess these indicators, and valuation methodologies for the analysis of trade-offs involved in decisions. These trade-offs concern the integration of CES in landscape management decisions. The following papers were studied as they have an importance in this matter: Casalegno et al. (2013), Nahuelhual et al. (2013), Wood et al. (2013) Martínez Pastur et al. (2016) and Tenerelli et al. (2016).

Each of these cases approach the valuation of cultural services slightly differently by using photo series method. Casalegno et al. (2013) present an innovative approach for assessing cultural services by mapping spatial distribution of CES by taking into consideration the aesthetic values of landscape. This is done by quantifying geo-tagged digital photos uploaded on social media. The study takes place in Cornwall UK, were tourism and agriculture are important components in the economy of the region.

Furthermore, the study looks at the covariance between different ecosystem services such as regulating (soil, carbon stocks), provisioning (agricultural production), and CES (aesthetic value of the landscape). They use a recently developed method to quantifying cultural-aesthetic values of landscapes, which consists in analyzing and classifying pictures that were uploaded on social media. The classification is used to provide a new type of measurement of aesthetic attributes of landscape. The study uses as a premise that "images will be captured by a greater number of people

in areas that are more highly valued for their aesthetic attributes". Moreover this research uses the aesthetic value of landscape as indicator in the same way as I used it in my study to refer to the non-use values of landscape. By doing so, it highlights people preferences for certain landscape elements for their existence and aesthetic value. The study demonstrates the applicability of the aesthetic value of landscape indicator in the valuation process of CES. Furthermore it concludes that the quantification of geo-tagged photos is an effective metric for mapping components of CES.

Nahuelhual et al. (2013) mapped CES categories, recreation and ecotourism, uses Geographical Information System (GIS) and participatory methods. The study was carried out at the local level in southern Chile. It uses as indicators of recreation and tourism, the potential of landscape to represent attributes such as scenic beauty, accessibility and tourism attraction. Furthermore the paper also refers to the capacity to represent the areas with high recreation and ecotourism qualities. All these information was mapped, demonstrating the potential to identify recreation areas trough these framework and that the information retrieved from such a study can contribute in decision-making regarding land use and planning. In addition, the paper uses indicators such as recreation and tourism potential (REPf) and recreation and tourism opportunities (REOi), which help to highlight and map the areas of most interest for tourists. The paper demonstrates that using information retrieved from photographs can serve as a means to identify potential recreation areas which can be used by different authorities in territorial planning or land management. People's perceptions of landscape seen through pictures helped to conceptualize what they appreciate from a conserved and protected ecosystem. It provides information concerning the outcomes of this newly developed methodology and it serves as a model to refer to in my study. Moreover, the study pinpoints the possibility to visualize people needs and perception at local and regional scales. The paper further provides useful information concerning the recreation indicator used as it relates to natural attributes, scenic beauty, accessibility, tourism attractions. In the case of the current thesis, I referred to some of these attributes.

There are several studies that assess recreation and tourism for the simple fact that have a more tangible characteristics than other cultural ecosystem indicators. Having this in mind, Wood et al. (2013) is another example of using recreation and tourism indicators, which contributes to the valuation of CES. The paper uses photo series analysis to determine the traveler's origin and the location of photographs from social media to quantify visitation rates. The obtained estimates were

attributed to each site and compared to empirical data. The study provides useful information contributing to the understanding of the elements that attract people to visit an area. The methodology used here offers the possibility to see if changes in ecosystem have an impact on visitation rates (tourist's flows). It serves as an example that several characteristics, indices of an ecosystem together with peoples preferences contribute to a better understanding of the functions perceived from ecosystem.

It is important to mention the significance of the 'nature-based' concept to better understand the applicability of these indicators. 'Nature-based elements refer to interactions with or appreciation of the natural environment (Wood et al., 2013). The paper mentions that the characteristics of these elements influence peoples' decision on the activity of recreation. Concerning this fact, this paper serves as another example of how recreation activities depend on the richness of environmental attributes. These are relevant to my study as I refer to some of these attributes along the classification such as cultural attraction and species richness. Moreover, the paper refers to human preferences to understand the importance of elements that attract people to visit a place whose information offers valuable insight into the assessment of CES and for the management of the areas.

The examples demonstrate that photo series analysis can serve as a powerful tool to develop indicators for mapping cultural services. All the three papers focus on recreation and the aesthetic perception and preferences towards landscape which provides useful information for future studies in this sense. Using the spatial distribution of photographs of natural environment is as a way to quantify what people want, like and need while recreating.

This method can contribute to transforming the intangible characteristics of CES into tangible ones that can be used to inform decisions about landscape and ecosystem management.

To sum up all the three papers mentioned above: Casalegno et al. (2013), Nahuelhual et al. (2013) and Wood et al. (2013) offer insights into non-monetary valuation methodologies, spatially explicit indicators of ecosystem services, which are useful for mapping specific components of CES.

The following section focuses on research methods directly related to the current study. It discusses the use of photo series methodology to identify CES values as well as it identifies weaknesses and limitations which need to be addressed. This section looks into papers that study people's

preferences and perceptions towards landscape and how these preferences affect the assessment of CES.

Research directly related to the main topic

This last section of the literature review aims to address issues related questions about the way in which social preferences can be identified and presented in a tangible way.

Social preferences and perceptions

By revising the existing literature, a number of studies have addressed the socio-cultural preferences related to ecosystems by taking into consideration human values, benefits and beliefs and by using a non-monetary valuation techniques. There are some examples of studies which evaluate CES by using monetary valuation like travel cost methods (Martín-López et al., 2009a, Plieninger et al., 2013, Van Berkel and Verburg, 2014) and also some using non-monetary valuation techniques. The use of non-monetary valuation techniques can serve to elicit social preferences and can help to identify which are the services that humans wish for (Martín-López et al., 2009b, Gómez-baggethun et al., 2014, Kelemen et al., 2014).

One study that looks at the spatial patterns of CES is the one by Martínez Pastur et al. (2016). This study as the other ones described above use the same methods in apprising CES values but I refer to it separately in these section as it is very close related to the current research. This is due to the fact that uses a similar categorization of cultural aspects of ecosystems. Furthermore it looks at the spatial associations between CES values in two regions in Southern Patagonia (Argentina) (Martínez Pastur et al., 2016). This two regions were Santa Cruz and Tierra del Fuego. The geo-tagged pictures posted on Panoramio were used to identify hot-spots of aesthetic value of landscape, existence value, recreational value and local identity to relate to socio-biophysical landscape features (Martínez Pastur et al., 2016). Furthermore, maps were created for both Santa Cruz and Tierra del Fuego regions to define the hot-spots for each of the cultural service value. The study used multivariate analysis to determine the relationship between landscape features and the CES values.

The results of the study show that aesthetic value was the most frequent value tagged by people followed by existence value, local identity and then recreational activity (Martínez Pastur et al.,

2016). Moreover, these study is relevant for the current thesis as it makes use of three of the indicators included in my study. It uses aesthetic value of landscape, existence value and recreational value to contribute in the assessment of CES values. The *'aesthetic value of landscape'* included natural and urban landscapes then the *'existence values'* which included photos related to individual species of flora and fauna. Furthermore, there was the recreational value including activities as hiking, trekking, climbing, riding, and camping, kayaking and sport fishing. Concerning the last indicator used in these study 'local identity 'it encompasses elements such as heritage, folklore, traditions, art and local workers (ranching, forestry, artisanal fishing, mining, and oil extraction);

This indicator includes some of the elements comprised in the intellectual indicator used in this thesis. In conclusion, these study is a very relevant example for my research as it uses very similar sets of indicators and methods to evaluate CES at regional scale. It serves as a useful example of valuating cultural services by using geo-tagged photos at regional scale in areas with low data availability and hard accessibility. The issues encountered in the study are very similar to the ones used in the current thesis. Moreover the study is a proof that social perception can be mapped and represented so that it can be considered in future research.

Furthermore another relevant paper is of Tenerelli et al. (2016) which addresses issues related to the representation of social perception, and how specific provision of landscape is distributed in a varying landscape in the France Alps. The aim of the paper was to look at the relationship between the landscape and social perception in the context of cultural services all this in an alpine setting.

The study proposed to identify the setting that shape the provision of CES. It uses the same kind of approach as the studies presented before. Both Martínez Pastur et al. (2016) and Tenerelli et al. (2016) refer to the valuation of landscape at regional scale as these current research does to. Furthermore these papers demonstrate the applicability of the used method in regions with a low accessibility. They refer to the same structure as in the current study which provide a strong reference in this sense. What is relevant in this context is that the indicators used for these study use the same structure as the current research, as they were divided in two categories referring to the physical and experiential interaction. This included photos of sports and recreation activities. Then the second group referred to 'intellectual and representative interactions 'including educational activities, photo group of students undertaking nature related activities, landscape

aesthetics, cultural heritage, lifestyle related to agricultural heritage. By using these indicators help identify the appreciation of humans towards nature. In addition by looking at the concluding result help in providing useful information for future planning at regional level. The paper demonstrates that crowd source data allows identifying spatial patterns of cultural services and their association with landscape. Crowd-sourcing geo spatial data is presented in this study as a useful tool in gathering a big amount of data worldwide. This fact contributes to a fast and cost-effective way of assessing CES at regional scale (Tenerelli et al., 2016).

The study uses special analysis and modeling of multiple data sources. First, a geo-tagged photo database was created. In this process was determined areas which characterizes the most CES. The uploaded photographs were used as dependent variables and landscape setting used independent variables in the assessment of CES. To continue with, a local analysis was performed to identify the factors of CES. Then for identifying any spatial relationship between landscape and CES. Moreover the weighed regression used in this study provides a valuable technique for spatial data analysis as it is mentioned in the conclusion section of the study. The statistical methods managed to identify connections between specific landscape variables and drivers of CES. The method used helps to find out the relationship between biophysical factors and cultural ecosystem relationships. It helps in determining key landscape features and there distribution in the studded environment.

However these two studies represent two different geographical areas, but both aim to identify the social perception by using photo analysis. The study carried in Patagonia compares to regions one in the north and the other one in the south taking in consideration indicators of cultural services and social and biophysical characteristics identified in pictures.

Furthermore the second study, carried in the France Alps represented by a landscape mosaic contains a single study area so called ‘Quatre Montagnes’.This study together with the other studies presented above looks at the relationship between CES indicators and biophysical characteristics. Both cases test the photo series analysis and conclude as being a time-cost effective methodology which can be used in the assessment of CES by taking in consideration the social perception. This type of data can contain large amount of information at a spatial and temporal scale. It is known that well educated people are more likely to access and to contribute in generating this kind of data. This social network contributes to the development of use of social media for future research.

Furthermore as the current research takes in consideration landscape elements to identify CES values, it is very useful for the analysis to relate to theories of landscape preferences and perception. A relevant paper in this sense is the one by Ode et al. (2008). This paper looks into the significance of landscape indicators by linking landscape aesthetic theory with visual indicators. Ode et al. (2008) define landscape indicators as "providing the possibility for a more objective basis for identifying landscape characters through dividing the totality of our visual perception of the physical landscape into quantifiable characteristics". As in this study, CES values are determined through a visual representation of landscape (photographs), visual indicators can have an impact on incorporating aspects of human perception of landscape into the assessment of these services.

In Ode et al. (2008) nine visual concepts were retrieved from the literature which characterize the visual aspect of landscape. From these indicators, five were of importance for this study. These indicators were: indicator of *complexity*, *coherence, stewardship*, *imageability*, *naturalness*. By referring to these paper helps to better understand and visualize the connection between landscape visual aspect and humans preferences and perceptions.

To conclude this section, the concept of CES is very broad and multifaceted these idea emphasize the need of a very strong foundation to be able to sustain different perspectives and issues which may interfere in the process of assessing CES at regional scale.

Methods

This chapter begins with recalling the general research problem and the research questions, followed by a description of the setting of study area, of the participants, and the tools used in collecting the data. In addition, it describes the validity and reliability of these tools, and I provide a description of the data collection through the study. The chapter ends by describing the procedures used to analyze the data.

This research aimed to assess CES associated with the network of national parks protected forest and alpine ecosystems in western Patagonia, Argentina, by taking into consideration social preferences and perception towards nature in these protected areas. I used a global platform of geo-tagged imagines (Flickr), to identify the most important values of CES in these landscapes. The disclosure of these values implies a direct assessment of the observer's preferences and an indirect appraisal of the ecosystem. They were characterized through the appreciation of the physical landscape, by signs indicative of the appreciation of knowledge acquisition or the satisfaction that people derive from this landscape. These values were attributed either by visiting a place (photos taken by visitors) or just by knowing about its existence (e.g. photos uploaded to describe the natural attributes of the protected areas), as well as photos documenting recreational activities performed by people in these landscape.

I considered the appreciation of nature through photos from six national parks aiming to identify the relationships between biophysical elements and CES categories (classes). This study used a non-monetary quantitative valuation technique to assess social preferences towards the six protected areas along the Andean Patagonia. All this aimed to understand the importance of CES and to contribute with new perspectives to the newly developed photo series methodology.

The objectives of this research were the following:

1. To identify the natural features and their qualities that are appreciated by visitors in the national park

2. To identify the relationship and specific characteristics of this CES values within the six parks.

3. To gain an understanding of how visitors perceive the protected landscape. Determine specific patterns that make this perception visible.

4. To contribute to the improvement of the photo analysis methodology in assessing CES.

The study area

This study retrieved data from six national parks (i.e. Lanín, Nahuel Huapi, Lago Puelo, Los Alerces, Perito Moreno and Los Glaciares) occurring along the Andean Patagonia in Argentina. These parks are situated along the Andean range, from the northern part of the Argentinian Patagonia in the province of Neuquén, to the southern province of Santa Cruz in mainland Patagonia. The distance between the northernmost parks, Lanín National Park, to the southernmost park, Los Glaciares National Park is 1,150 km. Lanín, Nahuel Huapi, Lago Puelo and Los Alerces are situated within a distance of 100-150 km between each other. Los Alerces and Perito Moreno National Park are situated within a distance of 640 km and between Perito Moreno National Park and Los Glaciares there is a distance of around 300 km. All the parks are within the *Nothofagus* species dominated forest (or Subantarctic forest). The description of these six national parks focused on placing the parks in a geographical setting and describing their landscape particularities. This section mentions some of the most important animal, plant species that were encountered in the photographs considered in this study and the description of these areas.

The ***Lanín National Park*** is situated in the northeastern area, covering a surface of 412,013 ha and it is located in the Neuquén Province. The main attraction in the area is the Lanín Volcano, several glacial lakes such as Huechulaufquen, Aluminé, Lácar, streams and rivers cross the landscape. Activities such as fishing, kayaking, hiking, and skiing in winter, are common. The dominant vegetation cover is represented by forests ranging from a dry savanna type dominated by *Araucaria araucana*, followed by several species of *Nothofagus* spp, in areas with intermediate rainfall, and Valdivian forests with *Fitzroya cupressoides* (alerce) trees in the high rainfall areas. The area houses 233 native vertebrate species including pumas, foxes, colocolo opossum (monito del monte) and bird species such as Magellan tapaculo, condors and red-tail hawk. The most representative touristic town is San Martín de los Andes which is considered a tourist hub in summer as well as in winter. The Lanín National Park, is the third national park in size in Argentina.

The ***Nahuel Huapi National Park*** is the oldest and second biggest park in Argentina. It covers a surface of 717,261 ha and it is located in the provinces of Río Negro and Neuquén. The park is divided in three parts mainly according to the vegetation zones, including an alpine zone (Altoandino) occurring above 1,600 m, the Andino-Patagonian zone, characterized by hills beneath 1,600 m and the lowlands. The vegetation follows a precipitation gradient from Patagonian steppe in the driest range and Valdivian forests in the areas with highest rainfall. This landscape is characterized by high mountains, numerous lakes, rivers, waterfalls, and glaciers. Half of the park is dominated by temperate rain forest (Valdivian forests) and the rest is dominated by different *Nothofagus* spp such as lenga (*N. pumilio*), ñire (*N. antarctica*) and coihue (*N. dombeyi*), with the understory layer dominated by colihue (*Chusquea culeou*, a native bamboo species*)*. Several species of otters, South Andean deer, pudu (small deer), guanaco (native lama) are some of the mammals present in this area. Bird species encountered are the Magellanic woodpecker, Austral parakeet (a parrot found in South America), cauquén (a native goose), Imperial shag, Andean condor and green-backed fire crown (Andean hummingbird), among others. San Carlos de Bariloche is a tourist hub and known for its chocolate factory and ski resort close to the city. The town serves as a pit stop for mountaineers and travelers.

Another park taking part in this study is ***Lago Puelo National Park***. It is located in the Chubut Province and covers an area of 27,674 ha. The park was created as an annex to Los Alerces National Park in order to protect the Valdivian forests present in this part of the province. The dominant species are *Nothofagus* spp and arayán with native bamboo in the understory, in addition to *Fitroya cuppresoides* and other typical species of the temperate rainforest in the area. The Puelo Lake is the largest water body, after which the Park takes its name. The fauna contains species that are specific to the Andean landscape such as the pudú (small deer), huemul (Andean deer), red fox, cougar and coypu (it resembles the river nutria, rat). Some of the bird species encountered here are the huala, *Tachyeres patachonicus* (pato vapor volador), black-faced ibis, Chilean Flicker (pitío) and two species of Austral thrush (Magellan thrush and Falkland thrush) (Information retrieved from: parquesnationales.glob.ar; tierraspatagonicas.com; patagoniapark.org; conservationpatagonia.org)

Los Alerces National Park is located in the Chubut province and it covers 259,570 ha. The park's name comes from the alerce tree (*Fitzroya cupressoides*) an endangered coniferous tree species

occurring in high rainfall areas. This national park was created especially to protect this forest type. Puerto Sagrario and Puerto Chuco serve as tourist hubs. The alerce are spectacular trees, considered one of the oldest in the world. In addition to the alerce forests are other forests with Nothofagus species (coihue, lenga). The fauna existing here include the same species as in the parks described before. This park is fragmented by several rivers and lakes. Some of the most important lakes are Menéndez, Futalaufquen and Krüger. One of the most important tourist attraction is the Torrecillas glacier. The park offers opportunities for hiking, fishing and boating activities.

The ***Perito Moreno National Park*** is located in the Santa Cruz province. It covers 126,830 ha. The park's landscape stands out for the spectacular mountain chain, which crosses the park from East to West. Impressing peaks as Heros hill (2,770m) and Sierra Colorada plain, which is distinguished by its colorful and abrupt shape, rule the landscape. The park includes several lakes such as Belgrano, Mogote, Volcano and Burmeister. There are several animal species encountered in this landscape, some of which are considered endangered. Two of these species are small wild cats named Pampas's cat and Kodkod cat (in IUCN's Red List as vulnerable species). Other representative species are guanaco, puma (cougar), lynx, Patagonian fox, dwarf armadillo, ferret, skunk and tuco-tuco. There are several species of birds recorded here such as: peregrine falcon, hooded grebe, and flamingo, different types of goose (Andean goose), eagles and falcons. Some of the main attractions of the park are the mountain picks that are situated within the park boundary or close by as: Heros hill 2,770 m, and Monte San Lorenzo which reaches 3,707 m in height.

Los Glaciares National Park is situated in the Santa Cruz province covering 726,927 ha and is part of a UNESCO World Heritage Site. It is characterized by rugged, towering mountains, numerous glacier lakes as Lake Viedma and Lake Argentino. The western end of Lake Argentino offers a spectacular view due to three glaciers that meet at its tip. This feature is an important attraction for tourists. Moreover, almost half of the park is covered by ice and snow and it contains several glaciers. The main attraction is the Perito Moreno glacier, which is famous for its cyclic movements of expending backwards and forwards in the southern part of the park. As most of the park's surface is covered by ice, the fauna is quite poorly developed and it contains the common forest Andean species of *Nothofagus* spp.: lenga, ñire, coihue and guindo. The drier parts are characterized by steppes with neneo bushes, woods with *Northofagus* species, highlands and semi

desserts with sub-Antarctic species and different types of grasses. The fauna includes various types of birds as Darwin's rhea (*Rhea pennata*, choique), Andean condor, torrent duck, white throated caracara, yellow bridled finch, black chested buzzard eagle, Magellan oystercatcher, cordilleran snipe and austral rail. Mammals as red and gray foxes, colocolo, huemul (south Andean deer) and one of the most representative species, guanacos, are found in this park. El Calafate is one of the touristic hubs in the park and the closest town to the glacier. Other attractions are Monte Fitz Roy (Cerro Chaltén) (3,405m) and Monte Torre (3,128m), at the foot of which stands the small village of El Chaltén. This village is considered a shelter for mountaineers and trekkers (Information retrieved from: losglaciares.com; conservation.patagonica.org, wikipedia.com).

Data sampling

The data for this research consisted of 18,607 pictures, which included all the images that had been uploaded for my study area, on Flickr, an online photo management and sharing platform, and that were geo-tagged within the six national parks boundaries. From the total amount of pictures, I classified 13,675 pictures from which only 1,752 pictures were relevant for the analysis. The dataset was obtained through a classification procedure and after the classification, the pictures were sorted according to the national park, in six groups.

The pictures were uploaded by different users of the Flickr platform. The number of photographs retrieved and the number of owners which provided my dataset is continually growing. This is due to the fact that Flickr users upload their data quite often, plus that new users join this platform every day. The amount of data retrieved daily on this platform is on average two million according to the Flickr website in 2015. Considering the size of this sample, we could expect a considerable degree of generalizability (the extent to which the results of a sample group are applicable to other groups, or larger groups).

Some of the Flickr users in my data set were professional photographers or some were tourists who visited the area. They had diverse background in terms of the country of origin. Each of these persons had an account on Flickr that was identifiable by a username. These usernames appeared in my dataset in two columns, once under the heading of ‘owner name ‘and second time under the heading of ‘owner’. The ‘owner name ‘field sometimes contained the actual name of the photographer or in other cases the field was coded. The ‘owner’ field had the same structure along

the column. This was a combination of eight numbers followed by '@' and again followed by a letter and two numbers as in the e.g. '11563230@N04'.

The photo resampling and classification was done by using a new developed tool created by Simon Abele from the School of Geography and Environment at the University of Oxford. The concept and design of the App was made in collaboration with Alison Smith and Rob Dunford at the same department. The app selected photos randomly from the shape file area (every picture had the same chance of being selected). The photos that were already classified were excluded from the next randomizations. A selected picture could be skipped at first and classified later by recording its ID. In that way, the picture could be retrieved anytime. With the (ID), the picture could be classified when it was selected again through the application.

Materials

Flickr hosted photos that presented landscapes with different natural features, people conducting different activities, as well as plants and animals in their natural environment.

These pictures were used to identify the biophysical features that underpinned the appreciation of areas (scenery, landscape elements, occurrence of species), and how they were used to indicate the importance of CES generated in the national parks throughout the study. Each of the photos retrieved from each national parks went through the same classification procedure.

For assessing CES, I used four indicators ('aesthetic value of the landscape', 'species features', 'recreational features' and 'intellectual features'). I used these indicators because they capture four dimensions often used to represent CES, i.e. appreciation of scenic beauty of landscapes and of the elements characterizing the landscape, appreciation of individual species of fauna and flora, and recreational and intellectual activities conducted in a natural setting. By doing so, I divided the indicators into two groups (Table 1): one group representing the appreciation of the landscape and its features more precisely the 'aesthetic value of landscape' and 'species features' categories. The other two indicators related to the use of the landscape 'recreational' and 'intellectual features'. The latter group includes benefits derived from the use of nature, whereas the benefits derived from the first group are based on the appreciation of natural and man-made features.

The pictures were further classified according to specific features contained in the landscape such as type of vegetation, elements of human infrastructure, water features, and elements of sky and weather features (Table 1).This way of dividing indicators of CES for classification was used in other OpenNESS case studies such in Tenerelli et al. (2016) as (Physical and experiential interactions, Intellectual and representative interactions) and as well in Martínez Pastur et al. (2016) (identifying characteristics in relation with the environment and in relation with the human presence).

Classes of recreational features included recreational activities such as hiking, swimming, climbing. Elements indicative of educational activities were for instance signs containing information about the national park.

The species features class included both 'aesthetic' and 'existence' category of CES value. These included pictures showing different species of animals and plants.

Although 'existence' and 'aesthetic' values are included in the typology defined for photo series analyses such in Martínez Pastur et al. (2016), in many cases, it was difficult to classify the photos according to these criteria. However, I attributed 'existence value' when for instance: the name of the species was provided in the local language or the scientific name and/or when the individual appeared to be the main motive of the photo, and when there was no particular aesthetic composition of the photo (e.g. composition in terms of colors, shade of the elements).

Fig. 4 *Picture representing the existence value*

Fig. 5 *Picture representing the aesthetic value*

The same picture included in the 'existence' category I included in the 'aesthetic' category as well to prevent any misclassification.

Furthermore in Tenerelli et al. (2016) and Martínez Pastur et al. (2016) the number of uploaded photographs and the landscape settings were used as dependent and explanatory variables to determine the elements that best reflects the presence of CES values. Moreover, regression analysis was used to identify the relationship between landscape elements and CES. In the case of the current study these representative nature elements were provided by the OpenNESS Classify App typology. These elements were divided in the following way:

The landscape features included both natural and human-made types:

- *Water features* with rivers and streams; canals; lakes and ponds
- *Vegetation features* with forest & woodland; scrublands; grasslands; agro-system; traditional; modern orchards; cropland; livestock; agricultural products; gardens; wetlands sub categories
- *Human infrastructure:* buildings; roads; footpaths, tracks; bridges; boats subcategories
- *Sky and weather features* with sky (clouds, sunrise/set, rainbow, moon, stars); weather (snow & ice, floods, storms)

Moreover, the typology was open to add the extra elements in the ‘other ‘field which was possible for each of the four indicator values of CES and main categories of this values. As long as this field was marked, it offered the possibly to type the name of the new feature.

- *‘Other’ category of landscape* were I included:

  “Wilderness area” in the ‘landscape features’ category including pictures showing pristine landscapes

  “Park “added in the ‘landscape features ‘category representing a large public garden or area of land used for recreation (definition retrieved from Wikipedia)

  “Rocks, sand and stones “in the landscape features category including pictures which contained a beach, it showed the shore of a lake.

  “Mountains’’ in the ‘landscape features’ category

Furthermore, extra categories were added in the ‘other ‘field attached to the main categories:

“Recreational area in the wild” added in the ‘human infrastructure ‘category representing landscape views which contained different facility elements for recreation such as tents, benches, fire place

“Information signs” in the Intellectual-educational activity category

“Glacier” and “ice “added to the ‘sky and weather category’

“Alpine landscape /vegetation” in the ‘vegetation feature’-which is a subcategory of ‘landscape features ‘category

In the ‘sky and weather’ features class of the landscape I included pictures offering a spectacular view due to the presence of weather elements which had an impact on the scenery of the landscape (e.g. picture showing a colorful sky, rainbows, moon, stars, clouds).

Fig. 6 *Picture showing a spectacular sky*

Fig. 7 *Picture included in the sky and weather category*

The ‘species features ‘consisted of:

- *Wild animal, vertebrate* with mammal; bird; reptiles; amphibians and fish sub categories
- *Wild animal, invertebrate* with non-insects, butterflies; beetles; dragonflies; bees; other insects
- *Non-wild animals* with pets; livestock subcategories
- *Plants* with tree; shrubs; grass and reeds etc.; flowers, moss and lichens

- *Fungi*
- *Aquatic*
- *Terrestrial*

It is important to mention that the vegetation features were present in both 'aesthetic value of landscape' class as well as in 'species' class. In the aesthetic class, vegetation features were considered as one of the elements which contributed to the aesthetic aspect of the landscape together with other elements such mountain picks, lakes etc. In the species class I called vegetation all the plant species included in these category. Here I have included pictures showing a close up of a plant species, the main focus of the picture was on the plant type itself.

Another group of CES values considered in this study was 'recreational value'. This category is divided into subcategories representing different recreational activities that can be performed in a natural setting. These activities were as follows: hiking or walking; cycling; mountain biking; road cycling; running; picking berries, mushrooms.; horse riding; swimming; leisure fishing; boating; camping, barbequing, picnicking.

Moreover some of these classes were added in an extra category 'other 'as they were missing from the classification typology. These extra categories were the following: kayaking, boarding, kite-surfing sightseeing, skiing motor biking, ice climbing, wakeboard photographing, rafting. The last feature of CES considered was the 'intellectual feature', represented by activities such: educational, scientific activities; artistic representations. In the education category I included pictures showing information signs and photographs of groups of students undertaking nature-related activities. In the artistic representation category I included pictures showing local heritage, traditions. The scientific activity category didn't include any picture for this case. In addition photo data used in this research included only photos where a cultural ecosystem service, i.e. generated by bio-physical features, could be identified. If for example a photo showed elements of human infrastructure surrounded by elements of landscape with aesthetic importance (Fig. 8), the photo was included in the classification.

Fig. 8 *Photo of elements of human infrastructure and landscape elements*

Pictures that could be included in one of the following categories, were excluded from the classification:

- People and pets as main subject and when they do not represent an outdoor activity;
- Photos showing objects not related to the landscape as the main motive;
- Pictures taken in the interior of structures;

All this criteria were considered in the actual classification of the pictures. To begin with I was provided with a set of shape files representing the boundaries of the six national parks and another shape file representing a topographic elements of Argentina. These two shape files were merged together to create a map showing the six national parks included in this study. The shape file data was downloaded from the following website: *(http://www.diva-gis.org/gData); (http://wagda.lib.washington.edu/data/geography/world/).*

Furthermore I used several applications to help and execute the classification such: Flicker API, OpenNESS Classify App, Carto DB, and Excel.

Classification procedures:

For this research I used four applications to gather and classify the pictures. One of these applications was used to retrieve all the pictures from Flickr and to classify them.

Step 1:

All the geo-tagged pictures uploaded on Flickr within the boundaries of the six national parks were downloaded by using a Flickr Application Programming Interface (API). The Flickr API uses standard Hypertext Transfer Protocol (HTTP) methods to select and manipulate data.

I provided the team at Oxford University with the geographical delimitation of each of the national parks so they could retrieve all the pictures uploaded on Flickr within the designated areas. The coordinates were expressed in decimal degrees and they were used under the following structure: minimum longitude, minimum latitude, maximum longitude, and maximum latitude. This method of identifying the relevant coordinates was suggested by Tenerelli et al. (2016) in a protocol created for its research.

I obtained the set of coordinates by using GIS (Geographical Information System). The coordinates were identified from a shape file containing the boundaries of the six national parks. To do so, I used the 'Identify' tab in Arc Map.

Step 2:

The group at Oxford University retrieved all the pictures and set up an application - 'OpenNESS-classify app-spot' – that enabled the data to be resampled and classified. The application was developed under the OpenNESS project with the aim to shorten the time spent with the classification of photos, and to quality check the retrieval process, and to standardize the classification process. The application has been used in other case studies in the OpenNESS project: UK -Warickshire and Essex, Belgium, Spain and Italy. The application was accessed through the following link: *http: //OpenNESS-classify.appspot.com/classify/ar*. OpenNESS Classify App has an easily usable interface that facilitates the classification process and highly reduces the processing time.

In using this application there are some procedures that need to be followed. Below I describe the steps that lead the classification for the gathered pictures.

Step 3:

The application shows one photo at the time, which is randomly selected from the photo database that was recovered from Flickr. In the case when the picture is not relevant, on the right side of the application, a tab under the name of "NOT RELEVANT" is used to delete the picture. This procedure filled up two fields in the classification dataset. If the photo was NOT RELEVANT, the field "IS_RELAVANT" was filled in with a "FALSE" status and in the same time the field "IS_CLASSIFIED "was set as "TRUE". This status can be seen in the downloaded data saved in Excel (add annex).

If the classification of a picture was postponed, the "SKIP "tab made this action possible. The picture could be retrieved anytime by using its identification ID. Each picture could be included in only one of the four groups of CES values, i.e. existence/aesthetic value of species and their features, aesthetic value of landscape and its features, various recreational uses and intellectual appreciation). At the same time, the various features and/or typologies of these major categories could be marked. The database compiled, contains information about each picture. First, on the left side of the typology it is shown the randomly selected picture and on the right side there is information regarding: the ID of the picture '(Flickr) id' and the title of the picture which may have a name or a code. There is also a field where a description of the content of the picture can be included ('description' field). The database stores information of geographical coordinates-latitude/ longitude of where the picture was taken, and there three maps links, which can be used to visualize the location of the picture. The 'tag' field includes words like ('park', 'Patagonia', 'Santa Cruz', 'mountain', 'Argentina', 'sunrise', 'dawn') which serve as labels to identify or give information. Certain tags and/or comments related to the photos were used in the interpretation of the pictures, providing additional information about the motivation of the photographer. The 'tags' and 'comments' in the database offered often a more in depth clear description of the meaning of the picture.

Finally, the database includes information about the status of the picture: 'is relevant' and 'is classified'.

Step 4:

All the classified pictures were saved automatically in CartoDB. This is a platform that provides GIS mapping tools for displaying on a web browser. The OpenNESS Classify app and CartoDB were connected, a procedure programmed also at Oxford University. I was provided with an account on CartoDB were I could access the photo database. The platform offered the possibility to download the saved dataset in different file formats as:

- *CSV*-this format allows the data to be saved in a table format.
- *SHP*-a geospatial format vector data for geographic information systems (GIS)
- *KML*- a file extensions for a place-mark file used by Google Earth.

- *GEOJson*- a standard file format designed to represent simple geographical features, along with their non-spatial attributes, based on JavaScript, Object Notation (according to Wiki) as e.g.({ "type": "Feature")
- *SVG*-scalable vector graphics for two dimensional graphic.

During the classification, I checked regularly if the data were saved properly in my CartoDB account. On the CartoDB platform, I could download the data after selecting the desired file format. I used CSV file format to download the classified data and then imported the table into Excel.

CartoDB offers an overview of the classified pictures on a constantly adjustable map. Pictures saved as 'is relevant' were marked with green dots on the map and pictures saved as 'not relevant' were marked with red dots. The instructions for using CartoDB were provided by the team from the Oxford University – UOXF-ECI Oxford University.

Step 5:

All the downloaded pictures from CartoDB were linked to an Excel spreadsheet. Several columns were labeled with the categories and subcategories found in the OpenNESS Classify App plus other fields providing information related to the picture. These headlines contained the following information: CartoDB picture ID, name of national parks, surface in 'ha' of the park, shape of the area, shape length, description of the photo, Flickr image ID, owner name, notes (where additional categories/subcategories were added), latitude and longitude of the picture location, 'is_ classified' field. This last field was marked with '1' if the pictures were classified and with'0' if they were not. Furthermore, a field for 'is relevant' pictures marked with '1' or for not relevant pictures marked with'0'.

Under the heading 'tags', the data include a column for the picture 'title' and another column for the location of the picture on the Flickr webpage under the heading 'url'. The column headlined with 'last viewed' shows the date when the classification was carried out.

After the data were added to Excel, I arranged my data by deleting unnecessary fields. I highlighted the columns representing the main categories of CES together with the columns with the following headings: 'is classified ', 'is relevant', 'national parks' name field. This procedure helped in the management of the data.

I used the ‘filter’ option in Excel to select all the relevant and classified pictures. From a total of 13,675 pictures classified, I ended up with 1,752 relevant pictures. By using again the ‘filter option’ I selected and created separate spreadsheet for each national park.

After filtering the data, I used the ‘statistics’ formula option in Excel to count the number of pictures retrieved for each CES feature. For this step I used the following formula: =COUNTIF (range, criteria) as in the example ‘=COUNTIF (H4:H18611, 1)’. In this example ‘H4’indicates the column name ‘H’ and the row number from where the formula starts to where it ends. Number ‘1’defines the relevant criteria for all fields in the classification. The row showing the result of this task was headed under the ‘Count IF’ name.

For being able to visually and compare values across different categories, I created five column charts and one pie chart to represent the entire data. This set of charts were created individually for each national park. They showed the number of pictures retrieved for each of the main feature of CES.

To be able to divide the pictures by national parks in Excel, I used the GIS software, Arc Map. First, I downloaded the photo data from CartoDB under the SHP file format. Then, I introduced the data on a map where polygons of the national parks were delimited. I used the ‘Join ‘feature in Arc Map to join the photo data shape file with the shape file of the park. By doing so, the photos were sorted by park. By using the attribute table (in Arc Map) of the new shape file, I was able to export the new data to Excel.

To be able to have a precise interpretation and classification of pictures, I had two meetings with my supervisors. During the meetings we discussed the classification criteria, we set an outline for a detailed classification protocol that included the criteria to suit the study, agreed on the additional categories and classified together approximately 100 pictures.

The classification of the pictures took place during one month; the average number of pictures classified per hour was between 30-40 pictures. For some of the pictures, the classification procedure took longer due to the complexity of the elements presented in the picture. Another three weeks were spent on arranging the data in Excel and creating charts.

Step 6:

I created four maps by using Arc Map. The shape files used for creating these maps were provided from the following links: http://www.diva-gis.org/gData;

http://wagda.lib.washington.edu/data/geography/world/

http://www2.demis.nl/worldmap/wms.asp

In the process of creating these maps I was advised by Monica Montalvan Ruano, Senior Engineer IT at NINA. Furthermore three of these maps are topographic maps of the national parks considered in these research. They contain three layers, including: a layer with the topographic elements present in the parks, a layer representing the boundary of the national parks and a layer showing the classified/relevant pictures gathered for each park. Each of these maps include a legend, scale in kilometers, The World Geodetic System (WGS) 1984 .As a projection I used Mercator projection. Furthermore the fourth map shows the location of the six national parks and contains the same properties as the ones described before.

Reliability and Validity

The reliability of a scientific study encompasses whether or not the study can be repeated and if so, whether similar results can be obtained through different classification events. As a matter of fact, cultural ES are difficult to assess generally, and also it is difficult to use quantitative indicators of importance and/or value. This research uses a newly developed methodology, which is very dependent on the context of the study. It derives its particularities from the setting of the study. A growing popularity in using social media have attracted researchers to use this methodology due to its potential of providing geographic data in an inexpensive and fast way (Barchiesi et al., 2015, Hollenstein and Purves, 2010, Willemen et al., 2015).

So far, the photo methodology has proved to be reliable as seen in the studies mentioned in the Literature Review chapter.

To ensure consistency in the classification, I created a protocol with different criteria to follow along the classification of photos. As a model in designing this protocol, I used as guideline protocol created by Patrizia Tenerelli for the OpenNESS case study in southern Patagonia. The

protocol consists in different criteria concerning the classification of pictures. These criteria were elaborated with the advice of my supervisors (Graciela M. Rusch and Nina Irene G. Berg). The protocol criteria for this research were explained into details along this chapter.

Table 1 *CES categories and the different features corresponding to each of the categories*
**extra categories included in the classification in the 'other' field*

Biophysical elements	Cultural Ecosystem Services (CES)	Broad feature classes	Specific features
Landscape	Aesthetic value of landscape	Water features	River and streams
			Canals
			Lakes and ponds
		Vegetation features	Forest & woodland
			Shrublands
			Grasslands
			Traditional
			Modern orchards
			Cropland
			Gardens
			Wetlands
			*Alpine vegetation
			Park
		Human infrastructure	Buildings
			Roads
			Footpaths, tracks
			Vehicles
			Bridges
			Boats
			*Recreational area in the wild
		Sky and weather features	Sky (clouds, sunrise/set, rainbow, moon, stars)
			Weather (snow & ice, floods, storms)
			*Ice
			*Glacier
		Other landscape features	*Mountains
			*Wilderness area
			*Rocks, stones and sand

	Intellectual interactions	Educational activities	Information signs,
		Scientific activities	
		Artistic representations	local heritage, folklore, traditions,art
	Recreational use		Hiking or walking
			Cycling
			Mountain biking
			Road cycling
			Running
			Picking berries, mushrooms, etc
			Horse riding
			Swimming
			Leisure fishing
			Boating
			Camping, barbequing, picknicking
		Other recreational use	Kayaking
			Boarding
			Kite-surfing
			Sightseeing
			Skiing
			Motorbiking
			Ice climbing
			Climbing
			Wakeboard
			Photographing
			Rafting
Species	Aesthetic/Existence value	Wild animal, vertebrate	Mammals
			Bird
			Reptiles
			Amphibians
			Fish
		Wild animal, invertebrate	Non-insects

		Butterflies
		Beetles
		Dragonflies
		Bees
		Other insects
	Non-wild animals	Pets
		Livestock
	Plant species	Tree
		Shrub
		Grass, reeds etc
		Flowers
		Moss & lichens
	Fungi	
	Aquatic	
	Terrestrial	
	Other species	

Results

"However beautiful the strategy, you should occasionally look at the results."

-Sir Winston Churchill

As explained in the methodology section, several steps were followed along the framework which lead to the final results. For a visual interpretation of the result several charts were created. These charts helped in identifying the relationship and specific characteristics of the CES values within the six national parks, helping in fulfilling the second objective of this study. This contributed to gain an understanding of how visitors perceive the protected landscape. In addition, the charts helped to identify some specific patterns that make this perception visible. These facts helped answer the third objective of this study. The data for this research consisted of 18, 607 pictures uploaded on Flickr which were geo-tagged within the six national parks boundaries. From the total amount of pictures, I classified 13,400 pictures from which only 1,752 pictures fulfilled the criteria to represent CES.

Overall patterns of CES provision in protected areas along the Patagonian Andes

The analysis of the broad CES categories revealed that the aesthetic appreciation of the landscape is the most important CES provided by these areas when considered as a whole (Fig. 9). Of the total of 1,752 pictures classified, 1,172 pictures referred to the 'aesthetic value of landscape'. The appreciation of individual species, individual species as the main motive of the picture, was also important with 421 pictures. The photos reveal also specific recreational activities (258) and satisfying 'intellectual' needs (50 pictures).

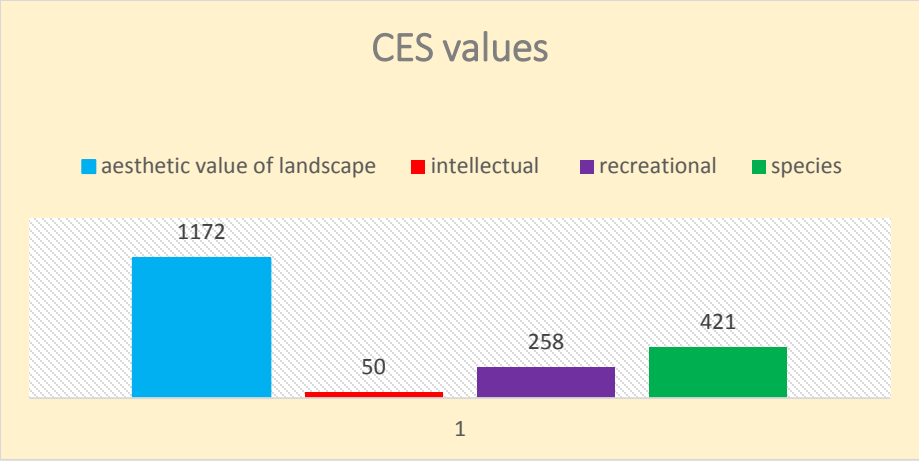

Fig. 9 *Broad categories of cultural ecosystem services (CES) provided by six national parks along the Patagonian Andes in mainland Argentina*

Within the aesthetic appreciation of the landscape, specific features were represented in different magnitude (Fig. 10). The largest number of pictures (852) is represented by the 'vegetation features 'category including (forest & woodland, shrub lands, grasslands, orchards, gardens wetlands, followed by 'water features' (754) including (rivers and streams, canals, lakes and ponds) and the 'sky and weather' category (642) representing (sky with clouds, sunrise/set, rainbow, moon, stars, weather features showing(snow & ice, floods, storms). About 15% of the pictures (268) pictures included 'human infrastructure' elements including (buildings, roads, bridges, footpaths, tracks. 195 pictures included in the 'other' category. Landscape elements contributing to the aesthetic value that were not included in the original classification but that were found relevant for this study were: glacier, ice, rocks, sand and stones, mountains, alpine landscape/vegetation, and recreational area in the wild. Wilderness areas was added to represent experience value (intellectual/spiritual).

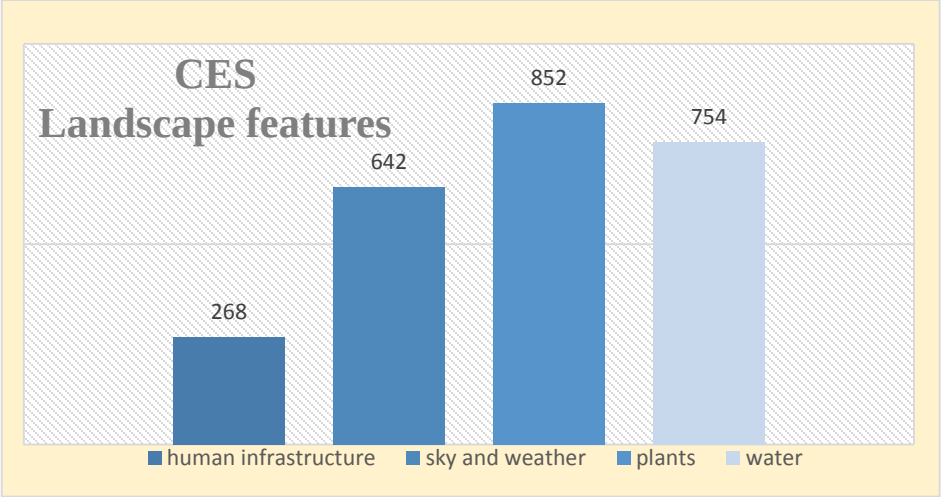

Fig. 10 *Landscape features identified in pictures representing the aesthetic appreciation of the landscape.*

In the case of species, the majority of the photos under this category include plants (398) showing a close up shot of a types of tree and flowers species, types of shrubs, grass, reeds, moss & lichens, and a few fungi species (5). The most photographed species were tree species, followed by flower species. Despite the low number, pictures of wild species, from terrestrial and aquatic habitats (6), are represented in the data set (Fig. 11). Eleven pictures retrieved show 'wild animals' category.

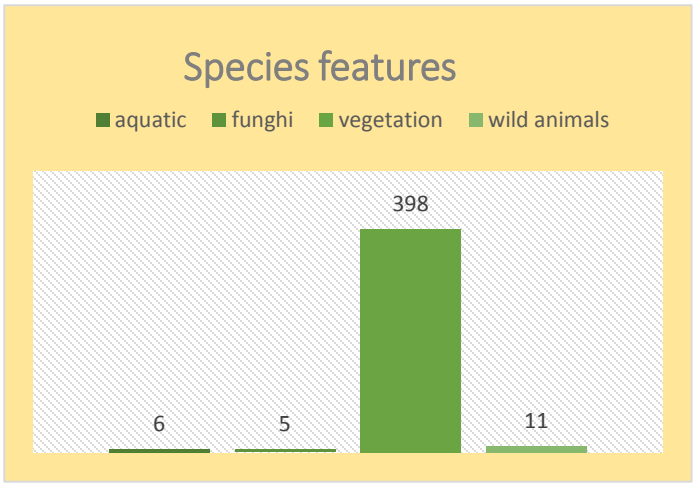

Fig. 11 *Species groups identified in the pictures.*

The photo series analysis reveals a wide range of recreational activities conducted in the set of protected areas in this study (Fig. 12). Hiking is the most important (131 photos). Within the 'other' category (64), the pictures show a variety of activities, not included in the original classification; these include: kayaking, boarding, kite surfing, sightseeing, motor biking, riding, ice climbing, photographing, climbing, skiing and wakeboarding. The next largest number of pictures (30) revealed camping activities followed by 28 pictures showing 'boating' activities. The following activities included less than 10 pictures in each :(8) pictures in the 'leisure fishing', (7) 'swimming' and (7) 'cycling'. Five categories were represented by (4) pictures each: mountain biking, road cycling, running (jogging), horse riding.

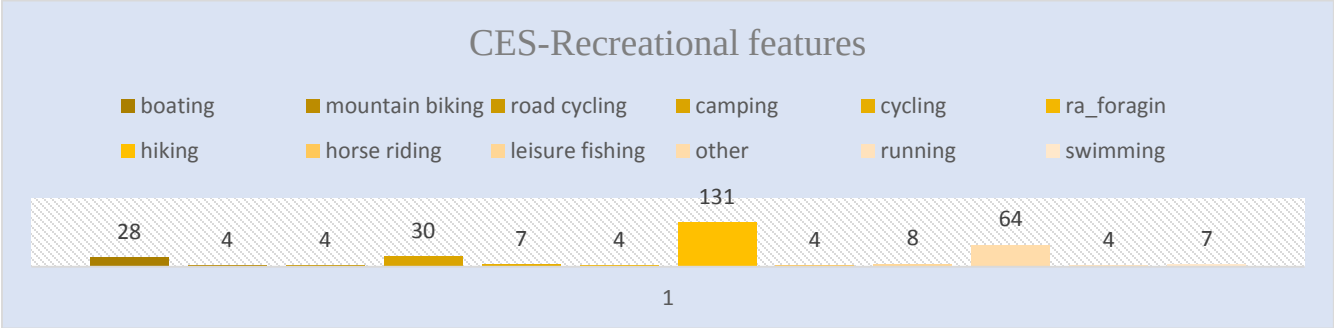

Fig. 12 *Recreational activities conducted in six national parks along the Patagonian Andes, in mainland Argentina as revealed by photo series analysis.*

Regarding features revealing intellectual interaction with nature 'educational activities' shows the largest number of pictures (18) (Fig. 13). The 'artistic representations' included 5 pictures. The 'other' category included 4 pictures representing groups of people having a climbing course as described in the comments attached to the pictures.

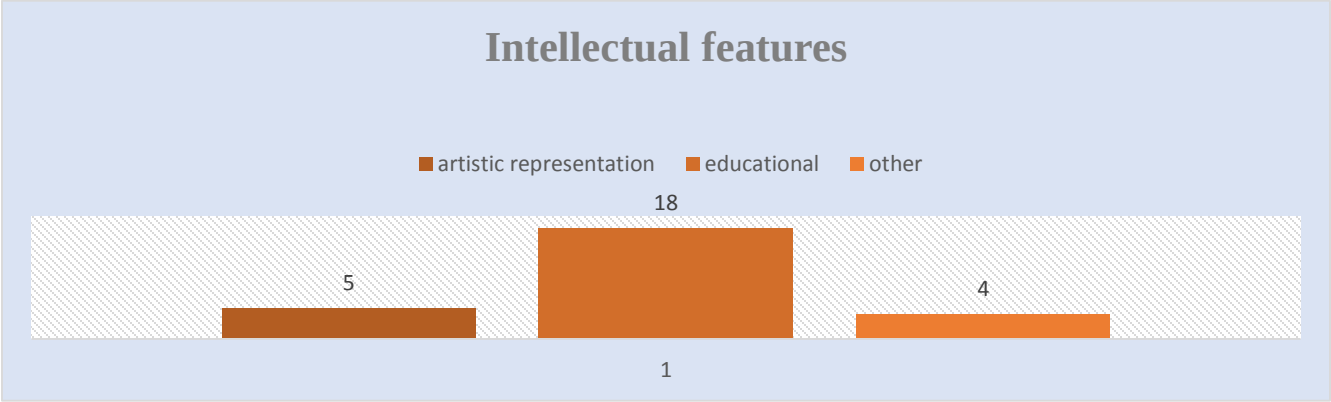

Fig. 13 *Intellectual activities conducted in the six national parks along the Patagonian Andes*

Between-park comparisons of CES provision

Aesthetic value of the landscape (Table 2)

There is a large spread in the number of photos that were classified from the different national parks. Los Glaciares National Park was the one with the largest number of pictures (54%), representing 'aesthetic value of landscape features', followed by Nahuel Huapi (31.1%). The Lanín National Park included 11.06% followed by Los Alerces National Park (2.4). Only 0.9% of the total number of photos related to 'aesthetic value' of the landscape were uploaded from Lago Puelo, and a few (4) from Perito Moreno National Park (Table 2).

Table 2 *Landscape features represented in photos revealing an aesthetic appreciation of the landscape. The proportions in the body of the table indicate the relative representation in each of the six national parks included in the study.*

Aesthetic values	% total	Plants	Water features	Human infrastructure	sky and weather
Lanín	11.06%	37.20%	28.70%	9.20%	24.70%
Nahuel Huapi	31.10%	33.60%	35.40%	9.40%	21.30%
Lago Puelo	0.90%	35.20%	35.20%	5.80%	23.50%
Los Alerces	2.40%	36.30%	36.30%	6.40%	20.70%
Perito Moreno	0.34%				
Los Glaciares	54.00%	42.10%	33.10%	15.70%	8.90%

Plants features (Table 2)

As represented in Table 2, the different landscape attributes reflecting the aesthetic value, are similarly represented in all the national parks. The plants feature was the feature most captured in the photos (Fig. 14).

Fig. 14 *Picture added in the aesthetic value of landscape class as including types of plants features.*

In Los Glaciares 42.1% of the pictures represented plants characterized by shrublands, grasslands, forests and woodlands. In Nahuel Huapi 33.6% of the pictures were represented by plants elements included forests and shrublands. The pictures represented in this park included some extra features compared to Los Glaciares, such as wetlands and agricultural products. In Los Alerces National Park 36.3% included plants features represented by categories as forest and some pictures with gardens, wetlands. The Lanín National Park contained mostly pictures showing plants elements (37.2%), represented by plant species which were found in the other national parks. In Lago Puelo 35.2% of pictures included, represent plants features. In Perito Moreno National Park there were four pictures included in the plants category.

Water features (Table 2*)*

This category was either the first or second category most encountered in the pictures depending on the national park. In Los Glaciares, 33.1% of the pictures included in the water features category included several glacier lakes, rivers, streams. As in Los Glaciares, Nahuel Huapi 35.4% of the pictures included in the aesthetic value of landscape category, are represented by water features elements (lakes, rivers and streams). In Lanín National Park 28.7% of these pictures were characterized by water features including lakes, rivers, wetlands, canals. Los Alerces included 36.3% of pictures representing water features as in Lago Puelo 35.2% were representative for this category.

Sky and weather (Table 2)

In Los Glaciares 8.9% of the pictures included sky and weather elements, comparatively fewer than in Nahuel Huapi (21%), in Lanín (24.7%), and in Los Alerces (20.7%).

Human infrastructure results (Table 2)

The elements present in this category were encountered mostly in the parks with a well-structured and organized tourism infrastructure. In Los Glaciares, human infrastructure elements (tracks, roads, bridges, buildings, and boats) are present in pictures taken around the touristic attraction areas (Fig. 15). These elements were present in 15.7% of the aesthetic valued pictures and in Nahuel Huapi 9.4%, showing bridges, roads, foot paths, buildings and boats. In the case of Los Alerces National Park includes 6.4% of the aesthetic valued picture included elements of human infrastructure. In Lago Puelo National Park, 5.8% of the total number of pictures included in the aesthetic value of landscape contained human infrastructure elements.

Fig. 15 *Picture including human infrastructure elements such foot path, orientation signs.*

Species features (Table 3)

Los Glaciares included 43% of the total species features pictures. It was followed by Nahuel Huapi National Park with 35.7%, Lanín with 13.3%. In Los Alerces there were comparatively fewer photos of species (4.7%) as was the case in Lago Puelo with 2.8%.

Table 3 *Classes represented in photos revealing the appreciation of species. The 'total' proportions in the body of the table indicate the relative representation in each of the six national parks in relation to the total proportion of species present in the park. The proportions present in the other columns refer to the particularities of each park individually.*

Species values	% of species in total nr of photos	plants	wild animals	Non-wild animals	aquatic	fungi
Lanín	13.30%	91.60%	3.30%		1.60%	3.33 %
Nahuel Huapi	35%	96.20%	2.60%		0.66%	0.66 %
Lago Puelo	2.80%	91.60%			8.30%	
Los Alerces	4.70%	95%	5%			
Perito Moreno						
Los Glaciares	43.00%	92.80%	2.70%	1.60%	1.60%	1.10 %

Plants (Table 3)

Plants encompassed the majority of pictures under the class of CES. It included mostly types of trees and flowers (Fig. 16) followed by grass, moss and shrub types. In Los Galciares 92.8% of the pictures included in the species class, had the main focus of picture a plant species. 35% of pictures taken in Nahuel Huapi National Park, were plants. This is followed by 13.30% pictures in Lanín, 2.8% in Lago Puelo and in Los Alerces 4.70%.

Fig. 16 *Picture included in the species class as showing the aesthetic and existence value of a plant species.*

Wild-animals (Table 3)

Along the parks there is a general pattern with pictures taken on animals. The species captured in pictures are generally endangered and protected species. The highest number of pictures were represented by pictures in Los Glaciares 2.7 % showing different species of mammals and birds. In Nahuel Huapi 2.6% of pictures captured mammals and birds. In Lanín there were 3.30% of the pictures included in these category and in Los Alerces, 5%.

Aquatic (Table 3)

In the aquatic category there were pictures showing different plant species. These pictures were taken along the river, lakes shore (Fig. **17**).

Fig. 17 *Picture showing different plant species included in the aquatic species category.*

In Lago Puelo National Park were 8.3% of the pictures included in the aquatic category followed by Lanín and Los Glaciares which both included 1.6% of their pictures including aquatic elements. In Nahuel Huapi included 0.66% of pictures in the aquatic category.

Fungi (Table 3)

This category included pictures taken in forests areas showing different species of fungi. In the Lanín National Park there were 3.33% of the pictures including fungi followed by Los Glaciares with 1.10% and Nahuel Huapi with 0.66%.

Recreational features (Table 4)

The pictures included in the recreational activities, were encountered mostly in Los Glaciares 60% followed by Nahuel Huapi 27.3%, Lanín National Park with 8.9%, Lago Puelo with 1.5% of the total number of pictures showing recreational activities. Los Alerces encompassed 1.17% of these pictures. In Perito Moreno National Park, there were no pictures included in this category. Furthermore the relative number of activates vary across the parks. The main activities were hiking, kite-surfing, ice climbing, climbing. Furthermore it seems that in Los Glaciares people visit the park for very specific features(main attraction of the park-Perito Moreno glacier) and conduct few activities (sightseeing, climbing) whereas the in the other parks offer more variety and are enjoyed in a more diverse way as people conduct more activities such as hiking, climbing, swimming, kite-surfing, rafting, boating.

Table 4 *Recreational activities represented in photos revealing characteristics of human interaction with nature. The 'total' proportions in the body of the table indicate the relative representation in each of the six national parks in relation to the total proportion of recreational activities present in the parks. The proportions present in the other columns refer to the particularities of each park individually.*

Recreational value	%total	hiking	Camping	boating	other
Lanín	8.90%	16.10%			38.70%
Nahuel Huapi	27.30%	20.20%	15.90%	14.40%	49.20%
Lago Puelo	1.50%				
Los Alerces	1.17%				32.20%
Perito Moreno					
Los Glaciares	60%	68.50%	9.80%	9.80%	11.70%

Intellectual features (Table 5)

Pictures representing this educational category were mostly represented in Los Glaciares National Park with a total of 65% of the total intellectually valued pictures retrieved for this area. In Nahuel Huapi, there were only three pictures included in this category as in the other parks there was one picture or none. These categories included pictures represented by photographs of groups of students undertaking nature-related activities.

Table 5 *Intellectual activities represented in photos revealing characteristics of human interaction with nature. The 'total' proportions in the body of the table indicate the relative representation in each of the six national parks in relation to the total proportion of intellectual activities present in the park. The proportions present in the other columns refer to the particularities of each park individually.*

Intellectual value	%total	scientific activities	artistic representations	educational activities	other
Lanín	8%	25%	25%	25%	25%
Nahuel Huapi	16%	16.60%	16.60%		16.60%
Lago Puelo					
Los Alerces	2%			100%	
Perito Moreno					
Los Glaciares	74%	0.66%	15%	65%	0.66%

The "other" category was introduced in each of the main classes of CES values to add extra elements in describing the pictures, which were not included in the original classification. As seen in the above tables, only some of the parks included elements in this category. It is mostly in the recreational class and aesthetic class that this category was present. In the aesthetic class the elements added follow the same pattern in all the parks. In the aesthetic class there were several elements added to describe the photographed landscape such: mountains, alpine vegetation, rocks, sand and stones, glacier. In the recreational class, however, the activities seem to be influenced by topographic elements of the landscape (water bodies and mountains). Some of the most practiced activities were kite-surfing, kayaking, ice climbing, climbing. These activities were dependent on the topography of the landscape as in the parks with favourable landscape for climbing or for water related activities as boating, kite-surfing, and kayaking.

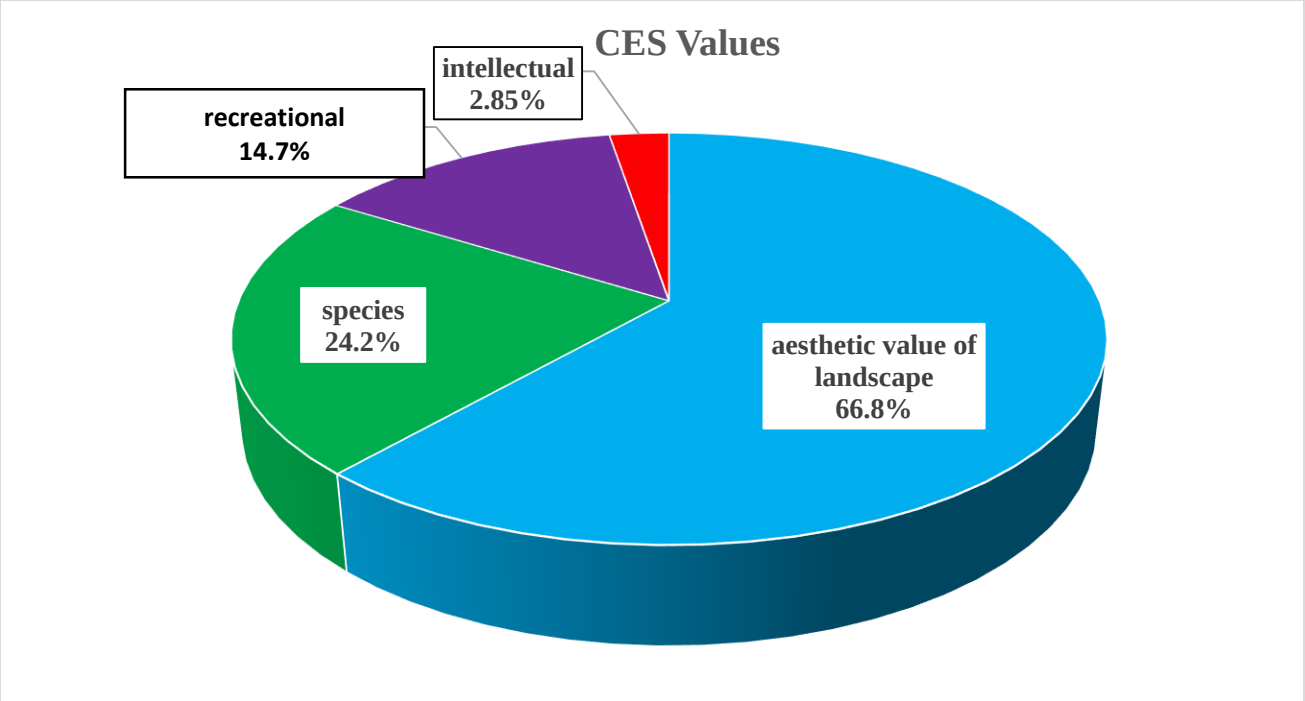

Fig. 18 *Percentage of the number of pictures representing aesthetic, species features, recreational and intellectual values of CES in the six national parks along the Patagonian Andes.*

Lastly the results indicate that aesthetic value of landscape was the main cultural ecosystem service tagged by people in the six national parks (Fig. 18). In total, there were (66.8%) of the pictures tagged. The second cultural ecosystem service tagged by people was species features group. Here (24.02%) of the pictures were included in this group from the total amount of pictures. Further on, Recreational value of cultural ecosystem services was tagged in (14.7%) of the pictures. The less tagged value was the Intellectual value of cultural ecosystem services which consisted in (2.85%) of the pictures.

Discussion

Say not, "I found the truth", but rather, "I have found a truth."

-Kahlil Gibran

There is a need in research to explore social preferences and perceptions towards ecosystems to be able to integrate abstract dimensions of ecosystem services in decision-making about environmental management (Milcu et al., 2013). It is a way of making the intangible characteristics of cultural services, more tangible.

Cultural Ecosystem Services (CES) are considered to encompass non-material and non-consumptive aspects of services generated by nature that affect our physical and mental state. At the foundation of perceiving and interpreting these services lies a complex process. Moreover, assessing cultural services can contribute to a more fully valuation of nature and to trigger social and environmental benefits as Daniel et al. (2012) explain.

There are different ways of evaluating CES service; this research, as was mentioned before focuses on the non-monetary (e) valuation of CES.

Many authors have increasingly focused on using non-monetary valuation techniques for appraising intangible aspects of ecosystems (Daily et al. 2009). Some of these methods are, for instance, Delphi surveys (a technique to gather data from respondents within their domain of expertise).This method is based on a group communication processes which discuss different debates. Another technique used is the Q method (a method which studies peoples "subjectivity", viewpoint). Furthermore, some authors focus on the relationship between the CEC and the users, applying methods to reveal preferences, personal experiences, and expectations of the observer towards the ecosystem (e.g.Martín-López et al. 2009; Gee & Burkhard 2010). In this sense, there is an increasing trend in using mapping methods to appraise CES. Several studies that use spatial representation of these services refer to social perception and preferences such (Klain and Chan, 2012, Plieninger et al., 2013, Martín-López et al., 2012). Some studies that use both mapping methods and access photo series analysis, more precisely, use social platforms of geo-tagged photos to map and identify CES values. Such examples are seen in the following studies: Casalegno et al. (2013); Nahuelhual et al. (2013); Wood et al. (2013); Martínez Pastur et al.

(2016)and Tenerelli et al. (2016). Having this review in mind, it provides insights of the applicability of the photo series analysis in appraising CES values.

Indicators

The first step in evaluating services is the selection of indicators (Müller and Burkhard, 2012). As this research aims to assess CES at a regional scale, I used several indicators of cultural services to be able to conceptualize the relationship between these services in the six national parks. CES indicators help understand and frame messages to contribute to the management of the environment by referring to the intangible aspects of ecosystems (Müller and Burkhard, 2012). These indicators are needed to help "cope with the complexity of the assessment of this process" (Müller and Burkhard, 2012). Especially in the case of this study, well framed indicators are even more important as they can provide a framework to appraise the non-use values of cultural services which are challenging to assess (Schaich et al. 2010; Chan et al. 2011).

In this research, I used four CES indicators which were provided and used within the OpenNESS project. They were designed based on conceptual frameworks developed to understand and analyze ecosystem services, i.e. MEA (2005), TEEB (2010), IPBES and CICES (Haines-Young & Potschin 2011) in which the last one, binds the ideas presented in the other frameworks.

The indicators created for the OpenNESS project were designed with the aim to contribute to produce a protocol to be followed in future research to help capture CES from photo series analysis. The idea behind this protocol was to provide a standard framework for assessing these services based on social media sources and which could be repeated for different case studies. In the current research, I followed these protocol to create a framework to be able to appreciate the cultural values offered in the interaction between people and landscapes protected for the conservation of their natural assets. The indicators considered in this research were used in other studies such in Casalegno et al. 2013; Nahuelhual et al. 2013;Wood et al. 2013; Martínez Pastur et al. 2015; Tenerelli et al. 2016). Casalegno et al. (2013) refer to the aesthetic value of the landscape and its spatial distribution. This paper shows the effectiveness of photo series analysis in mapping components of CES. Nahuelhual et al. (2013) use recreation and tourism potential and

opportunity as indicators and relate these indicators to visitation rates to inform land-use planning. The paper demonstrates the potential to identify areas with interest for recreation, providing useful information that can contribute to the management of landscape. In Wood et al. (2013), photo series analysis is used to quantify nature based tourism and recreation. The method enabled to identify elements that attract people to visit a place. Furthermore, Martínez Pastur et al. (2016) use aesthetic, recreational, intelectual and existence value indicators to identify hot-spots of CES. In this case, photo series analysis method offers the possibility to access CES in areas with low data availability and accesibility. In the case of work by Tenerelli et al. (2016), the study was carried in the French Alps 'Quatre Montagnes' region using the CICES framework, and using only two indicators of ecosystem services in the photo classification process. The 'Physical and experiential interactions 'indicator included photos showing experiential use and enjoyment of wildlife. More precisely, it included photographs of wildlife and of physical use of landscape, i.e. photographs showing different recreational activities. In my case, I used the same classification procedure, structuring the indicators into two groups as in Tenerelli et al. (2016), and incorporated in the framework aesthetic appreciation of specific landscape elements such as vegetation, water and ice. In the same category of aesthetic appreciation of natural features, I included species represented by different type of species of plants and animals. Here, I included pictures showing plant parts (flowers), insects, aquatic / terrestrial animals and plants, both native and exotic. Aesthetic value encompassed both the landscape and species, corresponding to the different natural elements often distinguished in conceptual frameworks of ecosystem services such as the CICES classification. Furthermore I considered the actual use of landscape and the perception or appreciation of landscape where I included recreation and indicators of intellectual interactions. By doing so, this last categorization enabled to see what people appreciate in protected landscape through the experiences that they get out of the driven recreational, intellectual activities. As an example 'scenic beauty' and sense of wilderness indicate the appreciation / value given to a particular landscape.

I found it helpful to use the CICES framework as it includes indicators/typologies that could be captured through photo series analysis. Furthermore, by using the CICES framework, I managed to identify several particularities specific for the cases in this study. Having this in mind, I first refer to the indicators that included appreciation value at two different levels: the landscape level

and the species. Furthermore the landscape also provides other CES as recreation opportunities and intellectual interactions.

In this study, CES values are determined through a visual representation of landscape (photographs), since visual indicators can help incorporate aspects of human perception of landscape into the assessment of these services. As stated by López-Santiago et al. (2014)"most of the information that shapes our behavior and orients our biological adaption to the environment is captured visually"; this idea serves to indicate that pictures can provide much information concerning people's perceptions of nature. Visual stimuli presented in pictures can provide a consistent means for communicating and sharing how people understand and appreciate the environment (López-Santiago et al., 2014). As this study takes in consideration national parks, the nature protected in these areas already has attached values of importance. Hence, we can assume that the specific visual stimuli present in these landscape are the ones that attract people to experience the area. This is to be seen in the results, as the aesthetic value of the landscape and its particular biodiversity seem to be important in attracting people to visit these areas.

The aesthetic value of landscape is one of the values that mostly shapes the way people perceive and appreciate the landscape. Relevant literature concerning this aspect refers to the interpretation of aesthetic view of landscape. In Ode et al. (2008) nine visual concepts were retrieved from the literature which characterize the visual aspect of landscape. From these indicators, five were of importance for this study. These indicators were: indicator of *complexity*, *coherence, stewardship*, *imageability* and *naturalness*. These indicators can be identified in the particularities of the studied landscape in the six national parks.

The *indicator of complexity* refers to the diversity and richness of landscape elements and features. These indicators introduce both the content and spatial configuration of the landscape. The study by Ode et al. (2008) refers to the distribution of landscape attributes (diversity and density of landscape elements) as well as variation and contrast between landscape elements (shape and size variation). In the current study the indicator of complexity can be identified through the rich distribution of landscape elements seen in the classified pictures. Here a single picture encompasses several elements such as vegetation, water, human infrastructure features. These elements have a degree of variation concerning their shapes and sizes. In addition, a picture can contain elements of vegetation which vary in shape and size such as different species of plants.

Having these in mind there are a couple of points worth discussing in relation with the complexity indicator such as the complexity of water features elements and human infrastructure.

Water features

Concerning the 'water features' category, this includes features as lakes, ponds as well as rivers and streams. In the Patagonia Andes the headwaters included in Lanín, Los Glaciares, Nahuel Huapi National Parks are considered important conservation areas (Martin and Chehébar, 2016). These water bodies are of major importance as they are considered to contribute to the ecological sustainability of the ecosystem. In addition, water bodies have a positive effect on the aesthetics of the landscape and on tourism (Martínez Pastur et al. 2015; García-Llorente et al. 2012; Termansen et al. 2004). In many pictures it can be noticed that the water features present in these parks are seen as an aesthetic element of landscape as well as a means for recreation. The 'water feature' category was present in the majority of the pictures in the analysis which reveals the cultural value represented in this area, rich in glacier lakes. Other studies have identified the importance of water features contributing to the aesthetic aspect of landscape (Martin and Chehébar, 2016, Zagarola et al., 2014). Some pictures reveal that water features were used for practicing different recreation activities such as: kayaking, fishing and swimming. The pictures also revealed that water features such as rivers, lakes, glacier lake, were used to access specific touristic attractions, e.g. Los Glaciares National Park with Lake Argentino which offers access to three glaciers, and the Belgrano, Mogote, Volcano and Burmeister lakes in the Perito Moreno National Park. In the case of the Nahuel Huapi Lake, this one is used to access the strictly protected areas of the park. These protected areas can be visited with guided tours, but no overnighting is allowed.

Human Infrastructure

The presence of elements of human infrastructure in pictures is of major importance as it shows structures that facilitate the access to the touristic attractions. This fact influenced the number of pictures taken in different parts of the parks. In areas including important touristic attractions, the number of pictures were considerably higher than in areas with poor infrastructure.

Different 'human infrastructure' elements were present or missing in some of the national parks. Perito Moreno, the park with the least number of pictures uploaded in Flickr, lies in a remote area,

being accessible by a dirty road with very limited services provided. This emphasize the fact that there are only a few pictures uploaded in areas with few visitors, which is in turn related to the level of accessibility like distance to roads, footpaths, etc.

In Los Glaciares, Nahuel Huapi and Lanín, human infrastructure was the third element in importance after vegetation and water features. This pattern reveals a well-developed tourism infrastructure represented by footpaths, roads, bridges, buildings and services (e.g. offer of tours with boat). An important role is played by the existent towns and villages around the national parks some of which have become important tourist hubs. Some examples are: San Martín de los Andes in Lanín National Park, San Carlos de Bariloche, Villa La Angostura and Villa Traful in Nahuel Huapi and El Calafate in Los Glaciares National Park. These towns offer tourism infrastructure that attracts many visitors, which is reflected in the number of pictures uploaded from this particular area. This can be seen by looking at the picture database map on the CartoDB web page, and also at the map created in ArcMap (Appendix A).

The next indicator, *coherence indicator* refers to the spatial arrangement of landscape elements (Ode et al., 2008). It takes in consideration the degree of repeating patterns of color and texture. In this sense, the paper refers explicitly to the spatial arrangement of water and vegetation. More precisely, it refers to the degree of fragmentation occurred by the presence of these elements and by the replication of these patterns across the landscape. In the current thesis, the coherence feature was identifiable through the vast areas occupied by water bodies and forest covers. It can also be identified through the variety of species present in the study landscape. It can be noticed a repeatability of these elements in the landscape seen in the pictures. More precisely many of the pictures that were included in the classification were characterized by the same natural elements such as the same kind of *Nothofagus* forests, glaciers, lakes and spectacular mountains.

Furthermore, I provide an insight into how this coherence indicator can be identified through species of plants and animals, and the characteristics of these elements in the current study.

Species plant features

One of the main reasons for establishing protected areas is to conserve its biodiversity. The pictures included in the classification often represented protected plant species from which some are very specific to these parks. For example the ‘alerce’ tree (*Fitzroya cupressoides*) (Fig. 20), is an

.encountered in the pictures. One of the reasons which contributed to the establishments of Los Alerces National Park was to protect this species, and so it got its name after it (Martin & Chehébar 2016).

Fig. 19 *Picture showing Araucaria araucana*

Fig. 20 *Picture showing Alerces tree species from Los Alerces National Park*

But also, the strictly protected part of the Nahuel Huapi National Park, has this status for the protection of alerce forest. The pictures showed also some other representative tree species such as the araucaria (*Araucaria araucana*) (Fig. 19) and different types of forest with *Nothofagus* trees and Valdivian temperate rain forests.

The pictures representing different type of plants were included in one of the subcategories according to what type of species they resembled the most (colorful species such as neneo bushes (*Mulinum spinosum*) (Fig21).

Fig. 21 *Picture showing Neneo bush*

Fig. 22 *Picture showing Alerce tree trunk*

I have noticed a preference in taking pictures of plants that had either a specific shape as in Fig.22 or brightly colored as in Fig. 21. These are aspects which I considered represented the aesthetic value of a species.

Wild-animals

The second most tagged element in this feature was given by the 'wild animals' category. One of the most photographed bird species was the Magellanic woodpecker (Fig. 23), followed by Chilean Flicker (pitío, Fig.24). Other bird species that are specific for this areas were the Andean Condor and Darwin's rhea or choique (*Rhea pennata*), yellow bridled finch. In addition, fewer pictures showed some of the protected mammal species such as: guanaco (Lama guanicoe, native lama, Fig. 25), huemul or Southandean deer), Pampas cat (*Leopardus colocolo)*, and red and gray foxes. The pictures used in this document were pictures retrieved from the classified database. Usually, the photographs showed animal species that are specific for the particular area. Some of these species are threatened species according to IUCN Red-list. There were only a few pictures representing species of the aquatic and fungi category.

These aesthetic elements are one of the values of CES most easy to identify as seen through literature (Milcu et al., 2013). As the current study takes in consideration protected areas which are aesthetically richt this idea helps to conclude that as the socio-physical elements are representative for this park, so does the ecosystem service cultural value.

Fig. 23 *Magellanic woodpecker*

Fig. 24 *Chilean Flicker (pitío)*

Fig. 25 *Lama guanaco*

What is unique about these species is that some can be considered as symbols for these parks. As this pattern is present in most of the pictures, forest vegetation can be considered one of the main reasons why people chose to visit these parks. The number of pictures including vegetation features vary however, between the landscapes, revealing the variety of natural values which raise interest for visitors.

Furthermore another indicator described by Ode et al. (2008) is the indicator of stewardship.

The *indicator of stewardship* refers to the "sense of order and care present in the landscape reflecting active and careful management" as Ode et al. (2008). This indicator takes in consideration the level of management for vegetation referring to the level of abandonment, presence of weeds, areas under different management regimes, number of highly maintained vegetation features. In this sense, the photos considered in the current analysis include different types of protected species (alerce, araucaria trees). Concerning this aspect of stewardship, it can be noticed that the photographed features appear to be more related to actively managed landscapes. However, it could be said that in the case of protected parks stewardship indicators could include elements which represent the condition of man-made structures such as well-

maintained tracks, information signs, can contribute to this indicator of stewardship. In this sense, the pictures in this study included several elements concerning these structures such bridges for improving the access to different touristic attractions, as well as several pictures showing managed footpaths as seen in the picture in Fig. 27 below.

Fig. 26 *Picture showing human infrastructure in protected landscape*

Fig. 27 *Picture showing managed footpath in a protected landscape*

Also it is important to mention in this respect, aspects related to accessibly, visitation rates, management regimes. Concerning this issues there are several particularities discovered trough the classification of pictures and by looking at the results.

Visitation rates variables can affect the number of pictures taken in a certain area (Levin et al. 2015). Other studies indicate that "crowd-source data can serve as reliable proxy for empirical visitation rates" (Wood et al., 2013). 'Accessibility' can also influence the way in which cultural services are perceived in different areas. This element has a visible impact on the cultural service in remote areas. In the classification typology, different tags were added to pictures such (e.g. wanderlust, wild, explore) to define these kind of appreciation. Other have demonstrated a correlation between CES and access infrastructure (Richards & Friess 2015; Martínez Pastur et al. 2015).

Moreover, the number of pictures taken in an area can be influenced by different rules concerning the conservation of nature (Martin & Chehébar 2016). More precisely, it depends on whether the

parks have areas with restrictions for touristic activities or not. In the Argentina-Patagonia region, the existent conservation areas are divided into three categories: national parks, national reserves and strict nature reserves, strict conservation areas (Martin and Chehébar, 2016). In this paper I used the term 'national park' together with the name of the parks as well as a conservation divisions. 'National parks' are those areas in which "no extractive use and installations of tourism infrastructure is allowed, for recreational use". The entire areas are national parks but the parks contain areas of more restricted use. 'National reserves' are those areas where regulated access may be permitted. Parks are areas with a tract of land managed to preserve the physical features present there (some tourist infrastructure). All the parks considered in this study have areas conserved under the nature reserve typology. This areas are under certain restrictions which allows day visits with guides.

Having this in mind, Table 6 shows all the parks include areas in one of the described conservation divisions. This fact can be considered as a proof of why some areas of these parks are more visited than others which affect the amount and kind of pictures taken in each of these areas.

Table 6 List of Patagonian national park, national reserves (Martin & Chehébar 2016).

	Surface area (ha)				
Park and year of declaration	Total	National Park	Strict Nature Reserve/ Strict Conservation Area		National Reserve
Lanín 1937	412 000	216 993	56 785	(13.8%)	195 007
Nahuel Huapi 1934	708 845	473 557	75 525	(10.7%)	235 288
Los Arrayanes (included within Nahuel Huapi)	1 840	1 840	–		–
Puelo 1971	27 674	19 247	3 512	(12.7%)	8 427
Los Alerces 1937	259 570	187 280	127 769	(49.2%)	72 290
Perito Moreno 1937	126 830	94 878	30 000	(23.7%)	31 952
Los Glaciares 1937	726 927	538 550	63 737	(8.8%)	188 377
Tierra del Fuego 1960	68 909	68 909	12 400	(17.9%)	–
Laguna Blanca 1940	11 250	8 250	1 100	(10%)	3 000
MN Bosques Petrificados 1954	61 245	61 245	–		–
Totals	2 405 090	1 670 749 (69.5%)	370 828	(15.4%)	734 341 (30.5%)

In Los Glaciares, visitors were more interested in very specific features of landscape, such as the Perito Moreno glacier. In the pictures from this park, in the majority of cases, the vegetation features were photographed because they were part of the background, not for main interest. In other parks as Perito Moreno and Los Alerces there was a slightly higher importance given to plant species types. These contained more vegetation as a main reason of taking the picture.

Martínez Pastur et al. (2015), discuss the role of the vegetation as determining the setting for people while recreating and its influence on specific recreation activities. These issues can be considered a fact in my study too. As all the study areas are conserved territories, the vegetation features (e.g. the forest) are elements of major importance. In Tenerelli et al., (2016), the study area focuses on the particularities of alpine landscape vegetation with several environmental variables that were considered a representative pattern for the cultural value.

The 'plants' category under 'species' and the 'vegetation' feature of the 'landscape' were at times difficult to discern. I included 'vegetation' features as part of the background when the picture focus was on as specific element of landscape such a mountain pick and /or an element of landscape which is represented by water features. Furthermore, vegetation in these pictures was considered as the main feature in pictures when together with other elements of the landscape they represented a panoramic view of a certain area.

Previous studies as in Martínez Pastur et al. (2016) considered pictures revealing the appreciation of vegetation at a landscape level as representing the aesthetic value of landscape. Concerning the plants category included in the species class, these ones were included in the 'existence' (specie which offered a benefits just by knowing of their existence) category under the species class.

Elements showing vegetation features were considered to represent aesthetic value of landscape. In these current research I included pictures representing plant species both as encompassing existence and aesthetic value. This is due to the difficulty in deciding whether the purpose of a picture was to represent one of the mentioned values or both. In Martínez Pastur et al. (2016) the 'existence value' and the 'aesthetic values 'were considered individually, each being valued separately. In the 'existence' category, the example includes vegetation features as well as fauna features. In the 'aesthetic value' category the study includes natural and urban landscapes.

The *imageability* criterion in Ode et al. (2008) refers to the ability of the landscape to create a strong visual image in the observer's perception. This fact makes the landscape view distinguishable and memorable. This indicator as Ode et al. (2008) explains, refers to theories of spirit of place and vividness (producing a very clear image in the mind). These elements are also characteristics of CES values, for example when referring to spiritual experiences which is one of the dimensions evaluated by CES. Here the article refers to spectacular, unique and iconic elements such as the existence of a density of landmarks which in my case study is represented by for instance the Perito Moreno glacier, and the mountain peaks Cerro Torre and Monte Fitz Roy. The paper also refers to the density of viewpoints as elements encompassing this indicator. As seen in several pictures, there are various such viewpoints around the most significant touristic attractions. These elements were included in the human infrastructure category in the classification typology of a picture. Furthermore the existence of such viewpoints enforce the idea of the existence of a good management of tourism activities.

'Other' category:

The typology presented in the classification App includes an extra category 'other' providing the option of adding types/features not captured in the classification. In my case, the presence of glaciers in Los Glaciares, Nahuel Huapi and Lanín National Parks was indicated by 'glaciers' feature. This element of nature was present in the majority of the pictures of these parks. As in Los Glaciares the main attraction is the Perito Moreno glacier, this aspect influenced the number of pictures taken in the area. Moreover, it can be observed a trend in the way people took the pictures. A large number of pictures showed a panoramic view (a view of a large area of the glacier including some vegetation features in the background. It can be noticed that the majority of the pictures were taken from the same location, usually panoramic view points along the foot-paths. Due to this fact, the pictures were very similar as they represented the glacier from the same perspective. Some of these panoramic pictures included elements of human infrastructure such as boats close to the glacier and small bridges that facilitated the access to different viewpoints. In

addition, some of the pictures included in the 'glacier' feature, present a closer view of these elements showing massive icebergs.

Fig. 28 *Picture showing panoramic view of the Perito Moreno glacier*

The last indicator is *naturalness*. This indicator it is relevant for these study as it refers to the close relationship between man and nature. It describes the "perceived closeness to a preconceived natural state" as Ode et al. (2008) describes it. This indicator refers to the theory which describes man's biological need to affiliate with nature. It considers that this indicator's characteristics can be identified through the activities that people drive in these protected parks. Regarding these idea I refer to the two indicators used in this study which can reflect the *'naturalness'* through the recreation and intellectual activities.

The most challenging part of assessing CES refers to the elements that I included in the appreciation of landscape elements indicator category. To show the connection of humans with the environment I used indicators that represent the interaction of humans within the conserved environment. To manage this aspect I looked into what are the activities that can best provide an insight into these kind of appreciation revealed through the recreational activities.

As other studies have proved it before as in Nahuelhual et al. (2013); Wood et al. (2013) the recreational indicator provides a straight forward way of identifying CES's value and are very representative for this type of service.

Recreation value:

The recreational features were the ones including 14.7% of the total pictures classified as representing CES. This feature included a category for each of the recreational activities allowed in the national parks. These recreational categories in the classification app typology were chosen to fit any case study, however, several other activities were identified as being conducted in these areas such as: ice climbing, photographing, sightseeing, climbing, kayaking, boarding, kite-surfing, and skiing and wakeboarding.

From all the activities included here*, 'hiking 'was* the category most tagged by people. Pictures showing hiking activities were present in areas with high touristic activities. The majority of these pictures were taken on the footpaths on the way to or back from touristic attraction, for instance pictures taken on the way to Perito Moreno glacier, Monte Fitz Roy (Cerro Chaltén) (3,405m) (Fig. 29) and Monte Torre. The pictures contained different natural elements including mountains and lakes often together with some human infrastructure such as bridges, foot paths and roads. Furthermore, pictures characterized by hiking activities were encountered in areas close to villages considered as tourist hubs. It does not come as a surprise the high number of pictures representing this activity as it is part of the touristic experience traditionally offered and practiced in these parks, but this facts stresses the importance of infrastructure and accessibility for the enjoyment of nature in protected areas, as well as the capacity of photo series analyses to detect these patterns of use and enjoyment.

The second largest number of pictures were classified in the *'other '*category. Most common pictures showed water activities such as kite-surfing, water boarding and kayaking. Other activities which were quite common were sightseeing, climbing and considered as separate categories were cycling and leisure fishing. The 'other' category included proportionally more pictures in Los Glaciares, Nahuel Huapi and Lanín National Parks than in the rest of the parks.

Fig. 29 *Picture showing tourist hiking towards Mount Fitz Roy*

Martínez Pastur et al. (2016), demonstrated that the vegetation cover can trigger recreation activities. These effects contribute in a positive way to the effects of social perception towards cultural ecosystem services. The study by Martínez Pastur et al. (2016), divides the recreation activities into two categories, referring to 'mass-tourism' determined by accommodation and entertainment facilities and 'eco-tourism' as "tourism with the intention to support conservation efforts and observe wildlife" (Martínez Pastur et al. 2015; Lacitignola et al. 2007). In this study, I followed an already existing typology which considered each activity as a separate category of recreation. I found this way of classifying more appropriate for this research as the study areas consist of several national parks whose policy/management plans restricts the recreational activities that can be performed. In addition, in my case, 'mass-tourism' is very much restricted so that I could consider that tourism activities can be considered as 'eco-tourism' (Martin and Chehébar, 2016, Zagarola et al., 2014). Furthermore, people's preferences in taking pictures change according to the recreational activity performed. For instance, Wood et al., (2013) show that hiking activities had a larger number of pictures than climbing, cycling and leisure fishing, so photo series analysis may provide a bias estimation of the importance of the different activities. However, the analysis is still useful to compare activities conducted across different areas.

Intellectual features

The intellectual and representational interactions features was the CES value that included the least number of pictures (2.85%) in all the six national parks. It was divided into four categories including *'educational activities'*, *'scientific activities'*, *'artistic representation'* and *'other'* category.

Moreover, I included pictures which had attached as a comment an informative description about the landscape present in the picture (Fig. 30) and text.

"The Perito Moreno glacier is 250 km2 and 30 km in length. Flowing into Lago Argentino, it is famed for the purity and color of the ice. At the right time of day huge blocks of ice can be seen falling from the advancing face. We took a short boat ride across the lake where we went on an ice trek on the glacier. Without doubt one of the highlights of the tour."

Fig. 30 *Picture included in the educational activity category showing a group of people ice climbing*

Concerning the 'artistic representation' in this category, I included pictures showing for example a spectacular, colorful sky or in some cases pictures showing driftwoods with interesting shapes. Pictures representing this category were found in Los Glaciares as in Nahuel Huapi, Los Alerces and Lanín. In the 'scientific activities' category, I included pictures showing painted caves, pictures that had attached some comments describing the presence of a scientific activity shown in the picture. In this category only a few pictures were included.

This CES value was used in Martínez Pastur et al. (2016) under the heading of local identity values. Here were included pictures showing heritage, folklore, traditions, art and local workers. In my research there were a couple of pictures showing some heritage sites which were included in this category. In addition this value of CES was the least tagged value in the six national parks.

These indicators as they are developed from different theories Ode et al. (2008) explaining people's experiences, preferences towards landscape, offer a valuable theoretical framework to refer to in assessing CES values, especially since the current study is based on visual aspects of landscape seen through pictures, the indicators in Ode et al. (2008) offer further insights into how these intangible aspects of ecosystems can be identified in the landscape.

Appreciation of the landscape

For the appreciation of nature to take place humans need to relate to the environment and seek for benefits that can contribute to their well-being (Maes et al., 2016). The protected areas in these current study appear to offer a lot of benefits to humans towards their biotic and abiotic elements. One of these benefits consists in the pleasure of being outdoors, experiencing scenic beauty, recreation and relaxation.

These elements are revealed through the interaction between people and nature. Moreover it triggers a certain appreciation towards landscape. This happens when people search to experience while recreating in certain landscape. In this sense, by looking into literature related to the motives for recreation, the paper by Zeidenitz et al. (2007) found out through surveys that experiencing nature and the landscape are the most important motives that drive people to practice recreational activities. Furthermore, studies mention values as escape, enhancing relationship, personal mastery (to reach your highest point) and winning ("pushing one's personal limits to the extreme") as core motives for recreation (Dillard and Bates, 2011). Moreover by referring to these studies it is more easily understandable what is that drives people to recreate which can be reflected in what they appreciate in the landscape.

Furthermore to be able to identify natural features and the qualities that are appreciated in the landscape, I looked for specific patterns that can help visualize this appreciation. Regarding this aspect and according to the results of my study, the aesthetic value of landscape was the main aspect that triggered people's appreciation towards landscape and their preferences.

Aesthetic appreciation

Since the very beginnings of civilizations, people shared knowledge about the landscape by referring to its aspect (Nogueira and Flores, 2004). Taking this into consideration, a strong

relationship can be identified between humans and the environment. Their "evolution will continue to evolve together with the landscape they inhabit, use, modify" (Ulrich, 1986). In my research, the aesthetic aspect of landscape plays an important criterion to be considered when an area is chosen to be protected. Protected areas are said to "ensure the continuity of what is important to sustain ecological structures and functions without the impact of human activities and provide a harmonious relationship between humans and nature "(Nogueira and Flores, 2004). This relationships are based on the benefits obtained from nature, said to be as "a story of preserving the sense of place" (Nogueira and Flores, 2004). Moreover this quote mentioned above refers to the fact that protected areas ensure a certain continuity of what is important and essential for us. This refers to the material and emotional part of the man/nature relationship" (Nogueira and Flores, 2004).

Having this in mind, the current study can prove once again that the aesthetic aspect of landscape captured by photo series analysis is indeed an indicator of how humans appreciate the landscape. Moreover the photo series method enables to see what people appreciate in landscape by analyzing the content of pictures. In this sense by classifying all the retrieved data with the OpenNESS classify typology, I identified the aesthetic appreciation of landscape. Furthermore this appreciation was visible through the number of pictures included in the aesthetic value of landscape category. In Martínez Pastur et al. (2016) the study shows the same results as in the current study such aesthetic value of landscape.

Aestethic value of landscape was the most tagged element in pictures followed by existence features as in the current reasearch, species features. This elements of landscape encompassed components as vegetation, water, ice as well as human infrastructures. The other category included species features such as wild and non-wild animals, fungi, aquatic, terrestrial species.

Furthermore other studies that used the referred to aesthetic values and recreational values to reveal peoples appreciation towards landscape same set of indicators and follow the same kind of principle in the methodology are Martínez Pastur et al. (2016), Tenerelli et al. (2016).

Preferences and Perceptions: main trends across the park

Preferences relate to and are part of the recreational experience. Preferences partly steam from perception. This being said, when people perceive something, this forms an image in their mind

about how something should look like, what someone would expect to see. To some degree, this is one of the things that drive people towards experiences of recreation and that contribute to the cultural experience between man and nature. In this research, people's perception of the protected areas triggered different recreational activities such as hiking, swimming, camping, which can be seen through pictures. Pictures were a way to disclose which people's preferences are when they visit the national parks. This is seen in the patterns represented by the high number of pictures uploaded in some of the most visited areas of the parks. Preference is an order of things, you might like something over another thing because of your initial perception.

As looking through literature I noticed that a lot of studies used qualitative methodologies to study people's preferences. Individual and group interviews was used in Lamarque et al. (2011), in Sodhi et al. (2009) individual interviews furthermore, semi-structured interviews were used in Rönnbäck et al. (2007) and face to face interviews in Martín-López et al. (2007a). In response to these aspect I considered that the photo series methodology it can be used for assessing peoples preferences in a more accessible way concerning data availability. This methodology it offers quite a vast amount of information concerning what people prefer while recreating in a certain area.

As it is mentioned before in this current paper, people's preferences are shaped by their identity and through their experiences (Martín-López et al., 2012). In the six national parks presented in this study, the main preference was for the elements with a high degree of natural value. This can be seen through the multiple pictures included in the same category (aesthetic) and showing the same motive (Perito Moreno glacier, Fitz Roy, Cerro Torre mountain pick). This is something that was expected to be so, as this research studies protected areas which due to their values worth protecting, already have a high degree of appreciation-driving preferences (Ulrich, 1986).

As mentioned in the literature review, aesthetic preferences were addressed in Casalegno et al. (2013), and these elements are considered as a key component of CES. Furthermore the pictures showed preferences towards recreational activities. Recreational activities were mentioned in previous studies as being a way of producing benefits through the interaction with nature (Keniger et al., 2013). Recreation indicators were used in many of the examined studies such in Nahuelhual et al. (2013),Wood et al. (2013), Martínez Pastur et al. (2016) and Tenerelli et al. (2016) as well as aesthetic value of landscape such in Casalegno et al. (2013). These indicators (aesthetic and

recreation) are considered as being very useful in the assessment of CES, as it is demonstrated, as well, through this research.

Application of photo analysis: What does it enable to capture and what it does not?

The framework for assessing CES designed in the OpenNESS project and used in this research uses a newly developed methodology based on crowd sourcing data (information obtained via social media). The photo analysis method applied in this study used pictures retrieved from one source only (Flickr photo-sharing platform), compared to other studies where more platforms were used Panoramio and Flickr. This, I found a bit problematic as for some of the national parks such as Perito Moreno and Lago Puelo, the data retrieved was very poor. As the photos are uploaded by different users of the platform, the method restricts the variety of perceptions that could be disclosed by interviewing people on site about their perception towards the landscape. In addition, I noticed that some of the users upload pictures showing the same view with very few differences between the pictures. Along the classification, there were a lot of pictures like these which had to be deleted. This kind of pictures reduced considerably the number of pictures included in the classification, leading also to a limited number of users which automatically results in a limited number of opinions.

Regarding the use of the OpenNESS Classify App, it would be useful to provide the possibility of saving the pictures by arranging the classified data according to a criteria e.g. in my case useful to save the photos according to each park from which they were retrieved. It is also very important that the App provides the possibility to interpret all the possible details which come with the pictures. By doing so it can offer the possibility to interpret more precisely this intangible aspects of CES.

I found very useful the presence of ‘tags’ and ‘comments ‘attached to the photos, to which I referred to in the classification of the pictures. In this research, similarly to what has been mentioned in the literature, ’tags’ were represented by words such as (mountain. landscape, perito moreno) and were used as labels to relate to the features present in the photo and describe the usage of the images (Sun and Bhowmick, 2010).

Concerning the comments attached to photos, these were not so common, even though sometimes they provided a very clear description of the content and the reason for taking the photo, for instance mentioning words such as ‘wilderness’. Other examples are shown in the comments field referring to the pictures uploaded next to them.

Fig. 31 *“Beautiful rock spires tower about the campsite and refugio Frey”“*

(-retrieved from Flickr)

Fig. 32 *”My second morning of glorious sunrise over Fitz Roy. I love the warm granite and cold glacier on its flank. Here it's framed by southern beech trees, aka lenga” a photographer says.”*

(-retrieved from Flickr)

Unfortunately not all the pictures have tags or comments, so this may be a cause of bias, but at the same time, an opportunity to enrich the dataset.

Since the photos in Flickr are geo-referenced, this method offers the possibility to retrieve information at a vast spatial scale, and was particularly suitable for assessing cultural values about nature at a regional scale. As noticed through the classification, this photo data set is unevenly spread across the landscape, but at the same time transmits information through pictures across a region even from remote areas.

One of the steps in the classification procedure was saving and downloading the data from Carto DB platform. This was very useful as the platform offered the possibility to download the data in different file formats as well as it offers the possibility to visualize all the classified pictures on a map.

This photo-analysis method enables to capture specific natural elements in their specific location. It offers an insight into the study area and it provides an image of the setting of the area were the pictures were taken. This method is different from other methods in assessing people's perception, in the sense that pictures serve as a channel to transmit this perception. A problem arises in interpreting some of these pictures as they not always transmit people's preferences, for example panoramic views of landscape can be very interpretable. In this sense, interviews and participatory methods can be more useful to reveal preferences. I found it very useful in the papers I presented in the literature review (Martínez Pastur et al., 2016, Tenerelli et al., 2016)that for assessing CES values, the photo analysis was combined with other methods which offered a good insight into ways of assessing these services. Even though, having this in mind, and looking at the results, the method used here can stand on its own to help identify important features of desirable cultural elements, and can reveal visual aspects that may be otherwise difficult to capture through interviews.

The current study enables to improve the photo series methodology with useful advice by looking at limitations encountered along the process. It offers the possibility to access a vast amount of data which can be used anytime and also helps to identify landscape features to which people are attracted in the Andean protected landscape. To sum up, these indicators (aesthetic, species/existence, recreational and intelectual interactions) were dealt with in different ways in several studies as described in the literature review chapter, all these to contribute to the appraisal of CES values. Concerning this fact these papers serve as referances of the possibility to use these indicators and access the photo series methodology to evaluate how people appreciate various aspects of ecosystems. It can be noticed that the majority of these studies used recreation, ecotourism and aesthetic value of landscape as these ones are most easily accessed in evaluating CES (Milcu et al., 2013).

Concerning the current study, the method used here is an accessible way of getting information concerning people's preferences on a site. The method is time and cost effective. If there is need

of more data this can be retrieved at any time. At the same time, it shows the importance of some areas even if these are sometimes difficult to access.

Can CES contribute to decision-making?

I used as a reference the paper by Daniel et al. (2012) as it provides insights to ways of assessing CES by looking at research on landscape aesthetics, cultural heritage, outdoor recreation and spiritual significance. The paper refers to the relationship between ecosystem elements and functions related to human needs. I consider this relationship fundamental in appraising CES, and as the paper describes, a problem arises due to the many ways in which an element of nature can be interpreted. As the paper describes, and as I noticed through this research, the most difficult part in evaluating CES is the multitude of categories in which an element can be included and by doing so, it is very difficult to interpret the value attached to individual features.

Much work has been done to provide a consistent framework that can be used to rate CES and their intangible values. Some of the indicators designed in this sense, like recreational and aesthetic indicators, provide a much easily understandable way of capturing what people value in natural parks, and as in this case, help in the operationalization of cultural services. By using the framework designed by the OpenNESS project, I found the chosen indicators very useful in the assessment and can be considered as contributing to a good framework in assessing cultural values of ecosystems.

Current study within Natural Resources Management (NARM) frame

This research takes in consideration six national parks along the Andeans Patagonia. It is a research which looks at the benefits provided by protected ecosystems and landscapes. Moreover, it identifies what people value about natural landscapes as revealed from photography. The research manages to identify preferences which can be useful information for future management plans, contributing to the Patagonian management system for protected areas and can help decision-makers to set levels of restrictions so that the landscape preserves its characteristic natural features and the values people attach to them. In other words, this research can help in preserving these protected habitats in perpetuity. Having this in mind, this research can serve as an example which contributes to the management of natural resources.

"Characterizing our intangible connections with nature will help shape decision that benefit people and the ecosystem on which we depend"(Russell et al., 2013) .

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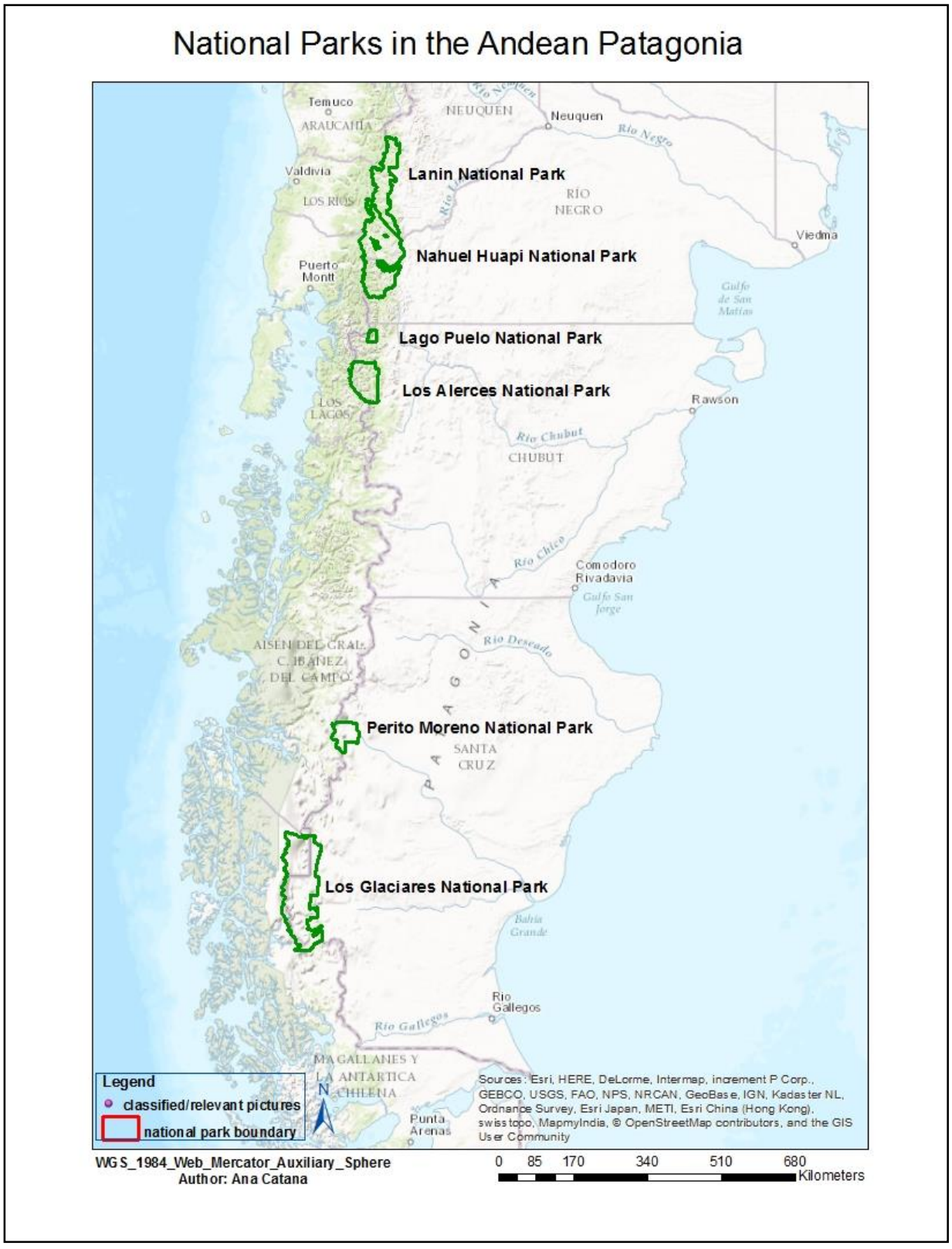
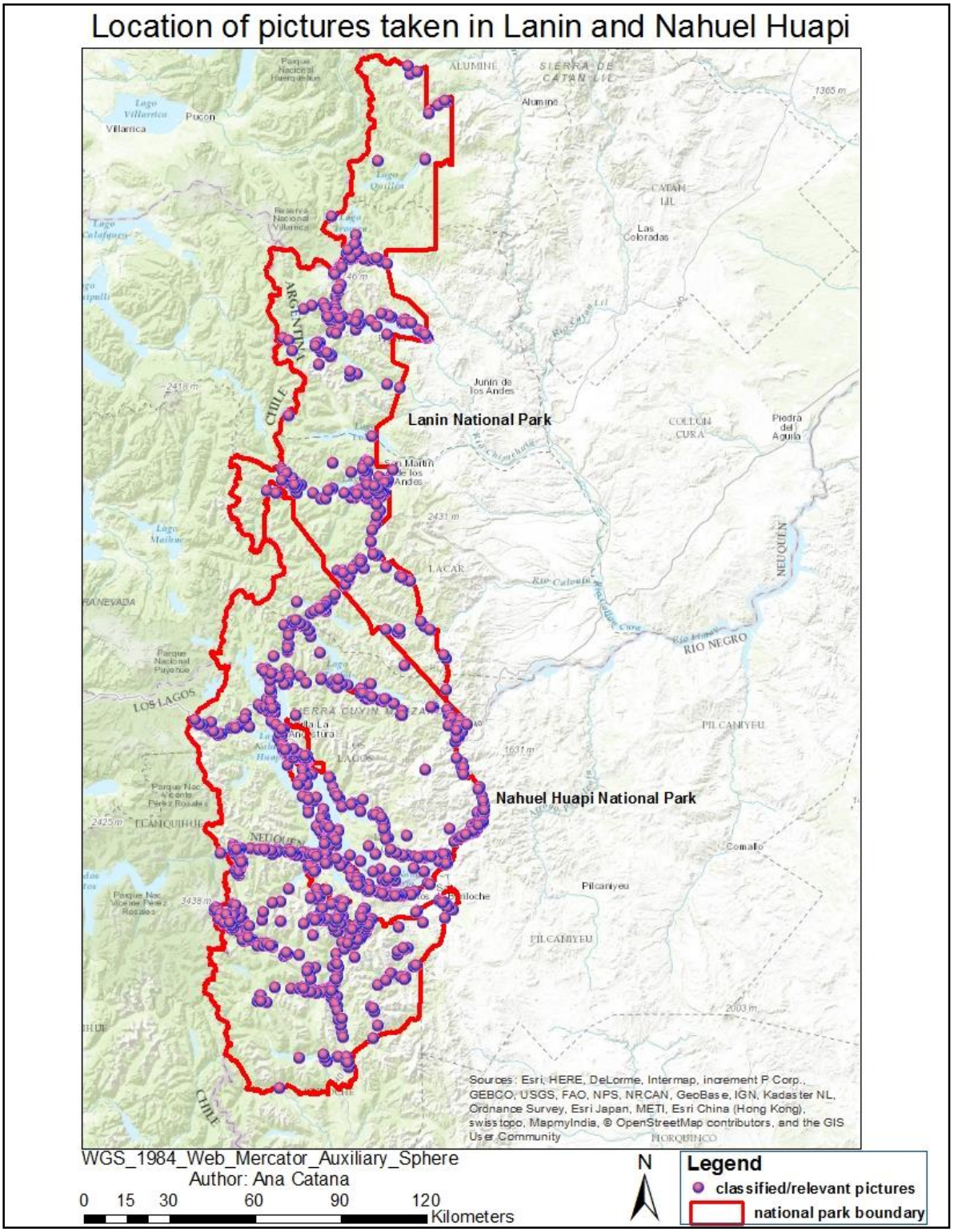
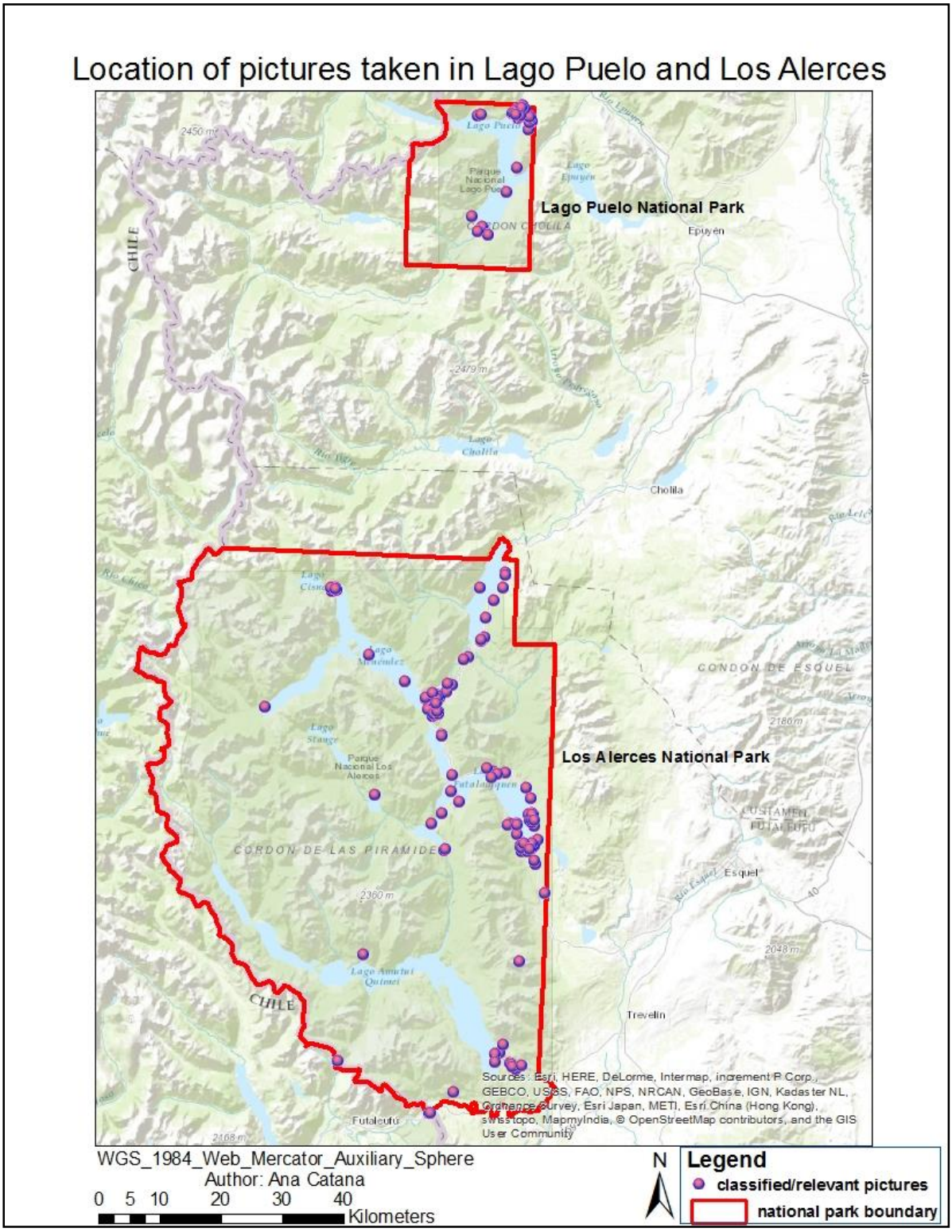
Appendix A: *Map showing the location of Lanín, Nahuel Huapi, Lago Puelo, Los Alerces, Perito Moreno, Los Glaciares National Parks in Patagonia*



Appendix B: Map showing the location of pictures taken in Lanín and Nahuel Huapi National Parks



Appendix C: Map showing the location of pictures taken in Lago Puelo and Los Alerces National Parks



Appendix D: Map showing the location of pictures taken in Los Glaciares National Park